



# INTERNATIONAL POULTRY SCIENCE CONGRESS OF WPSA TURKISH BRANCH'2018 Cappadocia / Nigde / TURKEY 09 - 12 May 2018



Venue : Cultural and Convention Center, Nigde Omer Halisdemir University Nigde, Turkey  
Email : [ahmet.sekeroglu@ohu.edu.tr](mailto:ahmet.sekeroglu@ohu.edu.tr) - [ahmetekerolu22@gmail.com](mailto:ahmetekerolu22@gmail.com)  
[rakbay@agri.ankara.edu.tr](mailto:rakbay@agri.ankara.edu.tr)  
Website: [www.ipc2018.org](http://www.ipc2018.org)



**International Poultry Science Congress  
of  
WPSA Turkish Branch'2018**

**CONGRESS BOOK**

**ISBN: 978-605-245-602-6**

**EDITORS**

**Prof.Dr. Ahmet ŞEKEROĞLU**

Niğde Ömer Halisdemir University  
Department Of Animal Production And Technologies  
Faculty of Agricultural Sciences and Technologies

**Assoc.Prof.Dr. Hasan ELEROĞLU**

Cumhuriyet University  
Şarkışla Aşık Veysel Vocational School  
58400 Şarkışla/Sivas

**Dr. Mustafa DUMAN**

Niğde Ömer Halisdemir University  
Bor Vocational High School  
51700 Bor/Niğde

*The responsibility of all the papers contained in this book belongs to the authors. The book can be utilized provided that reference is made.*

**May 2018**

## **FOREWORD**

On the behalf of the Organising Committee, it is a great pleasure and honour for us to welcome you all to the “**International Poultry Science Congress of WPSA Turkish Branch'2018**”.

This congress will provide a platform for the exchange of new ideas, information and to build up and to strength professional relationships.

We would like to express our sincere gratitude to the esteemed scientists who have made this congress more meaningful with their presentations and to the sponsors who made this congress possible.

We want to thank all the representatives of Niğde Ömer Hasdemir University, Department of Animal Production and Technologies, Faculty of Agricultural Science and Technologies for their priceless help in the organisation of the congress.

There are 350 scientists from 14 countries participating in the congress.

This is also the first time that we are inviting students to the congress. We hope that it will be an unforgettable experience for them.

We wish you all an enjoyable and productive time during the congress and a wonderful stay in this amazing wonderland right in the centre of Turkey, Cappadocia.

**Prof. Dr. Ahmet Şekeroğlu**  
Head of the Congress  
Organising Committee

**Prof. Dr. R veyde Akbay**  
President of WPSA Turkish Branch

**COMMITTEES**

**HONOURARY COMITTEE**

Yılmaz ŞİMŞEK  
Governor of Niğde

Prof.Dr. Muhsin KAR  
Rector of Niğde Ömer Halisdemir University

Prof.Dr. Mehmet Emin ÇALIŞKAN  
Dean of Ayhan Şahenk Faculty of Agricultural Sciences and Technologies

**CO-CHAIRS OF ORGANIZING COMMITTEE**

Prof. Dr. Rüveyde AKBAY  
Prof. Dr. Ahmet ŞEKEROĞLU

**CONGRESS SECRETARIAT**

Dr. Emre AKSOY  
Doç. Dr. Sibel CANOĞULLARI DOĞAN  
Dr. Mustafa DUMAN  
Dr. Burak ŞEN  
Dr. Sema YAMAN

## ORGANIZING COMMITTEE

- Prof. Dr. Mehmet AKAN  
President of the Veterinary Poultry Association
- Dr. Emre AKSOY  
Niğde Ömer Halisdemir University
- Prof. Dr. Ethem AKYOL  
Niğde Ömer Halisdemir University
- Nezihi ALPTÜRK  
Doğuş AGRO Projects R&D Services Corporation
- Rıfat ÖZKAN  
Mayor of Niğde
- M. Kemal AKMAN  
Vice President of the WPSA Turkish Branch
- Cemalettin BİLGİN  
Member of the Board of the WPSA Turkish Branch
- İhsan BOSTANCI  
President of the Konya Plains Project Regional Development Administration
- Associate Prof. Dr. Sibel CANOĞULLARI DOĞAN  
Niğde Ömer Halisdemir University
- Avni ÇAKIR  
Treasurer of the WPSA Turkish Branch
- Dr. Mustafa DUMAN  
Niğde Ömer Halisdemir University
- Associate Prof. Dr. Hasan ELEROĞLU  
Cumhuriyet University
- Dr. Betül GÜRER  
Niğde Ömer Halisdemir University
- Dr. Serdar KAMANLI  
Director of the Ankara Poultry Research Institute
- M. Ülkü KARAKUŞ  
President of Turkish Feed Manufacturers Association
- Şevket KATIRCIOĞLU  
Chairman of the Board of Directors of Niğde Chamber of Commerce and Industry
- Veli KENAR  
Head of the Niğde Agricultural Chamber (Niğde Agri. Platform)
- Hasan KONYA  
Chairman of Turkish Egg Producers Association
- Dr. Sait KOCA  
President of Turkish Poultry Meat Producers And Breeders Assoc.
- Prof. Dr. Isabel Margarita M. MUNOZ  
Niğde Ömer Halisdemir University
- Associate Prof. Dr. Cengizhan MIZRAK  
Secretary General of the WPSA Turkish Branch & Head of the Department of Agricultural Economics Research, General Directorate of Agricultural Research and Policies

**Dr. Burak ŐEN**

NiĐde Őmer Halisdemir University

**Prof. Dr. Erol ŐENGŐR**

Member of the Board of Directors of Veterinary Poultry Association

**Prof. Dr. Nizamettin ŐENKŐYLŐ**

President of the Animal Nutrition Science Association

**Prof. Dr. Őakir DoĐan TUNCER**

President of the Turkish Veterinary Medical Society

**Prof. Dr. Mesut TŐRKOĐLU**

President of the Animal Science Federation of Turkey

**Dr. İlknur UŐAK**

NiĐde Őmer Halisdemir University

**Zafer UYANIK**

Chairman of the Board of NiĐde Commodity Exchange

**Bekir VAROL**

Secretary General of the Ahiler Development Agency

**GŐlbenk YALŐIN**

Member of the Board of the WPSA Turkish Branch

**Dr. Sema YAMAN**

NiĐde Őmer Halisdemir University

**Davut YEŐİL**

Head of the Office of Ahiler Development Agency in NiĐde

**Prof. Dr. Zeliha YILDIRIM**

NiĐde Őmer Halisdemir University

**Associate Prof. Dr. Arda YILDIRIM**

GaziosmanpaŐa University, Turkey

## HEAD OF SCIENTIFIC BOARD

Prof. Dr. Servet YALÇIN  
Member of the Board of the WPSA Turkish Branch

## SCIENTIFIC BOARD

Prof. Dr. Sezai ALKAN  
Ordu University, Turkey  
Dr. Henry Van Den BRAND  
Wageningen University, The Netherlands  
Prof. Dr. Ömer CAMCI  
Mustafa Kemal University, Turkey  
Prof. Dr. Kezban CANDOĞAN  
Ankara University, Turkey  
Prof. Dr. Martino CASSANDRO  
Padova University, Italy  
Prof. Dr. Osman ERGANİŞ  
Selçuk University, Turkey  
Prof. Dr. Aykut GÜL  
Çukurova University, Turkey  
Prof. Dr. Hafez Mohamed HAFEZ  
Berlin Free University, Germany  
Prof. Dr. Hasan Rüştü KUTLU  
Çukurova University, Turkey  
Dr. Roel MULDER  
Secretary General of the WPSA, The Netherlands  
Prof. Dr. Estella Pruckner RADOVCIC  
President of the WPSA Croatian Branch, Croatia  
Prof. Dr. Mustafa SAATÇI  
Mehmet Akif Ersoy University, Turkey  
Prof. Dr. Musa SARICA  
Ondokuz Mayıs University, Turkey  
Prof. Dr. Ahmet ŞAHİN  
Ahi Evran University, Turkey  
Prof. Dr. Kazım ŞAHİN  
Member of TUBA, Turkey

## ADVISORY BOARD

- Prof. Dr. Tülin AKSOY  
Akdeniz University, Turkey
- Prof. Dr. Mustafa AKŞİT  
Adnan Menderes University, Turkey
- Prof. Dr. Nesimi AKTAŞ  
Nevşehir Hacı Bektaş-ı Veli University, Turkey
- Prof. Dr. Özge ALTAN  
Ege University, Turkey
- Prof. Dr. Zeki BAYRAMOĞLU  
Selçuk University, Turkey
- Prof. Dr. Atıf CANSEVDİM  
Süleyman Demirel University, Turkey
- Prof. Dr. Tayfun CARLI  
Uludağ University, Turkey
- Prof. Dr. Necmettin CEYLAN  
Ankara University, Turkey
- Prof. Dr. Behiç COŞKUN  
Selçuk University, Turkey
- Prof. Dr. M. Fatih ÇELEN  
Uşak University, Turkey
- Prof. Dr. Güray ERENER  
Ondokuz Mayıs University, Turkey
- Prof. Dr. Aydın İPEK  
Uludağ University, Turkey
- Prof. Dr. Sedat KARAMAN  
Gaziosmanpaşa University, Turkey
- Prof. Dr. Figen KIRKPINAR  
Ege University, Turkey
- Prof. Dr. Osman KÜÇÜK  
Erciyes University, Turkey
- Prof. Dr. Yusuf KONCA  
Erciyes University, Turkey
- Prof. Dr. Sezen ÖZKAN  
Ege University, Turkey
- Prof. Dr. Pınar SAÇAKLI  
Ankara University, Turkey
- Prof. Dr. Ümran ŞAHAN  
Uludağ University, Turkey
- Prof. Dr. Ramazan YETİŞİR  
Selçuk University, Turkey
- Prof. Dr. İskender YILDIRIM  
Selçuk University, Turkey

**SPONSORS**

MAIN SPONSOR



PLATINIUM SPONSORS



SILVER SPONSORS



OTHER SPONSORS



ORGANIZATION PARTNERS



# Contents

<b>OPENING PRESENTATION</b> .....	<b>21</b>
<i>Trends, Chalanges and Sustainability in World Poultry Production</i> .....	<b>21</b>
Dr. Roel Mulder .....	21
<b>ORAL PRESENTATIONS</b> .....	<b>22</b>
<b>SESSION-1</b> .....	<b>23</b>
<b>PLANARY SESSION</b> .....	<b>23</b>
<b>INVITED PRESENTATIONS</b> .....	<b>23</b>
<i>Global poultry meat production trends: Future prospects and Turkey</i> .....	<b>24</b>
Sait Koca.....	24
<i>Egg industry in Turkey: From production to consumption</i> .....	<b>25</b>
Sezen Özkan.....	25
<i>Evaluation of Different Control Programs of Coccidiosis in Poultry and the Invention of a Related Comprehensive Method</i> .....	<b>30</b>
E. Barbour, H. Shaib, L. Van Waeyenberghe, N. Kurkure, E. Matyas,.....	30
I. Arpaci, T. Kumosani, U. Truyen, R. Sultan, W. Krull.....	30
<b>SESSION-2</b> .....	<b>31</b>
<b>NUTRITION-I</b> .....	<b>31</b>
<b>INVITED PRESENTATIONS</b> .....	<b>31</b>
<i>Global Poultry Feed Production: Natural Resources and Future</i> .....	<b>32</b>
Murat Ülkü Karakuş.....	32
<i>The Role Of Eubiotics In Today's Poultry Nutrition</i> .....	<b>40</b>
Andre Meeusen .....	40
<b>SESSION-2</b> .....	<b>45</b>
<b>NUTRITION-I</b> .....	<b>45</b>
<b>SHORT ORAL PRESENTATIONS</b> .....	<b>45</b>
<i>Efficacy of in-feed Preparations of an Anticoccidial, Multi-Enzyme, Prebiotic, Probiotic, and Herbal Essential Oil Mixture in Healthy and Eimeria spp.-Infected Broilers</i> .....	<b>46</b>
Mehmet Bozkurt <sup>a</sup> , Nuran Aysul <sup>b</sup> , Gökhan Ege <sup>c</sup> , Bahattin Koçer <sup>c</sup> .....	46
<i>Effects of the dietary Black Pepper (Piper nigrum) and Turmeric Powder (Curcuma longa L.) on the Performance and Egg Quality in Laying Hens</i> .....	<b>51</b>
Muhittin Ünal <sup>a</sup> , Cem Özalp <sup>a</sup> , Zeynep Şahanb Uğur Serbest <sup>a</sup> , Fatma Yenilmez <sup>c</sup> , Yusuf Uzuna, Hasan Rüştü Kutlu <sup>a</sup> , Ladine Çelik <sup>a</sup> .....	51
<b>SESSION-2</b> .....	<b>55</b>
<b>NUTRITION-I</b> .....	<b>55</b>
<b>5 MINUTE ORAL PRESENTATIONS</b> .....	<b>55</b>
<i>In Vitro Determination of The Effect of Rosemary and Thyme Essential Oils on Intestinal Motility in Broiler</i> .....	<b>56</b>
Aziz Bülbül <sup>a</sup> , Vural Özdemir <sup>b</sup> , Tuba Bülbül <sup>c</sup> .....	56
<b>Recording Isometric Duodenum, Jejunum And Ileum Contractility</b> .....	<b>58</b>
<i>Investigation of Eimeria species in chickens in Samsun region by Real Time PCR</i> .....	<b>61</b>
Çağrı Aslan <sup>a</sup> , Alparslan Yıldırım <sup>a,b</sup> , Önder Düzlü <sup>a,b</sup> , Zuhal Önder <sup>a,b</sup> , Arif Çiloğlu <sup>a,b</sup> , Gözde Şahingöz Demirpolat <sup>a</sup> , Abdullah İnci <sup>a,b</sup> .....	61
<i>Foodborne Diseases and Poultry Production</i> .....	<b>66</b>
Hafez Mohamed Hafez <sup>a</sup> , Hosny El-Adawy <sup>b</sup> .....	66
<b>SESSION-3</b> .....	<b>76</b>
<b>HEALTH</b> .....	<b>76</b>
<b>SHORT ORAL PRESENTATIONS</b> .....	<b>76</b>
<i>Molecular Investigation of Atoplasma Spp. in Free-Range Chickens Along with Some Findings on Migrating Avian Species from Sultan Marshes in Turkey</i> .....	<b>77</b>

Mübeccel Okur <sup>a</sup> , Alparslan Yıldırım <sup>a,b</sup> , Önder Düzlü <sup>a,b</sup> , Arif Çiloğlu <sup>a,b</sup> , Zuhâl Önder <sup>a,b</sup> , Arzu Gürsoy Ergen <sup>c</sup> , Bilal Dik <sup>b,d</sup> , Gamze Yetişmiş <sup>a</sup> , Abdullah İnci <sup>a,b</sup> .....	77
<b><i>Antagonistic Activity of Intestinal Lactobacteria against Salmonella enterica isolated from chicken and turkey.</i></b> .....	<b>81</b>
E. V. Yerlituerk (Dudareva) <sup>a</sup> , V. N. Afonyushkin <sup>a,b</sup> M. L. Filipenko <sup>b</sup> , E. A. Khrapov <sup>b</sup> .....	81
<b>SESSION-4</b> .....	<b>86</b>
<b>NUTRITION II</b> .....	<b>86</b>
<b>INVITED PRESENTATION</b> .....	<b>86</b>
<b><i>Effect of Phytoenics on Heat Tolerance</i></b> .....	<b>87</b>
Jan Dirk van der Klis, Andreas Müller.....	87
<b>SESSION-4</b> .....	<b>92</b>
<b>NUTRITION II</b> .....	<b>92</b>
<b>SHORT ORAL PRESENTATIONS</b> .....	<b>92</b>
<b><i>Predicting the Weights of The Body Parts of Two Strains of Growing Turkeys Using Allometry</i></b> .....	<b>93</b>
R.M. Gous <sup>a</sup> , C. Fisher <sup>b</sup> , E. Tumova <sup>c</sup> , V. Machander <sup>d</sup> .....	93
<b><i>Diet Ca and P levels affect early bone development of broilers without any deterioration in growth performance</i></b> .....	<b>98</b>
Canan Kop-Bozbay <sup>a</sup> , Ahmet Akdağ <sup>b</sup> , Helin Atan <sup>a</sup> , Lütfi Bayyurt <sup>b</sup> .....	98
<b><i>Supplementary Polyphenols Improved the Welfare of Heat Stressed Broilers Under Different Protein Matrix</i></b> .....	<b>102</b>
Gopi, M <sup>a</sup> , Dutta, N <sup>b</sup> , Jaydip, J.R <sup>c</sup> , Gautham, K <sup>d</sup> .....	102
Khillare, G.S <sup>e</sup> , Mohan J <sup>f</sup> .....	102
<b><i>The Use of Potassium Carbonate in The Lysine-Deficient Broiler Diets</i></b> .....	<b>108</b>
E. Andrianova <sup>a</sup> , I. Egorov <sup>a</sup> , A. Shevyakov <sup>a</sup> , E. Grigoryeva <sup>a</sup> , .....	108
A. Kosterev <sup>b</sup> , D. Kuznetsov <sup>b</sup> .....	108
<b><i>The Effect of Different Levels Of Lentil Byproduct On Growth Performance, Carcass Traits And Egg Production In Quail (Coturnix Coturnix Japonica)</i></b> .....	<b>111</b>
Tugay Ayaşan <sup>a</sup> , Bünyamin Söğüt <sup>b</sup> , Hakan İnci <sup>b</sup> .....	111
<b><i>Effects of Fermented Sour Cherry (Prunus cerasus) Kernel with Aspergillus niger under Solid State Fermentation on Performance, Digestibility and Cecal Microflora in Broiler Chicks*</i></b> .....	<b>115</b>
Emrah Güngör, Güray Erener .....	115
<b><i>Effect of Oregano Essential Oil and Carob Extract Mixture on Egg Quality Traits of Laying Hens</i></b> .....	<b>120</b>
Mahmut Kaliber <sup>a</sup> , Gökhan Filik <sup>b</sup> , Ayşe Gül Filik <sup>b</sup> , Savaş Sarıözkan <sup>c</sup> , Yusuf Konca <sup>a</sup> .....	120
<b>SESSION-5</b> .....	<b>125</b>
<b>GENETICS AND GENOMICS</b> .....	<b>125</b>
<b>INVITED PRESENTATIONS</b> .....	<b>125</b>
<b><i>Poultry Genetic Resources</i></b> .....	<b>126</b>
Martino Cassandro .....	126
<b><i>Antioxidant Supplementation and Its Effect on Alleviation of Negative Effects of Stress: Molecular and Genetic Basis</i></b> .....	<b>134</b>
Kazim Sahin <sup>a*</sup> , Cemal Orhan <sup>a</sup> , Mehmet Tuzcu <sup>b</sup> , Nurhan Sahin <sup>a</sup> .....	134
<b>SESSION-5</b> .....	<b>135</b>
<b>GENETICS AND GENOMICS</b> .....	<b>135</b>
<b>SHORT ORAL PRESENTATIONS</b> .....	<b>135</b>
<b><i>Determination of Polymorphism in the Dopamine D2 Receptor (DRD2) Gene in Five White Layer Lines Using PCR-RFLP Method</i></b> .....	<b>136</b>

Eymen Demir <sup>a</sup> , Taki Karşlı <sup>a</sup> , Murat Soner Balcıođlu <sup>a</sup> , Hüseyin Göktuđ Fidan <sup>a</sup> , Mehmet Aslan <sup>a</sup> , Sedat Aktan <sup>b</sup> , Bahar Argun Karşlı <sup>a</sup> , Kemal Karabađe <sup>c</sup> , Emine Şahin <sup>d</sup>	136
<i>Productive and reproductive performances of different poultry breeds conserved in northeast of Italy</i> .....	142
Martino Cassandro <sup>a</sup> , Filippo Cendron <sup>b</sup> .....	142
<b>SESSION-6</b> .....	146
<b>INCUBATION</b> .....	146
<b>INVITED PRESENTATIONS</b> .....	146
<i>Incubation period and its effect on postnatal development in chickens</i> .....	147
Henry van den Brand, Roos Molenaar.....	147
<b>SESSION-6</b> .....	159
<b>INCUBATION</b> .....	159
<b>SHORT ORAL PRESENTATIONS</b> .....	159
<i>Comparison of Embryo Development and Quality Characteristics of Uncontrolled Village Eggs and Commercial Eggs Produced in Different Seasons</i> .....	160
Musa Sarica, Kadir Erensoy, Ayşe Özsoy.....	160
<i>The Effect of Egg Storage Period, Hatching Time, and Initial Brooding Litter Temperature on Performance of Chicks from Young Breeder</i> .....	165
Reza Shiranjang, Serdar Özlü, Okan Elibol.....	165
<b>SESSION-6</b> .....	171
<b>INCUBATION</b> .....	171
<b>5 MINUTES ORAL PRESENTATIONS</b> .....	171
<i>Effects of Propolis and Thyme Essential Oil as a Biofumigants on Growth Performance Parameters of Hatching Eggs</i> .....	172
Ayşen Bulancak, Mikail Baylan.....	172
<i>Effect of Oregano and Rosemary Essential Oil Supplementation on Broiler Performance and Caecal Microflora</i> .....	173
Ece Cetin <sup>a</sup> , Bahadır Anar <sup>b</sup> , Seran Temelli <sup>c</sup> ,.....	173
Serife Sule Cengiz <sup>d</sup> , Mustafa Eren <sup>d</sup> .....	173
<i>Probiotic Effect of Yogurt on Caecal Microflora of Quails (Coturnix coturnix Japonica)</i> .....	180
İsa Coşkun, Figen Saydut, Abdurrahman Korkmaz, Ahmet Şahin.....	180
<i>Changes in Embryo Development and Chick Quality from Four Different Egg Sizes in Bronz Turkey</i> .....	184
Arda Sözcü, Aydın İpek.....	184
<b>SESSION-7</b> .....	189
<b>MANAGEMENT</b> .....	189
<b>INVITED PRESENTATION</b> .....	189
<i>Preparing Broiler Breeder Females for Optimum Production</i> .....	190
Zekeriya Yıldırım, Mert Yalçınalp.....	190
<b>SESSION-7</b> .....	196
<b>MANAGEMENT</b> .....	196
<b>SHORT ORAL PRESENTATIONS</b> .....	196
<i>The Current Situation of Free Range Egg Production Farms: The Model of Çanakkale Region</i> .....	197
Coşkun Konyal <sup>a</sup> , Hakan Erdem <sup>b</sup> , Türker Savaş <sup>b</sup> .....	197
<i>Positive impact of AviPlus®P on the growth performance of broiler chickens exposed to a mild necrotic enteritis challenge model with C. perfringens and re-used litter</i> .....	202
Benedetta Tugnoli, Antonino Messina, Andrea Piva, Ester Grilli.....	202
<i>The Consumption and Consumer Preferences of Poultry Meat and Egg: The Case of the University of Niğde Ömer Halisdemir</i> .....	206
Betül Güner, Ethem Akyol.....	206

<b>SESSION-8</b> .....	211
<b>PRODUCT QUALITY</b> .....	211
<b>SHORT ORAL PRESENTATIONS</b> .....	211
<i>Quality Attributes of Chicken Nuggets Produced by Using Different Gluten-Free Ingredients</i> .....	212
Burcu Öztürk, Meltem Serdaroğlu, Merve Karabyıkoğlu .....	212
<i>Performances of fast, medium and slow growing broiler chickens reared barn and free-range production systems</i> .....	217
Musa Sarıca <sup>a</sup> , Umur Sami Yamak <sup>a</sup> , Mehmet Akif Boz <sup>b</sup> , Kadir Erensoy <sup>a</sup> .....	217
<i>Effects of a Meal Feeding Regimen and the Availability of Fresh Alfalfa on Meat and Bone Quality of Broiler Genotypes</i> .....	222
Bahattin Koçer <sup>a</sup> , Mehmet Bozkurt Gökhan Ege, Ahmet Engin Tüzün, Osman Olgun, Ramazan Konak <sup>a</sup> .....	222
<i>Ultrasound Treatment of Fresh Eggs: Effects on Microbial Quality</i> .....	226
Muhammed Yüceer <sup>a</sup> , Cengiz Caner <sup>b</sup> .....	226
<b>SESSION-8</b> .....	233
<b>PRODUCT QUALITY</b> .....	233
<b>5 MINUTES ORAL PRESENTATIONS</b> .....	233
<i>Reducing Gut Lesions Caused by Bacterial Enteritis with A Specific Blend of Esterified Fatty Acids</i> .....	234
Krzysztof Kozłowski <sup>a</sup> , Angelo Lauwaerts <sup>b</sup> , Jan Jankowski <sup>a</sup> .....	234
<i>Investigation of Emulsion Capacity of Game Bird Meat</i> .....	237
Süleyman Baytur, Hasan Murat Velioglu .....	237
<i>A Note on Seroprevalence of Toxoplasma gondii in Turkeys*</i> .....	240
Cahit Babür <sup>a</sup> , Bilge Karatepe <sup>b</sup> , Selçuk Kılıç <sup>a</sup> , Mustafa Karatepe <sup>b</sup> , Gül Ergün <sup>c</sup> .....	240
<i>Effects of Photoperiod Length and Light Intensity on Performance and Some Carcass Characteristics in Broilers</i> .....	245
Evrin Dereli Fidan.....	245
<i>Effect of Dietary Supplementation of Kefir on Body Measurements, Giblet Weight and Gut Morphology in Geese</i> .....	251
Abdur Rahman <sup>a</sup> , Ibrahim Sadi Cetingul <sup>b</sup> , Cangir Uyarlar <sup>b</sup> ,.....	251
Abdul Burhanettin Akkaya <sup>b</sup> , Eyup Eren Gultepe <sup>b</sup> ,.....	251
Aykut Ulucan <sup>c</sup> , Ismail Bayram <sup>b</sup> .....	251
<i>The Effects of Melatonin on Poultry</i> .....	256
Süleyman Çalışlar <sup>a</sup> , Beyhan Yeter <sup>a</sup> , Mustafa Duman <sup>b</sup> , Ahmet Şekeroğlu <sup>c</sup> .....	256
<i>Growth Performance and Carcass Characteristics of Slow Growing Broilers Grazed on Pasture Covered with Chicory, White Clover or Purslane</i> .....	263
Zekeriya Kıyma <sup>a</sup> , Ahmet Akdağ <sup>b</sup> , Yasin Altay <sup>a</sup> , Süleyman Avcı <sup>c</sup> .....	263
<b>POSTER PRESENTATIONS</b> .....	267
<b>SESSION-2</b> .....	267
<b>NUTRITION I</b> .....	267
<i>The Effect of Feeding of Poultry on Intestinal Health</i> .....	268
Soner Uysal <sup>a</sup> , Emre Yılmaz <sup>a</sup> , Mehmet Gül <sup>a</sup> .....	268
<i>The Determination of Consumers' Perception, Attitude and Behavior about the Influence of Nutrition on Chicken Meat Quality</i> .....	273
Kerem Karasu <sup>a</sup> , Ergin Öztürk <sup>b</sup> .....	273
<i>Expend Technology in Mixed Feed Production</i> .....	278
Emre Ekici, Yavuz Gürbüz .....	278
<i>Effects of Usage of Thyme And Black Cumin Oil on Performance, Histomorphological Parameters and Cecum Volatile Fatty Acids in Broilers</i> .....	280
Özlem Durna Aydın, Gültekin Yıldız .....	280
<i>The Effect of Dietary Conjugated linoleic acid (CLA) on the Fatty Acid Composition and Cholesterol Content of Eggs in Turkeys</i> .....	282

R. Aydin <sup>a</sup> , A.K. Özüğür <sup>b</sup> .....	282
<i>Usage Possibilities of Mealworms (Tenebrionolitor) in Poultry Diets</i> .....	283
Kübra Melis Sabuncuoğlu <sup>a</sup> , Firdevs Korkmaz <sup>a</sup> , Doğan Narinç <sup>b</sup> , Hasan Ersin <sup>a</sup> Şamlı .....	283
<i>Factors Affecting Egg Quality Due to Egg Chicken Feeding</i> .....	287
Yavuz Gürbüz .....	287
<b>SESSION-3</b> .....	288
<b>HEALTH</b> .....	288
<i>Influence of Different Population Sizes of Poultry Red Mite (Dermanyssus gallinae) on Hematological Values in Japanese Quail Chicks</i> .....	289
Hakan Erdem <sup>a</sup> , Coşkun Konyalı <sup>b</sup> , Hande Işıl Akbağ <sup>a</sup> , .....	289
Baver Coşkun <sup>a</sup> , Türker Savaş <sup>a</sup> .....	289
<i>Isolation Escherichia coli O157:H7 Bacteriophages from Different Water Sources and Wastewaters</i> .....	293
Tuba Sakin, Zeliha Yildirim .....	293
<i>Effects of Energized Oxygen in Drinking Water to Laying Hens Feces Microorganism Count</i> .....	295
Özlem Sahan Yapıcıer <sup>a</sup> , Mustafa Saatci <sup>b</sup> , Sibel Yaman <sup>c</sup> , Orçun Sav <sup>c</sup> .....	295
<i>Prevalence of Dermanyssus gallinae and Relation with Henhouse Conditions of Backyards in Çanakkale Province in Turkey</i> .....	301
Coşkun Konyalı <sup>a</sup> , Hakan Erdem <sup>b</sup> , Türker Savaş <sup>b</sup> .....	301
<i>Serological Study of H5, H7 and H9 Avian İnfluenza Viruses in Native Geese and Ducks of Rural Areas Around Near Lake in Ardabil Province, Northwestern Iran</i> ....	307
Aidin Azizpour <sup>a</sup> , Saeed Seif <sup>b</sup> .....	307
<i>Physical Control Deficiencies Dermanyssus gallinae, and How to Overcome Them</i> ...	308
Pavlicevic, A. <sup>a</sup> , Ratajac R. <sup>b</sup> , Milica Dotlic <sup>a</sup> , Igor S. <sup>b</sup> , Pavlovic I. <sup>c</sup> .....	308
<i>SibMOS Pro as An Alternative to Fodder Antibiotics</i> .....	313
Berezin S.S. <sup>a</sup> , Kozlova Ju.N. <sup>b</sup> , Davidova N.V. <sup>c</sup> , Afonyushkin V.N. <sup>b,c</sup> .....	313
<i>Hepafon - Complex Hepatoprotector</i> .....	316
Berezin S.S. <sup>a</sup> , Zinchenko E. <sup>a</sup> , Kozlova Ju.N. <sup>b</sup> , Afonyushkin V.N. <sup>b,c</sup> .....	316
<i>Effects of Dietary Glutamine and Quercetin on Performance and Jejunum Histomorphology of Broilers</i> .....	318
Pinar Sacaklı <sup>a</sup> , Ahmet Ceylan <sup>b</sup> , Ali Calik <sup>a</sup> .....	318
<i>The Use of Immunomodulator in Drinking Water for Broiler Chicks</i> .....	323
Ovseychik E.A., Lukashenko V.S., Andrianova E.N. ....	323
<i>Point Prevalence of Gastro-Intestinal Parasites and Zoonotic Risk Associated with Captive Birds of Gujranwala and Jhang District (Punjab, Pakistan)</i> .....	326
Muhammad Zeeshan Akram, Hassan Jalal, Usman Siddiq, Arslan Ahmed, Muhammad Arif, Ateeqa Aslam, Sadaf Qadir .....	326
<i>Probiotic Effect of Tarhana on Caecal Microflora of Quails (Coturnix coturnix Japonica)</i> .....	330
İsa Coskun <sup>a</sup> , Huseyin Cayan <sup>a</sup> , Kubra Sacihan <sup>a</sup> , Guray Erener <sup>b</sup> .....	330
<b>SESSION-4</b> .....	334
<b>NUTRITION II</b> .....	334
<i>Changing Nutritional Composition of Pomegranate (Punica granatum L.) Seed by Aspergillus niger Solid State Fermentation to Making Suitable for Poultry Nutrition</i> 335	
Emrah Güngör, Aydın Altop, Güray Erener .....	335
<i>Aspergillus niger can Improve Nutritional Composition of Wheat Bran under Solid State Fermentation to Make a Protein Source for Poultry Diets</i> .....	340
Aydın Altop, Emrah Güngör, Güray Erener .....	340
<i>Chickens Are Not Omnivore Any More</i> .....	345
Hüseyin Çayan, İsa Coşkun, Ahmet Şahin .....	345

<b>Determination of The Effect of Myrtle (<i>Myrtus Communis L.</i>) Oil on Small Intestinal Motility In Broiler</b> .....	348
Tuba Bülbül <sup>a</sup> , Vural Özdemir <sup>b</sup> , Elmas Ulutaş <sup>c</sup> , Aziz Bülbül <sup>c</sup> .....	348
<b>Recording Isometric Duodenum, Jejunum and Ileum Contractility</b> .....	350
<b>Effects of Dietary Supplementation of Arginine and Lysine on Total Number and Volume of Nuclei of The Cardiomyocytes in Laying Quails</b> .....	352
Murat Sırrı Akosman <sup>a</sup> , Tuba Bülbül <sup>b</sup> , Aziz Bülbül <sup>c</sup> , Mehmet Akalan <sup>a</sup> , Vural Özdemir <sup>a</sup> .....	352
<b>Technical and Economic Effect of Constant and Variable Feeding During and After Molting Period in White Free Ranged Hens</b> .....	357
Savaş Sarıözkan <sup>a</sup> , Yusuf Konca <sup>b</sup> , Mehmet Küçükoflaz <sup>a</sup> , Aytaç Akçay <sup>c</sup> .....	357
<b>New Feeding Strategies in Organic Poultry Breeding</b> .....	361
Arda Yıldırım <sup>a</sup> , Hasan Eleroglu <sup>b</sup> , Ahmet Şekeroğlu <sup>c</sup> , Mustafa Duman .....	361
<b>Effects of Dietary Panax Ginseng Leaf Extract on Production Performance and Egg Quality of Laying Hens</b> .....	363
Merve Işıl Şen Mutlu, Arda Yıldırım .....	363
<b>Effect of Dietary Trace Mineral Sources on Performance, Bone Development and Leg Health of Broilers</b> .....	365
Yusuf Uzun, Hasan Rüştü Kutlu .....	365
<b>Phytase In Poultry Diets</b> .....	369
Şehnaz Özatay.....	369
<b>Effect of Shiitake Mushroom (<i>Lentinula edodes</i>) Inclusion to Quail Diets on Growth Performance</b> .....	373
İsmail Ülger, Çağatay Ay, Mahmut Kaliber.....	373
<b>Relationship between Nutrition and Intestinal Enzymes in Poultry: Review</b> .....	377
Emre Yılmaz <sup>a</sup> , Soner Uysal <sup>a</sup> , Mehmet Gul <sup>a</sup> .....	377
<b>Olive Leaf as Local Feed Additive for Sustainable Poultry Nutrition</b> .....	383
Pinar Özdemir <sup>a</sup> , Hatice Basmacıoğlu-Malayoğlu <sup>b</sup> , İsmail Yavaş <sup>c</sup> .....	383
<b>A Natural Feed Additive in Poultry Feeding: Resveratrol</b> .....	389
Mükremin Ölmez <sup>a</sup> , Mustafa Makav <sup>b</sup> , Hüseyin Avni Eroğlu <sup>c</sup> , Tarkan Şahin <sup>a</sup> .....	389
<b>Use of Quinoa (<i>Chenopodium Quinoa Willd</i>) Seed in Poultry Nutrition</b> .....	394
Sibel Canoğulları Doğan <sup>a</sup> , Sema Yaman, İlknur Uçak .....	394
<b>Fenugreek (<i>Trigonella foenum- graecum L.</i>) Seeds can be used as Feed Material in Poultry Nutrition</b> .....	398
Şefika Nur Özçelik, Ahmet Şahin .....	398
<b>Feeding Ecobiol® (<i>Bacillus Amyloliquefaciens CECT 5940</i>) Improves Performance of Broiler Chickens</b> .....	402
Alvaro Ortiz <sup>a</sup> , Lavinia Stef <sup>b</sup> , Ancuta Ion <sup>a</sup> .....	402
<b>Use of Licorice Root (<i>Glycyrrhiza glabra</i>) in Poultry Feed as Active Ingredient</b> .....	405
Sibel Canoğulları Doğan <sup>a</sup> , İlknur Uçak <sup>a</sup> , Sema Yaman <sup>a</sup> , Mikail Baylan <sup>b</sup> .....	405
<b>Lupine in Diets for Broilers, Commercial Laying Hens, and Layer Parental Flock</b> ....	410
E. Andrianova, I. Egorov, V. Fisinin, E. Grigoryeva .....	410
<b>A Research on The Determination of The Performance Properties of Imported Grand Parent Female Strains Being Raised in The Eskişehir Geçit-Kuşağı Research Institute</b> .....	413
Emrah Oğuzhan <sup>a</sup> , Ramazan Yetişir <sup>b</sup> , İsmail Özkan <sup>a</sup> , .....	413
Halil Harman <sup>a</sup> , Sinan Çağlak <sup>a</sup> .....	413
<b>Effects of Arginine-Silicate-Inositol Complex on Bone Mineralization in Laying Hens</b> .....	416
Cemal Orhan <sup>a</sup> , Mehmet Tuzcu <sup>b</sup> , Nurhan Sahin <sup>a</sup> , Kazim Sahin <sup>a*</sup> .....	416
<b>SESSION 5</b> .....	418
<b>GENETICS AND GENOMICS</b> .....	418

<b><i>Carcass Traits As Influenced By Different Body Weight Categories In Four Close-Bred Flocks Of Japanese Quail (Coturnix Coturnix Japonica)</i></b> .....	<b>419</b>
Ahmed Sultan Jatoi <sup>a</sup> , Erum Bughio <sup>a</sup> , Jibran Hussain <sup>b</sup> , Muhammad Hayat Jaspal <sup>c</sup> , Shahid Mehmood <sup>b</sup> , Abdul Waheed Sahota <sup>b</sup> , Khalid Javed <sup>d</sup> , Athar Mahmud <sup>b</sup> , Reema Bughio <sup>e</sup> And Hafiz Muhammad Ishaq <sup>f</sup> .....	419
<b><i>Effect of Parental Body Weight on Somebody Measurements in Sexed Progeny of Japanese Quail (Coturnix Coturnix Japonica) Studied at Different Ages</i></b> .....	<b>420</b>
Erum Bughio <sup>a</sup> , Ahmed Sultan Jatoi <sup>a</sup> , Jibran Hussain <sup>b</sup> , Muhammad Hayat Jaspal <sup>c</sup> , Shahid Mehmood <sup>b</sup> , Abdul Waheed Sahota <sup>b</sup> , Khalid Javed <sup>d</sup> , Athar Mahmud <sup>b</sup> , Reema Bughio <sup>e</sup> And Hafiz Muhammad Ishaq <sup>f</sup> .....	420
<b><i>Effect of SNP's on The Secondary Protein Structure of Prolactin Gene In Long-Term Selected Japanese Quail</i></b> .....	<b>421</b>
Kemal Karabağ <sup>a</sup> , Emel Tüten Sevim <sup>b</sup> .....	421
<b><i>Oncogenic Viruses on Poultry</i></b> .....	<b>423</b>
Kemal Karabağ <sup>a</sup> , Berkant İ. Yıldız <sup>b</sup> .....	423
<b><i>Effect of SNP's on The Secondary Protein Structure of Insulin-Like Growth Factor-1 Gene In Long-Term Selected Japanese Quail</i></b> .....	<b>425</b>
Kemal Karabağ <sup>a</sup> , Ayşe Alemlı <sup>b</sup> .....	425
<b><i>Some Plumage Mutations of Japanese Quail Resulting from The Level of Inbreeding</i></b> .....	<b>428</b>
Moise Noubandiguim <sup>a</sup> , Musa Sarıca <sup>b</sup> .....	428
<b><i>Poultry Breeding from Past to Today</i></b> .....	<b>432</b>
Kübra Melis Sabuncuoğlu <sup>a</sup> , Süleyman Baytur <sup>b</sup> Doğan Narinç <sup>c</sup> .....	432
<b><i>Bioinformatics and Sequence Alignment: An Example Calpain Gene in Japanese Quails (Coturnix coturnix japonica)</i></b> .....	<b>437</b>
Raziye Işık <sup>a</sup> , Hasan Hüseyin İpçak <sup>b</sup> .....	437
<b><i>New Approaches in Poultry Production: Candidate Genes Related with Growth and Meat Quality in Japanese Quails</i></b> .....	<b>442</b>
Raziye Işık .....	442
<b><i>Effect of SNP's on The Secondary Protein Structure of Ghrelin Gene In Long-Term Selected Japanese Quail</i></b> .....	<b>446</b>
Kemal Karabağ <sup>a</sup> , Emel Tüten Sevim <sup>b</sup> , Berkant İsmail Yıldız <sup>b</sup> ,.....	446
Emine Toparslan <sup>b</sup> .....	446
<b>SESSION 6</b> .....	<b>449</b>
<b>INCUBATION</b> .....	<b>449</b>
<b><i>Effect of Monochromatic Light Stimuli during Embryogenesis on Hatch Time</i></b> .....	<b>450</b>
Kübra Melis Sabuncuoğlu <sup>a</sup> , Doğan Narinç <sup>b</sup> , Firdevs Korkmaz <sup>a</sup> , .....	450
Hasan Ersin Şamlı <sup>a</sup> .....	450
<b><i>Strain Differences and Egg Weight Affected Leg Bones Development of Broiler Embryos and Chicks</i></b> .....	<b>454</b>
Serhat Yıldırım Aydın, Neslihan Kalkan, Tahir Shah, .....	454
Mojtaba Vafaenia, Servet Yalçın .....	454
<b><i>Egg and Hatchability Traits in Pekin Ducks</i></b> .....	<b>459</b>
Turgut Kırmızıbayrak <sup>a</sup> , Buket Boğa Kuru <sup>a*</sup> , Mahir Murat Cengiz <sup>b</sup> , Serpil Adıgüzel Işık <sup>a</sup> .....	459
<b><i>Effect of breeder age on hatching traits under long term storage conditions</i></b> .....	<b>462</b>
Umut Sami Yamak, Kadir Erensoy, Elif Cilavdaroğlu, Elvan Ergin, Musa Sarıca..	462
<b><i>Some Egg and Hatching Traits of Linda Geese Reared under Local Breeder Conditions</i></b> .....	<b>466</b>
Mehmet Sarı <sup>a</sup> , Aykut Asım Akbaş <sup>b</sup> , Kadir Emre Buğdaycı <sup>c</sup> , Mustafa Saatçı <sup>d</sup> .....	466
<b><i>The effect of injection of zinc-glycine on hatchability, hatching weight and some organs weight some in quail hatching eggs</i></b> .....	<b>470</b>
Abbas Fadhl Abdulqader, Osman Olgun .....	470

<i>Effect of egg shell thickness and storage period on hatching traits of chicken eggs....</i>	473
Umut Sami Yamak <sup>a</sup> , Mehmet Akif Boz <sup>b</sup> , Kadir Erensoy <sup>a</sup> , Musa Sarica <sup>a</sup> .....	473
<i>Effects of Dietary Replacement of Organic Minerals, Fish Oil and Hydrolyzed Collagen on Tibia Characteristics of Broiler Chickens.....</i>	479
Bahadır Can Güz <sup>a</sup> , Roos Molenaar <sup>a</sup> , Ingrid de Jong <sup>b</sup> , Bas Kemp <sup>a</sup> .....	479
Henry van den Brand <sup>a</sup> , Marinus van Krimpen <sup>b</sup> .....	479
<b>SESSION-7 .....</b>	<b>480</b>
<b>MANAGEMENT .....</b>	<b>480</b>
<i>Investigation of Growth Curves of Live Weight with Some Nonlinear Models in Broiler Chickens.....</i>	481
Turgay Şengül <sup>a</sup> , Şenol Çelik <sup>a</sup> , Bünyamin Söğüt <sup>a</sup> , Hakan İnci <sup>a</sup> , Ömer Şengül <sup>b</sup> .....	481
<i>Relations Between Welfare and Health of Laying Hens in Cage System .....</i>	485
Kadir Erensoy, Musa Sarica, Umut Sami Yamak .....	485
<i>The Effect of Altitude on Some Performance and Structural Features of The Village Chicken Production: Artvin Province Example.....</i>	491
Eren Bayraktar <sup>a</sup> , Ahmet Şekeroğlu <sup>b</sup> , Mustafa Duman <sup>c</sup> .....	491
<i>A Comparative Morphometric Study On Os Hyoideum Of Female And Male Geese Growing In Kars .....</i>	496
Gülseren Kırbaş <sup>*</sup> , İsmet Takcı .....	496
<i>Effect Of Different Breeding Systems On Growth Performance, Carcass And Meat Quality Of Japanese Quails.....</i>	499
Burak Gözet <sup>a</sup> , Mikail Baylan <sup>b</sup> , Ayşen Bulancak <sup>c</sup> , Kadriye Kurşun <sup>b</sup> .....	499
<i>Assessment of Chlamydiaceae contamination on litter and water in .....</i>	504
<i>free-range chicken flocks .....</i>	504
Quilicot, A.M.M. <sup>a,b</sup> , Horvatek Tomić, D. <sup>a</sup> .....	504
Gottstein, Ž. <sup>a</sup> , Prukner-Radovičić, E. <sup>a</sup> .....	504
<i>Effect of Litter Type and Gender on Some Temperature Parameters in Broiler .....</i>	507
Ahmet Şekeroğlu <sup>a</sup> , Mustafa Duman <sup>b</sup> , Sedat Karaman <sup>c</sup> .....	507
<i>Application of Fuzzy Nonlinear Regression for Egg Production Curve Fitting .....</i>	511
Ozkan Gorgulu <sup>a</sup> , Asli Akilli <sup>b</sup> .....	511
<i>The Effect of Lightening of Strip Led in Different Colors in Japan Quails (Coturnix Coturnix Japonica) on Performance Parameters.....</i>	512
Ömer Görgülü, Tülin Çiçek Rathert.....	512
<i>Rearing Factors Affecting the Immune System in Poultry.....</i>	513
Özlem Varol Avcılar <sup>a</sup> , Esin Ebru Onbaşıl <sup>b</sup> .....	513
<i>The Influence of Stocking Density on The Productive Performance in Cage-Housed Broiler Breeder Flock.....</i>	514
Saleeva I.P., Ivanov A.V., Andrianova E.N. ....	514
<i>The Chick Quality.....</i>	517
D. Narinç, E. Aydemir S. Baytur, T. Aksoy.....	517
<i>Effect of egg weight on breast muscle development in fast- and slow-growing broiler embryos and chicks.....</i>	521
Mojtaba Vafaieinia <sup>a</sup> , Gamze Turgay İzzetoğlu <sup>b</sup> , Serhat Yıldırım Aydın <sup>a</sup> , Neslihan Kalkan <sup>a</sup> , Servet Yalçın <sup>a*</sup> .....	521
<i>Climatic Environment and Control in Hen House .....</i>	527
Sezai Alkan <sup>1</sup> , İsmail Türker <sup>2</sup> , Kemal Karabağ <sup>3</sup> , Taki Karslı <sup>4</sup> .....	527
Tavuk Kümeslerinde İklimsel Çevre ve Denetimi .....	527
<i>The Situation of Organic Poultry within Organic Livestock in Turkey .....</i>	529
E. Uruk <sup>1</sup> , F. Yenilmez <sup>2*</sup> .....	529
<i>The Effect of Socio-Economic Status on Consumers' Thinking Towards Organic Products in TR72 Region (Kayseri, Sivas and Yozgat).....</i>	531
Hasan Eleroğlu <sup>a</sup> , Hüdaverdi Bircan <sup>b</sup> , Arda Yıldırım <sup>c</sup> .....	531

<b><i>Effects Of Energized Oxygen In Drinking Water On The Performance Of Broiler Chicken</i></b> .....	533
Mustafa Saatci <sup>a</sup> , Hasan Katranci <sup>b</sup> , Özlem ŞAHAN Yapicier <sup>c</sup> .....	533
<b><i>The Effect of Conventional and Enriched Litter System upon Incubation Result and Plumage Score in Layer Breeder Hens</i></b> .....	541
Bülent Tarım <sup>a</sup> , Murat Doğu <sup>a</sup> , Diydem Doğan <sup>a</sup> , Ayten Aşkın Kılınç <sup>a</sup> , Sunay Demir <sup>a,1</sup> , H. Öztürk <sup>b</sup> .....	541
<b><i>Performance Characteristics of Slow Growing Broilers Used in Alternative Broiler Breeding Systems</i></b> .....	547
Ahmet Şekeroğlu <sup>a</sup> , Mustafa Duman <sup>b</sup> .....	547
<b><i>An Overview of World's Goose Production and Global Trade</i></b> .....	553
Ahmet Şekeroğlu <sup>a</sup> , Mustafa Duman <sup>b</sup> .....	553
<b><i>Energized Oxygen Disinfection of Egg Shell</i></b> .....	557
Özlem Sahan Yapicier <sup>a</sup> , Mustafa Saatci <sup>b</sup> .....	557
<b><i>The Effect of Production System and Slaughtering Age on Meat Quality of Pheasants</i></b> .....	562
Mehmet Akif Boz <sup>a</sup> , Umut Sami Yamak <sup>b</sup> , Musa Sarıca <sup>b</sup> , Fatih Öz <sup>c</sup> , Ahmet Uçar <sup>d</sup> ... ..	562
<b><i>Comparison of Atabey and Atak-S Native Commercial Layer Hens in Term of Egg Quality Traits</i></b> .....	566
İsmail Türker <sup>a</sup> , Serdar Kamanlı <sup>b</sup> , Sezai Alkan <sup>c</sup> .....	566
<b><i>The Factors Affecting on Poultry Products Consumption in Kayseri Province</i></b> .....	567
Hasan Eleroğlu <sup>a</sup> , Hüdaferdi Bircan <sup>b</sup> , Arda Yıldırım <sup>c</sup> .....	567
<b><i>Behavioural Responses Of Broiler Chickens Fed Increasing Levels Of Wheat Distiller's Dark Grains With Solubles Managed Under Controlled Environment</i></b> .....	569
N. B. Rano, <sup>a</sup> A. S. Chaudhry <sup>b</sup> and S. A. Edwards <sup>b</sup> .....	569
<b><i>Fear Related Behavioral Responses of Slow and Fast Growing Broiler Chicks at Early Ages</i></b> .....	573
Tahir Shah, Serhat Yıldırım Aydın, Sezen Özkan.....	573
<b><i>Production Parameters and Feather Scores of Local Layer Hybrids Kept in Enriched Cages</i></b> .....	579
Kamanli S <sup>a</sup> , Özkan S <sup>b</sup> , Taşdemir A.N <sup>a</sup> , Demirtaş Ş <sup>a</sup> , Tülek E <sup>a</sup> , Pekcan, M., <sup>c</sup> Kurtdede, E., <sup>c</sup> Öztürk, H. <sup>c</sup> .....	579
<b><i>The Effect of Conventional and Enriched Litter System upon Performance and Plumage Score in Roosters</i></b> .....	583
Bülent Tarım <sup>a</sup> , Murat Doğu <sup>a,1</sup> , Diydem Doğan <sup>a</sup> , Ayten Aşkın Kılınç <sup>a</sup> , Sunay Demir <sup>a</sup> , Hakan Öztürk <sup>b</sup> .....	583
<b><i>Effect of Different Colours Clothes on Fear and Stress Responses, Some Meat Quality Traits and Performance in Broilers</i></b> .....	590
Evrin Dereli Fidan.....	590
<b><i>Uniformity and Welfare Problems at Broiler Houses and New Solution Approaches by Computer Modelling Programs</i></b> .....	597
A. Bulancak, N. Özen.....	597
<b><i>Chemical composition of breast meat from broilers affected by white striping myopathy<sup>a</sup></i></b> .....	600
Rodrigo Alves de Souza <sup>b*</sup> , Juliana Lolli Malagoli de Mello <sup>c</sup> , Larissa Tátero Carvalho <sup>b</sup> , Aline Giampietro-Ganeco <sup>c</sup> , Rodrigo Fortunato de Oliveira <sup>c</sup> , Erika Nayara Freire Cavalcanti <sup>c</sup> , Marco Antonio Trindade <sup>b</sup> , .....	600
Pedro Alves de Souza <sup>c</sup> , Hirasilva Borba <sup>c</sup> .....	600
<b><i>The Effect of Conventional and Enriched Litter System upon Performance and Some Blood Parameters in Layer Breeder Hens</i></b> .....	606
Bülent Tarım <sup>a,1</sup> , Murat Doğu <sup>a</sup> , Diydem Doğan <sup>a</sup> , Ayten Aşkın Kılınç <sup>a</sup> , Sunay Demir <sup>a</sup> , Hakan Öztürk <sup>b</sup> .....	606
<b>SESSION-8</b> .....	614

<b>PRODUCT QUALITY</b> .....	614
<i>The Role and Importance of Halal Food Certification in Turkish Republic's Broiler Exports</i> .....	615
Sinan Duru <sup>a</sup> , Seyit HAYRAN <sup>a</sup> , Gökhan FİLİK <sup>b</sup> , Aykut GÜL <sup>a</sup> .....	615
<i>Salmonella resistant to extended-spectrum cephalosporin isolated from broiler chicken farms in Skikda</i> .....	620
Djeffal Samia <sup>a</sup> , Mamache Bakir <sup>b</sup> , Elgroud Rachid <sup>a</sup> , Bouaziz Omar <sup>a</sup> , Jean-Marc Rolain <sup>c</sup> .....	620
<i>Effect of dietary supplementation with Rosmarinus officinalis powder on antioxidative potential and sensory and microbiological qualities of breast meat organic broilers...</i>	627
Essaidi Ismahen <sup>1,2</sup> , Hadj Ayed Mediha <sup>1,3</sup> , Mahmoudi Sarra <sup>1</sup> , Kebaili Safa <sup>3</sup> and Halouani Sonia <sup>4</sup> .....	627
<i>Attributes related to softness of breast meat from broilers affected by white striping myopathy<sup>a</sup></i> .....	633
Juliana Lolli Malagoli de Mello <sup>b</sup> , Rodrigo Alves de Souza <sup>b,c</sup> , Erika Nayara Freire Cavalcanti <sup>b</sup> , Aline Giampietro-Ganeco <sup>b</sup> , Rodrigo Fortunato de Oliveira <sup>b</sup> , Marcel Manente Boiago <sup>d</sup> , Pedro Alves de Souza <sup>b</sup> , Hirasilva Borba <sup>b</sup> .....	633
<i>The Effect of Production System and Slaughtering Age on Meat Quality of Guinea Fowls</i> .....	639
Mehmet Akif Boz <sup>a</sup> , Umut Sami Yamak <sup>b</sup> , Musa Sarıca <sup>b</sup> , Fatih Öz <sup>c</sup> , Kadir Erensoy <sup>b</sup> .....	639
<i>Turi Duck Egg Quality In Kretek Sub District, Bantul Regency, Special Region Yogyakarta As Original Germplasm Of Indonesia</i> .....	643
Fatah Nugroho <sup>a</sup> , Sukma Maharani <sup>a</sup> , Hanif Abdurrahman <sup>a</sup> , Abdurrahman Muhammad Fikri Rasdi <sup>b</sup> .....	643
<i>Effective Approaches to The Biofortification of Eggs With <math>\Omega</math>-3 Polyunsaturated Fatty Acids, Selenium, And Vitamin E</i> .....	649
Kavtarashvili A.Sh., Stefanova I.L., Svitkin V.S., Novotorov E.N., Andrianova E.N. ....	649
<i>Alterations in Proteins and Functional Characteristics of Chicken Breast and Thigh Meats with Microwave Cooking</i> .....	654
Melike Taşkıran <sup>a</sup> , Emine Olum <sup>b</sup> , Kezban Candoğan <sup>b</sup> .....	654
<i>A study on incorporation of sweet potato powder in model system turkey emulsions...</i>	659
Merve Karabıyıkoglu, Burcu Öztürk, Meltem Serdaroğlu.....	659
<i>Proteomics Approach for Poultry Meat Quality Assessment</i> .....	665
Esin Çalık, Kezban Candoğan.....	665
<i>Liquid Egg White Enzyme Modification Using Protease: Effects on Physio-Chemical Characteristics</i> .....	670
Muhammed Yüceer <sup>a</sup> , Cengiz Caner <sup>b</sup> .....	670
<i>Color traits, pH and water holding capacity of breast meat from broiler chickens affected by white striping myopathy<sup>a</sup></i> .....	679
Hirasilva Borba <sup>b</sup> , Juliana Lolli Malagoli de Mello <sup>b</sup> , Rodrigo Alves de Souza <sup>b,c</sup> , Erika Nayara Freire Cavalcanti <sup>b</sup> , Aline Giampietro-Ganeco <sup>b</sup> , Rodrigo Fortunato de Oliveira <sup>b</sup> , Pedro Alves de Souza <sup>b</sup> .....	679
<i>Quality Characteristic of Fresh Poultry Sausages Formulated with Linseed/Black Cumin O/W Gelled Emulsions as Fat Replacer</i> .....	685
Meltem Serdaroğlu <sup>a</sup> , Hülya Serpil Kavuşan <sup>a</sup> , Gamze İpek <sup>a</sup> , Berker Nacak <sup>a,b</sup> .....	685
<i>The Edible Coatings for Maintaining Eggs Quality and Minimize Eggshell Breakage: A-Review</i> .....	692
Muhammed Yüceer <sup>1*</sup> And Cengiz Caner <sup>2</sup> .....	692
<i>Emerging and New Non-Thermal Food Preservation Technologies in Egg Processing – Trends and Future Industrial Perspectives: An Overview</i> .....	703
Muhammed Yüceer.....	703

<i>Examination Of The Effects Of Some Egg Quality Characteristics On Yolk And Albumen Weight By MARS Method In Japanese Quails</i> .....	710
Şenol Çelik, Turgay Şengül, Bünyamin Söğüt, Yusuf Şengül, Hakan İnci .....	710
<i>Histopathological aspects of the Pectoralis major muscle of broiler chickens affected with deep pectoral myopathy<sup>a</sup></i> .....	715
Bruna Richelle de Oliveira Castilho <sup>b</sup> , Juliana Lolli Malagoli de Mello <sup>c</sup> , Maysa Longo Maduro <sup>b</sup> , Aline Giampietro-Ganeco <sup>c</sup> , Larissa Tátero Carvalho <sup>c</sup> , Hirasilva Borba <sup>c</sup> , Lismara Castro do Nascimento <sup>b</sup> , Lizandra Amoroso <sup>b</sup> .....	715
<i>A Comparison of Turkey and European Union Countries In Terms of Chicken Meat and Egg Prices with Cluster Analysis</i> .....	720
Aytaç Akçay <sup>1</sup> , Mehmet Küçükoflaz <sup>2</sup> , Savaş Sarıözkan <sup>2</sup> .....	720
<i>Effect of Thyme Species Extracts on Performance and Nutrients Digestibility of Broiler Chickens</i> .....	725
Mir Daryoush Shakouri, Mohammad Malekzadeh .....	725

# OPENING PRESENTATION

Trends, Chalanges and Sustainability in World Poultry Production

Dr. Roel Mulder  
Secretary General of the WPSA, The Netherlands

# ORAL PRESENTATIONS

**SESSION-1**  
**PLANARY SESSION**  
**INVITED PRESENTATIONS**

Global poultry meat production trends: Future prospects and Turkey

Sait Koca

*President of Turkish Poultry Meat Producers And Breeders Assoc.*

## **Egg industry in Turkey: From production to consumption**

**Sezen Özkan**

Ege University, Faculty of Agriculture, Department of Animal Science, 35100 İzmir-Turkey

### **Abstract**

The egg and poultry meat production has increased continuously during the last decade and this increase will continue during the next decades due to increase in global demand for animal food. The egg production market is one of the fastest growing animal food markets in the livestock sector and Turkish egg industry will take part in this global trend. Indeed, Turkish egg industry had a tremendous shift in both production and exportation during the last decade. Estimated number of eggs produced in Turkey reached to 20 254 million in 2017 with a 140 % increase as compared with the year of 2006. A total of 5 997 million eggs (29% of production) were exported. As global egg market keeps growing with an increased demand for egg products, a similar trend is expected in Turkey. There is still a large opportunity to increase annual per capita egg consumption in Turkey which has reached to 214 in 2017. Despite the many of challenges, a strategic approach to egg production including increased variability of products, investment for processing technology, incorporation with precise farming methods for sustainability will support this positive trend of egg production and consumption. The aim of this paper is to outline the challenges and opportunities faced by egg industry from production to consumption in Turkey.

**Key Words:** *Egg, Industry, Production, Consumption*

### **Introduction**

There is a global increase in the demand for animal originated food as the population grows. It is estimated that animal protein demand will increase 40% by 2030 (Mulder, 2017). Within livestock, egg production sector offers a global market opportunity. Because egg is an exceptional source of protein in human nutrition all over the world with affordable price. Expected growth in global demand for egg between 2015-2035 has been estimated as 50% (IEC, 2015). However, there is also a big change in egg producing areas. International Egg Commission (IEC) reported that highest growth rate in laying hen stocks have been occurred in the least developed countries (LLDC) and newly industrialized countries (NIC) during the last two decades (IEC 2016). From 1993 to 2013, the contribution of LLDC and NIC

to the laying hen population increased by 3.1 % and 10.1%, respectively. However, old industrialized countries (OIC) lost share by -10.6%.

Turkey has been included in NIC and economic predictions show that global economic ranking will change by 2050 and Turkey will be one of the most powerful economies (Business insiders UK, 2017). Although industrialization started to emerge only in the nineties, Turkish egg industry grew fast and had tremendous shift in both production and exportation during the last decade. This presentation will have an outlook for Turkish egg industry.

### Outlook, Challenges, and Opportunities

Estimated number of eggs produced in Turkey reached to 20 254 million in 2017 (Figure 1) with a 140 % increase as compared with the year of 2006 (YUMBİR, 2017). The number of eggs exported is 5 997 million in 2017 and egg consumption per capita has reached to 214. This gives a self-sufficiency rate of 130%, approximately.

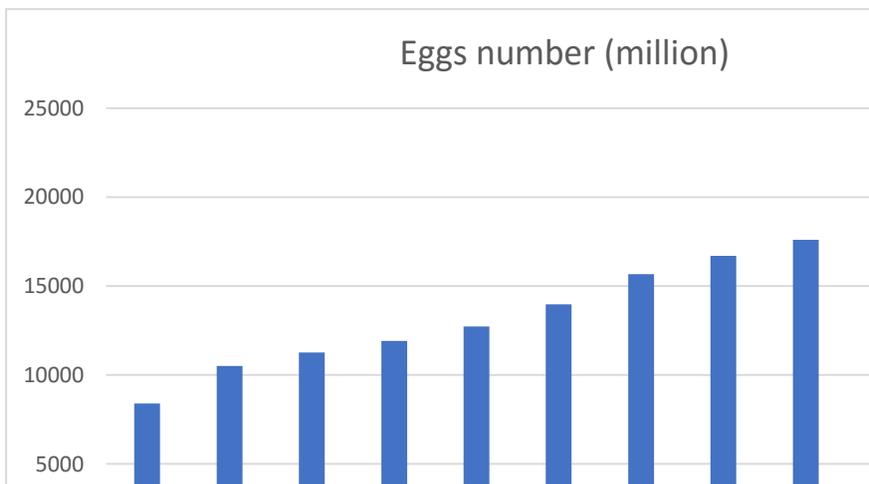


Figure 1. Egg production in Turkey from 2006 to 2017.

Turkish egg industry has become one of the fastest growing ones in the world and the growth rate of Turkish egg production as compared with leading egg producer countries is presented in Figure 2.

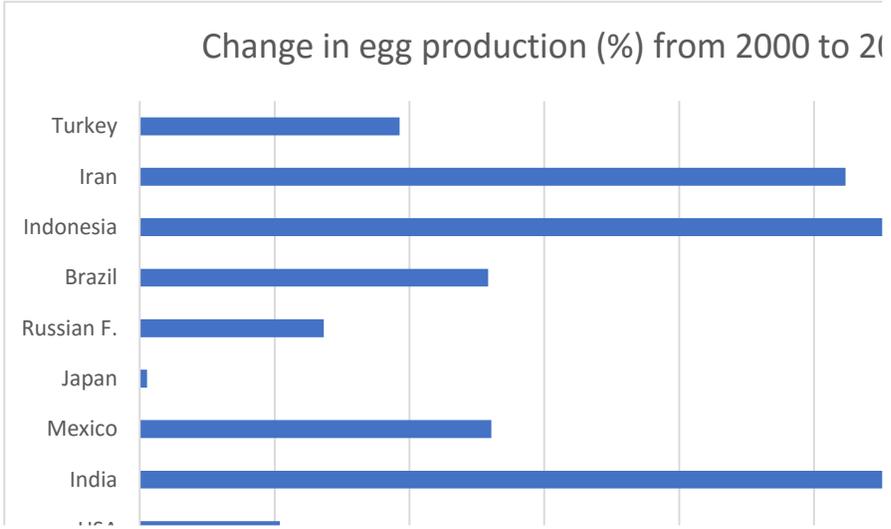


Figure 2. Change % in egg production of main producers from 2000 to 2016 (calculated from FAOSTAT database).

As a result of high growth rate in egg production and self-sufficiency, Turkey became one of the main exporters in the world. Figure 3 presents values of main export countries in the years 2012 and 2016. The trend of egg exportation in Turkey between 2006 and 2017 can be viewed by Figure 4.

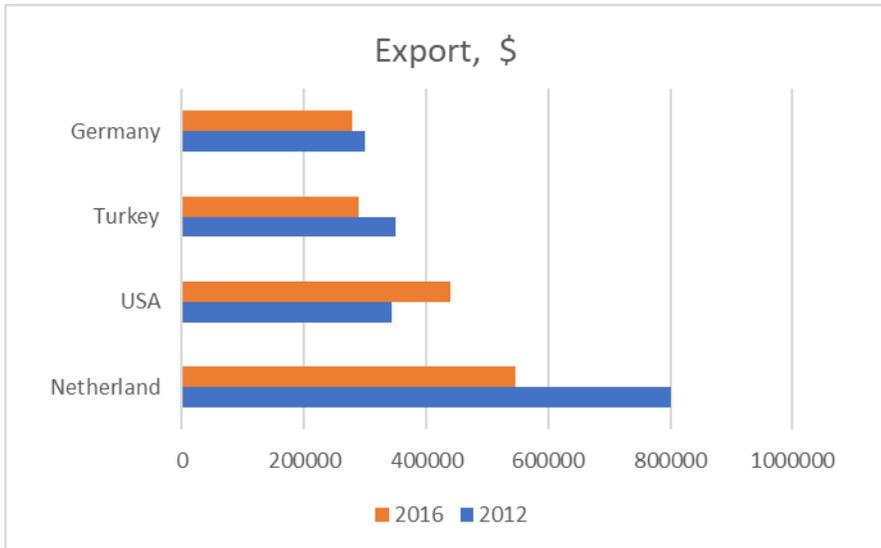


Figure 3. Export values (\$) of main exporters in the years 2012 and 2016.



Figure 4. Egg export values of Turkish egg industry between 2006 and 2017 (Source: YUMBİR, 2017).

The main issues affecting productivity in egg production are as following:

- the access to cheap and quality grains,
- increased efficiency of breeders and hatcheries,
- better management in the laying hen farms with the aid of precise technology,
- and, packaging and processing technology as related with shelf life.

Turkish egg industry faces many challenges from production to consumption and many of them are common to global egg industry. For example, the control of disease outbreaks with special emphasis on HPAI and feed prices are the most important threats to the global egg industry. Because poultry sector largely relies on importation of feed grains, the challenge with access to quality feed ingredients and volatility of feed prices are more vital to Turkish egg industry.

There is a growing consumer concern on the egg industry. Consumer concerns on food safety such as pesticide residue, environmental impact and animal welfare related issues are important drives on egg industry. Sustainability of egg industry is related to the economic, social, and environmental impact of production systems (Mench et al., 2016). In the developed countries or OIC, sustainability and consumer concerns and preferences have a significant economic impact on the egg industry. European Union banned conventional cages in 2012 and USA will do so by

2025. As commonly known, moving away from conventional cages to enriched cages and further transition to cage free production systems are important challenges for the egg industry. The Turkish egg industry should also participate in global discussions and develop solutions accordingly.

Global trade has significant impact on egg markets. Turkish egg industry faces challenge of competition with the other egg industries growing fast. To increase export market share, egg industry should not rely only on shell egg but further processed/value added products would offer to expand potential new markets.

### **Conclusion**

Turkish egg industry has potential to sustain a stable growth. Following approaches would possibly be the key to increase the strength of the industry:

- offering variability of products from different production systems such as barn, free range, and organic;
- promoting not only shell egg but also egg products to increase domestic consumption and expand potential new markets for export;
- incorporating technology with precise farming methods to improve sustainability;
- investment on research, development, and innovation for competitiveness.

### **References**

- FAOSTAT, (2017) <http://www.fao.org/faostat/en/#data/QL>
- INTERNATIONAL EGG COMMISSION (2015) Annual review 2015. 36 p.
- MENCH, J.A., SWANSON, J. C. and ARNOT, C. (2016) The Coalition for Sustainable Egg Supply: A unique public-private partnership for conducting research on the sustainability of animal housing systems using a multistakeholder approach. *J. of Animal Sci.* 94: 126-1308.
- MULDER, N.D. 2017. Outlook for the global and EU industry. <https://lf.dk/~media/lf/for-medlemmer/sektioner-og-udvalg/erhvervsfjerkraesektionen/kongres-2017/1--nan-dirk-mulder.pdf?la=da>
- YUMBİR (Turkish Egg Producers Asso.) (2017) Yumurta tavukçuluğu verileri- 2017. 31 p. <http://www.yum-bir.org/Yumurta/id30-Istatistikler>.
- MARTIN, W. (2017) Business insiders UK- Finance. <http://uk.businessinsider.com/pwc-ranking-of-biggest-economies-ppp-2050-2017-2/#11-turkey-5184-trillion-22>

## **Evaluation of Different Control Programs of Coccidiosis in Poultry and the Invention of a Related Comprehensive Method**

**E. Barbour, H. Shaib, L. Van Waeyenberghe, N. Kurkure, E. Matyas,  
I. Arpaci, T. Kumosani, U. Truyen, R. Sultan, W. Krull**

1Department of R & D, Opticon Co., Switzerland, and Distinguished Professor at Biochemistry Department, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia (KSA); 2Poulpharm BVBA, Belgium; 3Nagpar Veterinary College, India; 4Dremax kft, Hungary; 5ANC Hayvan, Turkey; 6King Abdulaziz University, KSA; 7Leipzig University, Germany; 8University of Veterinary and Animal Sciences, Pakistan; 9Opticon Co., Switzerland

### **ABSTRACT**

The present control programs of coccidiosis in poultry will include their advantages and disadvantages, based on literature from different parts of the world. The evaluation of the present coccidiosis control programs will include controls by house management, vaccines, and by the most common coccidiostat approach. A global data, accomplished in nine countries, aimed at replacement of synthetic poultry coccidiostats by an invented comprehensive dual approach of decontaminating poultry barns by a Wide Spectrum Disinfectant (WSD) and intermittent supplementation of drinking water with an emulsion of natural Essential Oil Blend in Water Extract (EOBWE) of plants. The first six trials were concluded in isolation unit facilities and laboratories and the other four were field trials. The first six trials had different objectives including, studying the protection against coccidiosis by intermittent or continuous administration of EOBWE in drinking water against controlled challenge by sporulated oocysts of *Eimeria* spp., administered intra-esophageally or through contaminated floors. Another two objectives studied the effect of different concentrations of EOBWE and WSD on lysis of *Eimeria* oocysts. A fourth objective compared the control of coccidiosis in broilers by the invented dual approach of applying WSD and EOBWE versus the application of classical disinfectants and synthetic coccidiostats. The four field trials compared the dual intervention by classical disinfectants and synthetic coccidiostats versus the invented intervention by WSD and EOBWE against controlled floor contaminated-challenge of broilers by equivalent number of sporulated oocysts of 8 *Eimeria* spp. The second and third trials had the same comparison but against field challenge of broilers by *Eimeria* spp. The fourth trial compared the impact of synthetic coccidiostat alone versus concurrent administration of both the synthetic coccidiostat and the EOBWE on protection of broilers against field challenge by *Eimeria* spp. The compiled data of this global research led to comprehensive control of poultry coccidiosis, by significant reduction of oocysts output and its associated lesions, and consistent improvement of the chicken performance.

**SESSION-2**  
**NUTRITION-I**

***INVITED PRESENTATIONS***

## Global Poultry Feed Production: Natural Resources and Future

Murat Ülkü Karakuş

Türkiyembir (Türkiye yem sanayicileri birliği) Çetin Emeç Bulvarı Lizbon Caddesi (Eski 2. Cad.) Öveçler Mah. No:38/7 Dikmen Çankaya ANKARA

### Introduction

The global demand for animal proteins has seen significant increase due to growing population, improved incomes and urbanization. Global meat production has reached 317 million tons in 2016; while pig meat and sheep meat production evidently declined, poultry and bovine meat production expanded. In terms of consumer preference poultry meat, in particular broiler meat, has been placed on the top.<sup>1</sup>

Poultry meat consumption is increasing globally for this more affordable animal protein source compared to red meats. Low production costs and affordable product prices contributed poultry meat to be preferred by both producers and consumers.

Global broiler meat production is expected to reach 91.3 million tons with the 1% growth in 2018, due to the increasing production particularly in USA, Brazil, India and EU. Increasing imports in USA and Brazil, consistent growth to meet local demand in EU and India are the primary drivers of global development in meat production. Broiler meat production is forecasted to increase by %7 in 2018 in China, which is the seventh large country importing poultry meat.<sup>1</sup>

Table 1. 2013-2018 Broiler meat production in certain countries (mmt)

	2013	2014	2015	2016	2017
USA	17.0	17.3	18.0	18.3	18.6
Brazil	13.3	12.7	13.1	12.9	13.3
EU	10.1	10.1	10.9	11.5	11.7
China	13.4	13.0	13.4	12.3	11.6
India	3.5	3.7	3.9	4.2	4.4
Russia	3.0	3.3	3.6	3.7	3.8
Mexico	2.9	3.0	3.2	3.3	3.4
Argentina	2.0	2.0	2.1	2.1	2.1
Thailand	1.5	1.6	1.7	1.8	1.9
Turkey	1.8	1.9	1.9	1.9	2.0
Malaysia	1.5	1.6	1.6	1.7	1.7
Others	15.6	16.2	15.7	15.5	15.7
Global	84.4	86.8	89.1	89.1	90.2

<sup>2</sup>USDA, October 2017

Sustainability of both raw material and poultry feed supply is very essential to support the growth of global poultry meat production. By the effect of Asia regions' development, parallel to the increase in demand for poultry meat also an expansion is expected in next years.

**Global feed sector**

Parallel to growth in poultry meat consumption poultry feed sector also has seen a development. While egg and poultry meat production increased by 2%, broiler feed and layer feed production developed by 3% and 1 % respectively.

Over the last five years, the global feed industry has seen 1.07 billion tons with a total growth of 13%, which translates to an average growth of 2.49% per annum. In 2017, 143.8 million tons of layer feed and 296.2 million tons of broiler feed has been produced, especially broiler feed constitutes the largest part of total feed production. The share of broiler and layer feeds was 41% in global feed production.<sup>3</sup>

**Table 2. The amount and share of feed species produced in 2017**

Species	Production (mmt)	Share in total production (%)
Aqua	37.4	4
Beef	79.4	7
Dairy	121.7	11
Pig	292.6	27
Layer	143.8	13
Broiler	296.2	28
Pet	28.1	3
Equine	8.1	1
Other	6.3	6
<b>Global</b>	<b>1070</b>	

<sup>4</sup>Alltech Global Feed Survey, 2018

China, USA, Brazil, Russia, Mexico, India and Spain can be viewed as the largest compound feed producing countries. In 2017, these top seven countries produced 50% of aggregate compound feed, 58% of global broiler feed and 47 % of global layer feed. The results demonstrate how significant these top seven countries in the overall feed business.

The comparison of feed species shows that the poultry feed has largest share in the global compound feed production. Broiler and layer feeds more prominent among all poultry feeds. Broiler and layer feeds constituted respectively 28% and 13% of total compound feed in 2017. Total poultry feed was consisted of 63% broiler feed, 31% layer feed and 6% of other poultry feeds.<sup>4</sup>

**Table 3. Change in poultry feed production in the world, in 2017 in comparison with 2016**

Layer Feed		Broiler Feed	
Region	Change	Region	Change
Africa	% 11	Africa	% 10
Asia-Pacific	-% 3	Asia-Pacific	% 1
Europe	% 3	Europe	% 7
Latin America	% 3	Latin America	% 2
Middle East	- %5	Middle East	% 1
North America	% 4	North America	% 2
Global	% 0,3	Global	% 3

<sup>4</sup>Alltech Global Feed Survey, 2018

Although broiler feed production increased in all regions compared to last year, Africa regions has shown the fastest growth in broiler feed production with 10% increase, followed by Europe with 7% increase. Layer feeds also showed an increase in most areas, again Africa has the largest growth with 11% preceding North America with 4% improvement. The Asia-Pacific region has the greatest share of 44% in layer feed the production.

Although Africa has been one of the fastest growing feed markets in last five years, it didn't keep this trend as a regional average in 2017. However with its nearly 30% growth in five years, Africa seems to be exceed the global growth average which is estimated as 13.1%. Egypt, Uganda, Mozambique and Morocco has added a total 1.3 million tons to Africa's improvement in feed production.<sup>4</sup>

North America, Latin America and Europe also made progress in layer feed production. While Russian broiler feed production also increased by 3%, Ukraine, Romania, the United Kingdom and Belgium also contributed the growth of the sector in Europe. China, which is known as the leader of global compound feed sector since 2011, has seen a small decline in total production. However 11 % and 5% decrease has been reported in broiler and layer feed industries. Russia which is one of the significant agricultural producers and getting more self-sufficient in compound feed production, has seen a growth in all feed species. As a result of this improvement Russia's layer and broiler feed production has reached 4.7 and 11 million tons respectively.

In India poultry feed production also increased, while layer feed production reached 10.1 million tons with a growth of 5%, broiler feed production reported as 12.3 million tons with a 12% growth.<sup>5</sup>

### **Compound Feed Prices**

Feed sector costs can change depending on region and raw materials which are used in feed manufacturing. Access to the raw material source and markets, appropriate infrastructure, land price, labor and transport issues being important determinants of feed industry costs.

In 2017, global average feed prices didn't changed too much, except a small decrease in layer and broiler feeds.

**Table 4. Regional average costs of layer and broiler feeds, 2017**

	Layer Feed	Broiler Feed
Africa	470 \$	565 \$
Asia-Pacific	401 \$	468 \$
Europe	305 \$	353 \$
Latin America	370 \$	414 \$
Middle East	408 \$	498 \$
North America	253 \$	282 \$

<sup>4</sup>Alltech Global Feed Survey, 2018

**Table 5. Global feed prices, 2017**

	Layer Feed	Broiler Feed
Global Average	363 \$	418\$
Change (%)	-% 1.7	-% 14
Highest feed cost	Algeria-660\$	Cameroon - 753\$
Lowest feed cost	Moldova- 180 \$	Slovakia -172\$

<sup>4</sup>Alltech Global Feed Survey, 2018

The highest poultry feed costs were seen in Africa and Middle East regions, while North America and Europe was the regions where the lowest feed costs occurred in 2017.

Global average cost of layer feed has seen as 363\$ declining by 1.7% while global production of layer feed increased by 1%. The average cost of broiler feed used in finisher diets decreased by 14%, resulted average cost as 418 \$ while global production of broiler feed increased by 3%.<sup>4</sup>

### **Raw Materials for Poultry Feeds and Alternative Resources**

International trade of feed materials determines the dynamics of feed sector. Global production and trade of these products affects significantly the production and costs of poultry feeds thereby international competition in broiler production.<sup>5</sup>

Grains, oil seeds and oil seed meals, in particular corn, wheat, soybean, sunflower seed and meals, are used in high amounts in poultry diets.

**Table 6. Global wheat situation (mmt)**

	2013	2014	2015	2016	2017
Production	715.1	728.2	735.3	750.4	755.2
Consumption	698.0	705.2	711.6	739.4	742.1
Ending stocks	195.0	218.0	241.7	252.7	268.4
Trade (Import/Export)	162.5	162.0	172.0	182.3	183.8

<sup>6</sup>USDA, January, 2018

Global wheat production is estimated to be 755.2 million tons in 2017 and 183.8 million tons of this amount is subjected to international trade. In recent years, the Black Sea region (Russia, Ukraine, and Kazakhstan) has become an important player that can compete with traditional producers such as Australia, Canada, USA and EU in wheat production with its low price and location advantage. This competition has affected all major producers in the global market. It is expected that the Black Sea Region will be the largest supplier of wheat in 2017/18 period.

**Table 7. Global corn situation (mmt)**

	2013	2014	2015	2016	2017
Production	996.2	1023.4	973.5	1076.0	1044.8
Consumption	954.8	987.9	968.2	1062.2	1068.0
Ending Stocks	174.3	209.7	215.0	228.8	204.1
Trade (Import-Export)	130.1	128.4	144.9	141.7	151.4

<sup>6</sup>USDA, January, 2018

Global corn production is estimated to be 1.05 billion tons, and 151 million of this amount is subjected to international Trade. USA (370 mmt), China (216 mmt) and Brazil (95 mmt) has been top three countries in the world in terms of corn production.

Global oilseed production has been 580 million tons in 2017. In terms of oilseed trade, the largest exporters were USA and Brazil, while the largest importer was China in 2017. In the same period USA oilseed exports decreased since Brazil's high amount of production.

**Table 8. Global soybean situation (mmt)**

	2013	2014	2015	2016	2017
Production	282.8	320.0	313.8	351.3	348.5
Ending Stocks	62.4	77.8	78.0	96.5	98.3
Imports	113.1	124.4	133.3	144.2	150.4
Exports	112.7	126.2	132.6	147.3	152.5

<sup>7</sup>USDA, January 2017

**Table 9. Global soybean meal situation (mmt)**

	2013	2014	2015	2016	2017
Production	190.5	208.6	216.1	226.3	237.0
Consumption	186.7	201.9	213.4	222.0	233.8
Ending stocks	10.8	13.7	12.8	12.4	12.3
Imports	58.0	60.7	61.9	59.9	63.9
Exports	60.6	64.4	65.4	64.6	67.3

<sup>7</sup>USDA, January 2017

It has been reported that the global production of soybean – which is most commonly used oilseed in poultry feeds- reached 349 million tons in 2017, with the high production levels of USA (120 million tons), Brazil (110 million tons) and Argentina (56 million tons).

Global soybean meal production was reported to be 236.7 million tons in 2017, with over 60 million tons of this subjected to international trade. The three countries where the largest soybean meal suppliers were China, USA and Argentina.

The increase in compound feed production in the African region has also led to an increase in use of oil seeds and meals in the region. Especially the countries of North Africa, such as Egypt, Tunisia, Morocco and Algeria, have been among the countries where soybean meal and corn consumption have increased.

**Table 10. High amount soybean producer countries**

Countries	2017/18 (mmt)
United States	119.5
Brazil	110.0
Argentina	56.0
China	14.2
India	10.0
Paraguay	9.4
Canada	8.0
Other	21.5

<sup>7</sup> USDA, January 2017

**Table 11. High amount soybean meal producer countries**

Countries	2017/18 (mmt)
China	75.2
United States	41.8
Argentina	34.4
Brazil	32.5
European Union	11.5
India	7.2
Russia	3.7
Other	30.4

<sup>7</sup> USDA, January 2017

**Table 12. Global sunflower seed situation (mmt)**

	2013	2014	2015	2016	2017
Production	41.5	39.3	40.3	47.6	45.8
Ending stocks	3.0	2.8	2.3	2.5	2.3
Imports	1.6	1.6	1.9	2.1	1.9
Exports	2.0	1.7	2.0	2.5	1.8

<sup>7</sup>USDA, January 2017

**Table 13. Global sunflower seed meal situation (mmt)**

	2013	2014	2015	2016	2017
Production	16.9	16.1	16.5	19.3	19.0
Consumption	15.9	15.6	16.3	18.9	19.2
Ending stocks	1.3	1.5	1.4	1.4	0.9
Imports	5.8	5.5	6.0	7.0	6.9
Exports	6.2	5.9	6.3	7.4	7.2

<sup>7</sup>USDA, January 2017

Also sunflower oil and meal can be used in poultry diets, whose production has reached 45.8 million tons and 19 million tons respectively in 2017.

Decrease in crop production in certain regions due to climate change and loss of water resources, problems in raw material supply, growing consumer demand and increasing prices lead the feed sector to search for alternative protein resources to be used in poultry feeds. In last years, it is reported that studies regarding usage of some alternative protein resources obtained from insects and worms in poultry feeds has given hopefully positive results. It is not always possible to access vegetable protein sources. Therefore, it is thought that the availability of insect proteins almost every period of the year will provide an advantage in terms of poultry feed sector.

Studies on the availability of other alternative plant and animal sources in poultry feeds as well as insect proteins continue. In this kind of studies it is reported that plant origin resources as sweet potatoes, hempseed, vetch, castor bean meal, pigeon peas, rapeseed, duckweed, cassava can be used as alternatives to soybean; animal resources such as snails, silkworms, locusts, toads are also reported to be used as an alternative to fish meal.<sup>8</sup>

Indeed, even positive results are obtained from some of the studies, many disadvantages of this kind of new alternatives should be considered. Especially in terms of plant originated resources can contain tannins, oligosaccharides and enzyme inhibitors which negatively effects the poultry animals' health. In terms of animal protein alternatives, the processes that need to be applied to inactivate microorganisms, which can damage both poultry and consumer health, need to be evaluated in terms of cost and effectiveness. For this reason, there is a need for further research on applications in this area.

### **Future of Poultry Feed Sector and Expectations**

The poultry feed sector has been in the development period for the recent years, particularly in developing countries. This can be clearly seen in 2017 with the rapid development of the African region in the production of poultry feed. Global poultry feed sector is expected to continue its growth in next years by the help of development of top egg and broiler meat producer countries such as China, Brazil and USA , besides developing countries. In

addition, the increase in large-scale, integrated poultry facilities will bring increased demand for poultry compound feed.

In global average, feed costs seems to be low and to remain that way for a foreseeable future. Because farmers and growers can better combat disease and drought in plants by the help of technologic and agricultural developments. Therefore, important raw materials for poultry diets such as corn, soy and wheat are can be produced at low costs with fruitful harvests.

Even though it is possible to produce abundant raw materials at low cost in developed countries, accessibility of safe and affordable food underdeveloped and developing regions still keeps its importance in the global agenda. So feed sector needs to continue its development to meet the protein demand the growing global population which is expected to exceed 9 billion people by 2050. For this purpose global feed sector fronts through new alternative raw materials which are more efficient, with better nutritional value and more affordable, to replace limited traditional sources. Challenges regarding globally acceptance of utilization of transgenic products in poultry feeds, seems to be continued in the future. Developing effective global policy to resolve the problems on asynchronous approval of existing and emerging events and to eliminate commercial disruptions is very important issue for the sustainability of global raw materials trade.

By the help of developing technology, on the one hand consumer awareness is expanding on the other hand misinformation about poultry meat and feed sector distributed by media and other communication ways negatively effects the consumer perception. This info pollution seems to be one of the insistent problems that poultry feed sector will continue combat with in the future.

## References

Food Outlook Biannual Report on Global Food Markets, FAO, June 2017

Livestock and Poultry: World Markets and Trade, USDA, October 2017

7<sup>th</sup> Global Feed Survey, Alltech, 2018

7<sup>th</sup> Global Feed Survey, Slide Set, Alltech, Aidan Connolly, 2018. Online at: <https://go.alltech.com/alltech-feed-survey-thank-you?submissionGuid=81d24c5c-ac05-4d92-93e9-d625932cff5b>

Chadd Stephen, Future trends and developments in poultry nutrition, Poultry in the 21st century: Avian influenza and beyond, International Poultry Conference, Bangkok, November 2007. Online at: [http://www.fao.org/AG/againfo/home/events/bangkok2007/docs/part1/1\\_7.pdf](http://www.fao.org/AG/againfo/home/events/bangkok2007/docs/part1/1_7.pdf)

Grain: World Markets and Trade, USDA, January, 2018

Oilseeds: World Markets and Trade, USDA, January, 2018

<http://www.allaboutfeed.net/New-Proteins/Articles/2015/10/Alternative-protein-sources-for-poultry-feeds-2700585W/>

## The Role Of Eubiotics In Today's Poultry Nutrition

Andre Meeusen

Framelco, The Netherlands

### Introduction

Gastro-intestinal disorders are the main reason for using antibiotics in food producing animals. As pathogenic bacteria are increasingly developing antibiotic resistance, it is important to stimulate optimal health conditions of production animals. However, the increased usage of vegetable proteins in feed formulations since the ban of animal meals in 2000 and the withdrawal of all antibiotic growth promoters (AGPs) in 2006 makes it even more difficult to formulate high quality diets for high performing production animals and to control the intestinal microflora. One must be aware that any non-digested nutrient is a potential source for pathogenic bacteria to develop and to colonize the small intestine of the host animal. Hence, a status of dysbiosis may occur, which is an imbalance of the microflora in the gastro-intestinal tract (GIT). To avoid dysbiosis, non-antibiotic feed additives, termed as Eubiotic additives must be developed and animal nutrition and feed formulas must be changed accordingly. Indeed, nutrients should be more easy to digest and must be properly absorbed to be of value to the animal and not to the intestinal microflora. The Eubiotic Nutrition concept is developed and plays an important role in this matter.

Eubiotic Nutrition is another approach for today's animal production and combines modern nutritional principles with the use of non-antibiotic feed additives to create a status of *Eubiosis* in the GIT and to achieve optimal performances and maximum profitability. Modern nutritional principles have to be introduced or reviewed, such as fiber- and prebiotic nutrition, the nutrition of digestible amino acids with a minimum of proteins in the feed, maximizing the utilization of proteins, fat and energy, better control over the dietary electrolytes and the acid binding capacity of the feed, up to the grinding and pelleting technology. The concept of using the Eubiotics is based on supporting the three pillars of the digestive system: the enzymatic break-down of feed by endogenous enzymes, supported by the addition of a multi-enzyme system to liberate more energy and proteins; the emulsification, transportation and absorption of those nutrients brought about by the bile phospholipids and assisted by the addition of lysolecithins to the feed; and last but not least, managing an optimal GI-microflora to stimulate gut health, which can be achieved with organic acids and their derivatives.

## Material and methods

To gain full benefit from diets containing cereal grains and high fiber plant proteins, a multi-enzyme system containing fiber-degrading enzymes such as xylanase, beta-glucanase, cellulase and pectinase are needed. Fibre should no longer be considered as an anti-nutritional factor. Indeed, the partial hydrolysis of fiber by exogenous Non-Starch Polysaccharide (NSP) enzymes makes a shift of the microbial fermentation in the small intestine, which is not desired, to a fermentation in the large intestine leading to the production of volatile fatty acids (VFA) which are well absorbed and give an extra energy for the animal (Choct, 1996).

The hydrolysis of hemicelluloses by hemicellulase enzymes (beta-glucanase) leads to the formation of betaglucans that have an immune-modulating effect at the intestinal mucosal level. Beta-1,3/1,6-glucans have the ability to activate the immune system by signaling mechanisms of the innate immune system. Enterocytes facilitate the transportation of  $\beta(1,3)$ -glucans and similar compounds across the intestinal cell wall into the lymph, where they begin to interact with macrophages to activate immune function. Due to the presence of non-digestible oligosaccharides in leguminous seeds, also alpha-galactosidase and beta-mannanase are needed. These also can lead to the formation of prebiotic compounds such as the galacto-oligosaccharides (GOS) and the mannan-ologosaccharides (MOS).

Moreover, the production of endogenous enzymes in young animals may not yet be sufficient for digesting all plant proteins and the high level of starch in current diets, especially those based on maize and soya. Therefore, protease and alpha-amylase supplementation is needed to maximize the utilization of proteins and starch. Any undigested protein is subject to be used by the intestinal microflora, mostly pathogens such as *Clostridium perfringens*. Moreover, protein fermentation in the hind-gut can lead to potential toxic metabolites, ammonia and amines and volatiles phenols and indoles.

Research has shown that such a multi-enzyme blend containing xylanase, beta-glucanase, cellulase, pectinase, alpha-galactosidase, mannanase, alpha-amylase and protease are beneficial to current broiler diets. Even under optimal conditions, adding such multi-enzyme blend showed to be able to improve growth and FCR of broilers (Figure 1).

When feed has been properly broken down into single nutrients, these need to be absorbed in the small intestine in order to be of value to the animal. More specifically, fat digestion is a real challenge in young broilers as they do not produce sufficient amounts of bile acids for an efficient emulsification. Nutritional emulsifiers, like hydrolyzed lecithins (lysolecithins) are beneficial in this matter. But it has to be mentioned also that intestinal enzymes, lipase, trypsin, chymotrypsin, amylase are all hydrophilic in nature and their activity is compromised by the fat matrix of the digesta. The next step is the hydrolysis of these fats by the action of the

pancreatic lipase enzymes into free fatty acids and finally their absorption via the intestinal epithelium cells. These have a membrane consisting of phospholipids, more particularly phosphatidylcholine (PC) and phosphatidylethanolamine (PE) and that is where the more hydrophilic lysophospholipids, such as the lysophosphatidylcholine (LPC) and the lysophosphatidylethanolamine (LPE) play a very important role in cell membrane fluidity and permeability. Hydrolyzed soy lecithins contain high levels of these two specific lysolecithins. This makes hydrolyzed soy lecithins even more interesting to be included in the Eubiotic Nutrition Concept for maximizing nutrient utilization from feed.

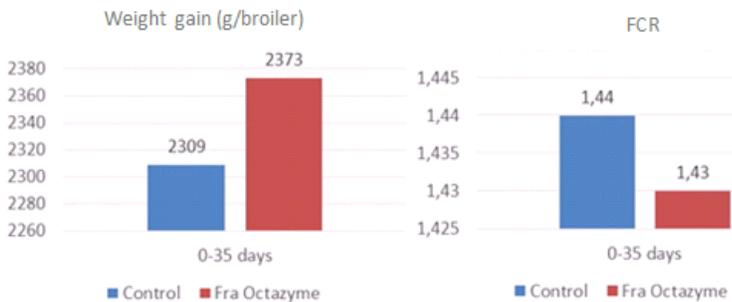


Figure 1. Broiler performance results receiving a maize-soya diet without enzymes (control) or with enzymes (Fra Octazyme). Trial performed at Schothorst Feed Research, the Netherlands, 2012.

Table 1. Broiler performance receiving a commercial diet without (control) or with lysolecithins (treatment) at commercial farm in Germany, 2017.

	Control group	Treatment group	Difference
<b>Broilers start (n)</b>	51 500	51 500	0
<b>Broilers slaughtered (n)</b>	50 454	50 832	+ 378
<b>Total weight at slaughter (kg)</b>	127 261	128 040	+ 779
<b>Weight/ broiler (kg)</b>	2.528	2.520	- 0.008
<b>Total feed intake (kg)</b>	201 389	194 684	- 6705
<b>FCR</b>	1.61	1.55	- 0.06
<b>Mortality (%)</b>	2.03	1.30	- 0.73

At a commercial farm in Germany six houses with in total 103000 broilers were used to test the effect of hydrolyzed soy lecithins. Three houses (51500 broilers) were kept as control group and three houses (51500 broilers) as treatment group. In the treatment group the hydrolyzed lecithins were added on top with a dose level of 500 gram per ton of feed. Both groups received

the same basal diet (crude fat content of 5.5% in the starter feed, 6.0% in grower 1, 7.25% in grower 2 and 7.0% in the finisher feed).

All broilers had a start weight of approximately 40 gram. Final body weight was not different between the groups (2.53 kg versus 2.52 kg for the control and treatment group respectively). However, feed intake was reduced in the treatment group resulting in a 6 points lower FCR (Table 1). Hence, hydrolyzed soy lecithins do have beneficial effect on broiler performance under field conditions by improving fat digestibility and enhancing nutrient absorption.

### Conclusion

The Eubiotic Nutrition concept can only succeed if one does manage the gastro-intestinal microflora.

Short- and medium chain fatty acids (SCFA & MCFA) have been widely used for their beneficial effects on general animal health and performance. However, they have their limitations as they are only active in their undissociated form, meaning in an acidic environment. Moreover they are quickly absorbed and further metabolized providing only energy. As many pathogens are invasive and may infect organs, such as lungs and liver, simple organic acid blends are no longer good enough. As AGPs are no longer allowed and the use of therapeutic antibiotics must be reduced, better alternatives must be available that are active throughout the whole digestive system independent of the pH and that can also circulate through the blood system.

According to scientific research,  $\alpha$ -monoglycerides of these fatty acids are much more powerful in their antibacterial effect than their respective fatty acid. This is shown by the growth curve of *Staphylococcus aureus* and *E. coli* in Figure 2.

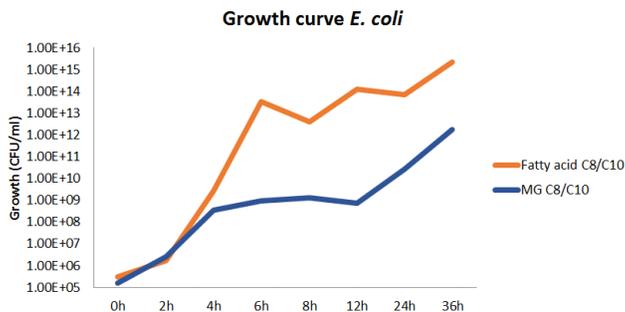


Figure 2. Growth curve of *Staphylococcus aureus* and *E. coli* in the presence of free fatty acids of C8/C10 vs. their corresponding monoglycerides (MG), University of Antwerp, 2016.

In addition,  $\alpha$ -monoglycerides of SCFA are more active against gram-negative bacteria and the  $\alpha$ -monoglycerides of MCFA more towards gram-positive bacteria. Moreover,  $\alpha$ -monoglycerides are stable molecules that are active through the entire GIT. This results in an optimal microbial balance and gut health, improving health and digestion and ultimately animal performances of food producing animals. The use of alpha-monoglycerides is therefore essential to succeed in the Eubiotic Nutrition concept.

**SESSION-2**  
**NUTRITION-I**

***SHORT ORAL PRESENTATIONS***

## **Efficacy of in-feed Preparations of an Anticoccidial, Multi-Enzyme, Prebiotic, Probiotic, and Herbal Essential Oil Mixture in Healthy and *Eimeria* spp.-Infected Broilers**

**Mehmet Bozkurt<sup>a</sup>, Nuran Aysul<sup>b</sup>, Gökhan Ege<sup>c</sup>, Bahattin Koçer<sup>c</sup>**

<sup>a</sup>Department of Animal Science, Faculty of Agriculture, Adnan Menderes University, Aydın-Turkey,

<sup>b</sup>Department of Parasitology, Faculty of Veterinary, Adnan Menderes University, Aydın-Turkey,

<sup>c</sup>Fig Research Institute, Department of Poultry, Aydın-Turkey.

### **Abstract**

The efficacies of 5 widely used dietary supplements were investigated on performance indices, fecal oocyst excretion, lesion score, intestinal tract measurements, and specific immune responses in healthy and *Eimeria* spp.-infected birds by using a comparative model. This study included 2400 sexed Ross 308 broiler chicks that were equally divided in 2 groups: the infected group, experimentally infected with oocysts of mixed *Eimeria* spp. at 14 days of age and the healthy controls. The birds in both the groups were further divided equally into 6 groups, of which 1 was fed a basal diet and served as control without treatment and the other 5 served as experimental treatments. These 5 groups were fed 5 diets containing preparations of 60 mg/kg of anticoccidial salinomycin (SAL), 1 g/kg of multi-enzyme (ENZ), 1 g/kg of probiotic (PRO), 1 g/kg of prebiotic (PRE), and 40 mg/kg of an herbal essential oil mixture (EOM). These preparations were used for their potential anticoccidial activities shown in previous studies. Body weight gain and feed conversion ratio showed significant improvement in the infected animals, which indicates that dietary supplemental regimens with SAL, ENZ, PRO and PRE initiated in 1-day-old chicks reduced adverse effects after challenge with coccidiosis; however, chicks that were administered essential oil mixture (EOM) failed to show such improvement. The data indicated that use of these sub-therapeutically efficacious supplements (except essential oil mixture) in broiler production can lessen the depression in growth due to coccidial challenge.

**Key words:** *Chicken coccidiosis, anticoccidial, multi-enzyme, prebiotic, probiotic, essential oil mixture.*

## Yeme Koksidiyoztat, Multi-Enzim, Prebiyotik, Probiyotik ve Esansiyel Yağ Karışımı İlavésinin Sađlıklı ve Deneysel Koksidiyoz Bulařtırılan Etlik Piliçlerin Büyüme ve Koksidiyoz Kontrol Potansiyeli Üzerine Etkileri

### Özet

Etlik piliç yetiřtiriciliđinde sıklıkla kullanılan 5 adet performans arttırıcı yem katkı maddesinin sađlıklı ve *Eimeria* spp. ile enfekte edilmiř piliçlerde performans, fekal oosit saçımı, bađırsak lezyon skoru, oransal organ ađırlıđı ve spesifik immün yanıt üzerine etkileri arařtırılmıřtır. Bu amaçla günlük yařta 2400 adet etlik civciv (Ross 308) eřit řekilde 2 gruba ayrılmıř, yarısı koksidiyozla bulařtırılmazken diđer yarısı *Eimeria* spp. ile 14 günlük yařta enfekte edilmiřtir. Birinci gruba temel yem karması verilirken diđer 5 deneme grubuna sırasıyla 60 mg/kg antikoksidial salinomycin (SAL), 1 g/kg multi-enzyme (ENZ), 1 g/kg probiyotik (PRO), 1 g/kg prebiyotik (PRE) ve 50 mg/kg esansiyel yağ karıřımı (EYK) ihtiva eden yemler verilmiřtir. İlk günlük yařtan itibaren SAL, ENZ, PRO, PRE ve EYK yedirilen etlik civcivlerin ilerleyen dönemlerde koksidiyozun olumsuz etkileri ile bařa çıkabildikleri, fakat EYK'nın bu konuda etkisiz kaldıđı görülmüřtür. Kullanılan tüm katkı maddeleri ince bađırsađın orta ve ařađı kısımlarında koksidiyal enfeksiyondan kaynaklanan lezyon skorlarını hafifletirken dıřkı ile oosit saçımının azalmasında yalnızca SAL ve EYK bařarılı olmuřtur. Elde edilen bulgular piliç yemlerinde kullanılan performans arttırıcı yem katkı maddelerinin koksidiyal enfeksiyona bađlı büyüme geriliđini telafi edebileceđini göstermektedir.

**Anahtar Kelimeler:** *Koksidiyoz, etlik piliç, antikoksidial, multi-enzim, prebiyotik, probiyotik, esansiyel yağ karıřımı*

### Introduction

Anticoccidial drugs added to the feed constitute a good preventative measure and are convenient for large-scale use, but prolonged use of these drugs inevitably leads to the emergence of *Eimeria* strains that are resistant to all anticoccidial drugs, including ionophores (Chapman, 1998). Despite the emerging resistance, feed compounders continue to add polyether antibiotics and chemicals as anticoccidial agents to poultry feeds over the past 5 decades (Chapman et al., 2010).

Concomitantly with the ban of antibiotic growth promoters (AGP) in animal production, the European Union (EU) has put to question the use of anticoccidials from the year 2012 onwards. This public debate has led to an urgent need for searching new methods of coccidiosis control that would replace anticoccidial drugs (Duffy et al., 2005; Dalloul and Lillehoj, 2010).

Therefore, recent studies have given prime consideration to feed additives of natural origins (i.e., herbal remedies, probiotic microorganisms, and prebiotic preparations) as an alternative means of disease control (Bozkurt et al. 2012; Abbas et al., 2012). There is still an increasing need for highly effective, non-antibiotic products that are cost-effective, stable, and widely usable. Common in-feed performance enhancers, such as enzymes, prebiotics, probiotics, and essential oils of medicinal herbs, have been used in broiler nutrition with considerable success. Scientific evidence has shown that these supplements may potentially be used to optimize the health of animals by positive manipulation of the gastrointestinal tract (Mountzouris et al. 2011; Applegate, 2009). Hence, further investigations are required to understand the exact mechanism underlying the effects of these feed additives, which are still in use in broiler nutrition as performance enhancers and as agents for controlling coccidiosis.

### **Materials and Methods**

Two thousand and four hundred 1-d-old broiler chicks (Ross 308) of mixed sexed were used in this experiment. In a 2x6 factorial arrangement, chicks were fed six dietary supplements either in coccidial infection procedure or left uninfected. Dietary treatments were 1) a basal diet with no anticoccidials or growth enhancers (CNT), 2) CNT + 60 mg/kg of ionophore anticoccidial (SAL), 3) CNT + 1g/kg enzyme complex (ENZ), 4) CNT + 1g/kg Probiotic (PRO), 5) CNT + Prebiotic, mannan oligosaccharide (PRE), 6) CNT + 24 mg/kg essential oil mixture (EOM).

All chicks were individually weighed on days 1, 14, 28 and 42 to determine body weight (BW) gain through relevant experimental periods. Feed intake (FI) within each subgroup was calculated at d 14, 28 and 42 by subtracting residual feed from the offered feed. The feed conversion ratio (FCR) was calculated as the ratio of food intake to body weight gain (BWG) (g feed/g gain). Mortality was recorded daily and expressed as a percentage of the initial number of chicks. Chicks were infected at 14 days age with a standard oral inoculum containing  $5 \times 10^5$  sporulated oocysts from field isolates of *E. acervulina*, *maxima*, *tenella*, *mitis*, *brunetti* and *praecox* respectively. Oocyst counts were determined in samples of excreta obtained from each subgroup at 10 and 14 days of age, i.e. before infection, and determined daily from day 19 (5 dpi) to day 36 (22 dpi) only for infected groups (dpi = days post infection). Oocyst counts were determined using McMaster chambers and expressed as the number of oocysts per bird (Hodgson, 1970).

Ten days after the inoculation (d 24), 3 birds whose body weights were similar to the group mean were selected from each replicate pen (15 birds per treatment group) after feed deprivation for 10 h. The 180 sampled birds were electrically stunned and slaughtered. After 3 min suspension for exsanguination, birds were eviscerated, and their complete intestines, liver

and pancreas were removed. The total length of the small intestine (duodenum, ileum, and jejunum) and large intestines (colon) provided the intestinal length. The weight of intestines, liver, pancreas and caeca was expressed as a percentage of live body weight. Complete intestines of the same birds used for determination of intestinal measurements were examined for degree of presence of coccidial lesions. Five different sections of the chick intestine (i.e., duodenum, jejunum, ileum and cecum and colon) were examined for lesions. Lesion scores were observed and recorded according to the system of Johnson and Reid (1970).

## Results

Broiler chicks differed in response to dietary supplements in terms of performance traits, including BWG, FI, and FCR under the coccidial challenge or sanitary conditions during 15–28, 15–42, 29–42 and 1–42 days. The differences in responses resulted in significant ( $P < 0.001$ ) infection by diet interactions for above-mentioned traits in both the post-infection and complete growth period excluding the period of 29–42 days. These results clearly indicate that these supplements have different efficacies under unchallenged and parasitic disease challenge conditions.

Coccidial infection induced substantial ( $P < 0.001$ ) increases in relative weights of the small intestine, cecum, liver and pancreas as compared to the uninfected birds. A similar pattern was observed in the length of the small intestine ( $P < 0.01$ ) and cecum ( $P < 0.05$ ). Compared to the CNT group, administration of supplemented diets significantly decreased the intestinal lesion score ( $P < 0.01$ ), with the jejunum and ileum showing a similar pattern. The reduction in lesion score ( $P < 0.01$ ) was more pronounced in birds fed diets containing PRE and EOM than in those fed diets containing other supplements. The total score showed a tendency similar to that of lesion scores observed in the jejunum and ileum, which suggests that these in-feed preparations provided adequate protection from the *Eimeria* infection. Feeding diets containing SAL decreased ( $P < 0.05$ ) the number of oocyst per gram of feces at 10 dpi, however this was the case for EOM treatment at 14 dpi as compared with the CNT treatment. With respect to fecal oocyst output, no significant difference was found among the dietary treatments at 6 and 18 dpi ( $P > 0.05$ ).

## Conclusion

Supplemental intake of SAL, ENZ, PRO, and PRE by chickens on exposure to experimental coccidiosis alleviated the influence of disease and positively influenced growth and feed conversion efficiency. However, anticoccidial activity of EOM was inferior to all other supplements tested. The anticoccidial efficacy of SAL, in terms of lowering oocyst output and overall feed conversion ratio, was more pronounced than any other supplement.

These observations verify current scientific evidence that these supplements may act as performance enhancers with remarkable benefits in coccidiosis-free broiler chickens.

### References

- ABBAS, R. Z., COLWELL, D. D. and Gilleard, J. (2012) Botanicals: an alternative approach for the control of avian coccidiosis. *World's Poultry Sci. J.* 68:203-215.
- BOZKURT, M., SELEK, N., KÜÇÜKYILMAZ, K., EREN, H., GÜVEN, E., ÇATLI, A.U., and ÇINAR, M. (2012c). Effects of dietary supplementation with a herbal extract on performance of broilers infected with a mixture of *Eimeria* species. *Brit. Poultry Sci.* 53:325-332.
- CHAPMAN, H. D. (1998) Evaluation of the efficacy of anticoccidial drugs against *Eimeria* species in the fowl. *Int. J. Parasitol.* 28:1141-1144.
- CHAPMAN, H. D., JEFFERS, T. K. and WILLIAMS R. B. (2010) Forty years of monensin for the control of coccidiosis in poultry. *Poultry Sci.* 89:1788-1801.
- DUFFY, C.F., MATHIS, G.F. and POWER, R.F. (2005) Effects of Natustat™ supplementation on performance, feed efficiency and intestinal lesion scores in broiler chickens challenged with *Eimeria acervulina*, *Eimeria maxima* and *Eimeria tanella*. *Vet. Parasitol.* 130:185-190.
- LILLEHOJ, H.S. and LILLEHOJ E.P. (2000) Avian coccidiosis. A review of acquired intestinal immunity and vaccination strategies. *Avian Dis.* 44:408-425.
- MOUNTZOURIS, K.C., PARASKEVAS, V., TSIRTSIKOS, P., PALAMIDI, I. and STEINER T. (2011) Assessment of a phytogenic feed additive effect on broiler growth performance, nutrient digestibility and caecal microflora composition. *Anim. Feed Sci. and Technol.* 168:223-231.

## Effects of the dietary Black Pepper (*Piper nigrum*) and Turmeric Powder (*Curcuma longa* L.) on the Performance and Egg Quality in Laying Hens

Muhittin Ünal<sup>a</sup>, Cem Özalp<sup>a</sup>, Zeynep Şahanb Uğur Serbester<sup>a</sup>, Fatma Yenilmez<sup>c</sup>, Yusuf Uzuna, Hasan Rüstü Kutlu<sup>a</sup>, Ladine Çelik<sup>a</sup>

<sup>a</sup>Çukurova University, Agricultural Faculty, Dept. of Animal Science, Adana, TURKEY,

<sup>b</sup>Adıyaman University, Vocational School of Kahta, Adıyaman, TURKEY, <sup>c</sup>Çukurova University, Vocational School of Tufanbeyli, Adana, TURKEY

### Abstract

The present study was initiated to determine whether dietary supplemental black pepper and turmeric powder affect performance and egg quality of Brown laying hens. The birds were fed basal diets (control group), black pepper (1.5 g/kg), turmeric powder (1.5 g/kg) and black pepper (0.75 g/kg) + turmeric powder (0.75 g/kg) supplemented diets. The results obtained at the end of the seven weeks period showed that black pepper and turmeric powder affected egg strength and yolk colour score of “a” of the birds and also the yolk colour score of “b” and albumen pH tended to slightly improve.

**Key words:** *Black pepper Powder, Egg Quality, Performance, Hens, Turmeric Powder*

### Yumurtacı tavuk rasyonlarına ilave edilen karabiber (*Piper nigrum*) ve zerdeçal (*Curcuma longa* L.) tozunun performans ve yumurta kalitesine etkileri

### Özet

Mevcut çalışma, karabiber ve zerdeçal tozlarının kahverengi yumurtacılar da yumurtlama performansı ve yumurta kalitesine etkisini belirlemek amacıyla yürütülmüştür. Çalışmada tavuklar bazal rasyon (kontrol), bazal rasyona karabiber (1.5 g/kg), zerdeçal (1.5 g/kg) ve karabiber (0.75 g/kg) + zerdeçal (0.75 g/kg) ilaveli rasyonlarla beslenmişlerdir. Yedi haftalık deneme sonunda elde edilen bulgular, karabiber ve zerdeçal tozu ilavelerinden yumurta kırılma direnci ve yumurta sarısının a değeri etkilenmiştir. Ayrıca yumurta sarısının “b” değeri ve albumen pH’sı rasyon muameleleri ile iyileşme eğilimi göstermiştir.

**Anahtar kelimeler:** *Karabiber Tozu Performans, Tavuk, Yumurta Kalitesi, Zerdeçal Tozu*

## Introduction

Due to the increased interest in functional food production, the number of studies on the use of natural resources in poultry feed has been increased. Black pepper and turmeric have been shown to be rich in antioxidant activities (Karami et al., 2011; Khalaf et al., 2008). They have also stimulatory effects in digestion process (Çabuk et al., 2003). Some researcher reported that piperine and curcumin can increase the absorption vitamin and minerals (exp. Khalaf et al., 2008). The present study was initiated to determine whether dietary supplemental black pepper (BP) and turmeric powder (TP) affect performance and egg quality of laying hens.

## Materials and Methods

72 Brown layers, 32-weeks-old, were used in the experiment for 7 weeks. The birds were fed basal diets (control group), black pepper (BP; 1.5 g/kg), turmeric powder (TP; 1.5 g/kg) and black pepper (0.75 g/kg) + turmeric powder (0.75 g/kg) (BP + TP) supplemented diets. The birds were housed in individual cages and a 16:8 hours light:dark photoperiod was employed. Laying performance was assessed by recording initial and final body weights, weight gains, feed intake, feed conversion ratio, egg weight, egg production daily; egg quality weekly.

## Results and Discussion

The results obtained at the end of the seven weeks period showed that black pepper and turmeric powder affected ( $P \leq 0.05$ ) egg strength and yolk colour score of "a" of the birds. *However*, feed intake, body weight changes, feed conversion ratio, shape index, yolk index, albumen index, egg shell weight *were not affected* ( $P > 0.05$ ), also the albumen length, yolk height, yolk colour score of "b" and albumen pH tended to slightly improve.

Black pepper supplementation, but not turmeric powder increased egg yolk colour score of "a" in laying hens. Turmeric (*Curcuma longa* L.) is an extensively used coloring material which has biological actions and medicinal applications (Burt, 2004). But in the current study, black pepper showed coloring properties in yolk. In a recent study conducted on Curcumin longa, it was observed that the availability of calcium for absorption was significantly high in *Curcuma longa* (Trinidad et al., 2012). This was similar to the results obtained from this study. According to the present study, egg breaking strength was improved dietary turmeric powder. Curcumin plays a role in the absorption of minerals (Khalaf et al., 2008). The difference is most probably due to the improved the absorption of calcium rate stimulated by turmeric.

**Table 1.** Effect of dietary black pepper and turmeric powder on performance and egg qualities of laying hens

Parameters	Control	BP(1.5 g/kg)	TP(1.5 g/kg)	BP + TP (0.75B + 0.75Tg/kg)	BP	TP	BP*TP	SED
<b>Laying performances</b>								
Initial body weight (g/bird)	1770	1750	1780	1700	0.0894	0.3704	0.3234	0.015
Final body weight (g/bird)	1680ab	1590b	1710ab	1770a	0.6806	0.0615	0.1898	0.028
Feed intake (FI) (g/bird/7 weeks)	5180.50	5129.22	5255.50	5105.11	0.5581	0.8824	0.7733	88.154
Egg mass (EM) (g/bird/7 weeks)	2552.82	2567.72	2556.35	2400.55	0.5243	0.4598	0.4408	56.633
Food conversion ration (EM / FI)	0.50	0.50	0.49	0.72	0.3871	0.4493	0.4241	0.070
Mean egg weight (g/day)	60.12	61.29	60.88	60.34	0.6947	0.9051	0.2957	0.416
<b>Egg qualities</b>								
Egg weight (g/egg)	59.99	61.14	60.22	60.10	0.535	0.626	0.444	0.423
Shell weight (g/egg)	6.29	6.28	6.11	6.25	0.504	0.285	0.458	0.049
Yolk weight (g/egg)	14.67	14.97	14.67	15.00	0.115	0.925	0.934	0.101
Albumen weight (g/egg)	39.03	39.89	39.44	38.85	0.843	0.641	0.292	0.222
Egg yolk score L	57.42	57.20	57.23	56.39	0.254	0.282	0.514	0.237
Egg yolk score a	9.29ab	9.74ab	8.71b	10.17a	0.014	0.839	0.183	0.194
Egg yolk score b	53.55ab	54.13ab	52.4b	54.87a	0.059	0.798	0.239	0.408
Shape index (%)	75.94	76.13	76.36	76.13	0.973	0.711	0.706	0.286
Egg yolk index	46.27	47.25	46.78	45.86	0.951	0.384	0.059	0.255
Albumen index	10.24	11.19	10.90	10.07	0.891	0.612	0.044	0.223
Breaking strength (kg /cm <sup>2</sup> )	3067.7b	3588.9a	3745.3a	3791.6a	0.117	0.016	0.189	92.048
Shell thickness (µm)	75.94	76.13	76.36	76.13	0.880	0.720	0.290	2.128
Albumen pH	8.26a	8.21ab	8.18b	8.23ab	0.990	0.134	0.028	0.010
Haugh unit	87.33	90.22	89.78	86.99	0.969	0.770	0.036	0.684

\*: P<0.05 ; \*\*: P<0.01 ; NS : Not significant (P>0.05) , SED: standart error of difference between means., BP: black pepper; TP: turmeric powder

## Conclusion

It is concluded that providing dietary black pepper and turmeric powder individually or together could have a potential to increase egg quality in terms of yolk pigmentation and shell quality.

## References

- BURT, S. (2004) Essential oils: Their antibacterial properties and potential applications in foods – A review. *Int. J. Food Microbiol.* 94:223-253.
- ÇABUK, M., ALÇIÇEK, A., BOZKURT, M. and IMRE, N. (2003) Antimicrobial properties of the essential oils isolated from aromatic plants and using possibility as alternative feed additives. II. National Animal Nutrition Congress; Konya, Turkey. 18–20 September 2003. pp. 184–187.
- KARAMI, M., ALIMON, A.R., SAZILI, A.Q., GOH, Y.M. and IVAN, M. (2011) Effects of dietary antioxidants on the quality, fatty acid profile, and lipid oxidation of *longissimus* muscle in Kacang goat with aging time. *Meat Sci.*, 88:102–108.
- KHALAF, A.N., SHAKYA, A.K., AL-OTHMAN, A., EL-AGBAR, Z. and FARAH, H. (2008) Antioxidant activity of some common plants. *Turkish J Biol.* 32:51–55.
- TRINIDAD, T.P., SAGUM, R.S., DE LEON, M.P., MALLILLIN, A.C., BORLAGDAN, M.P. (2012) Zingiber Officinale and Curcuma Longa as Potential Functional Foods/Ingredients. *Food and Public Health* 2(2): 1-4.

**SESSION-2**  
**NUTRITION-I**

**5 MINUTE ORAL PRESENTATIONS**

## In Vitro Determination of The Effect of Rosemary and Thyme Essential Oils on Intestinal Motility in Broiler

Aziz Bülbül<sup>a</sup>, Vural Özdemir<sup>b</sup>, Tuba Bülbül<sup>c</sup>

<sup>a</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Physiology, Afyonkarahisar - TURKEY

<sup>b</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Anatomy, Afyonkarahisar - TURKEY

<sup>c</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Diseases, Afyonkarahisar - TURKEY

### Abstract

This research was conducted to determine the effects of essential oils of rosemary and thyme on small intestine contractility, which are common essential oils in broiler nutrition.

The effects of essential oils of rosemary and thyme obtained by hydrodistillation method of Clevenger device were applied in a concentration range of 0.1-1000 µg / ml on the duodenum, jejunum and ileum tissues obtained from broiler chickens, to determine effects and effective dose of oil.

It was determined that the essential oils of 1000 µg/ml of rosemary and thyme inhibited spontaneous contractions of all three tissues completely, whereas no significant responses were observed in these tissues at other concentration levels. In tissues stimulated by acetylcholine and EFS, the effective doses of the essential oils inhibited contractions in the range of 15-35%.

In conclusion, the essential oils of rosemary and thyme were demonstrated to inhibit the contractions of small intestine. However, it has been observed that higher doses are needed to be applied to obtain this effect.

**Key words:** *Broiler, Essential oil, small intestine, Motility*

### Broiler tavuklarda mersin (*Myrtus communis* L.) yağının ince barsak motilitesi üzerine etkisinin belirlenmesi

#### Özet

Bu araştırma broyler beslemede yaygın kullanılan esansiyel yağlardan olan biberiye ve kekik esansiyel yağlarının ince bağırsak kasılımları üzerine etkisini belirlemek amacıyla yapıldı.

Clevenger cihazın hidrodistilasyon metodu ile elde edilen mersin bitkisi esansiyel yağı; 0,1–1000 µg/ml derişim aralığında broyler tavuklardan elde

edilmiş duodenum, jejunum ve ileum dokularına uygulanarak etkileri ve etkili dozları belirlenmiştir.

Her üç dokuda da biberiye ve kekik esansiyel yağlarının 1000 µg/ml, düzeyinin spontan kasılmaları tamamen engellediği diğer derişimlerin dokular üzerinde belirgin bir yanıt oluşturmadığı görüldü. Asetilkolin ve EFS le uyarılmış dokularda ise esansiyel yağların etkili dozlarının kasılmaları %15-35 aralığında engellediği ortaya konuldu.

Sonuç olarak biberiye ve kekik esansiyel yağlarının ince bağırsak kasılmaları engellediği belirlendi. Buna karşın bu etkinin oluşması için yüksek dozlarda uygulanması gerektiği görüldü.

**Anahtar kelimeler:** *Broyler, esansiyel yağ, ince bağırsak, motilite.*

### **Introduction**

Natural herbs and spices such as rosemary (*Rosmarinus officinalis*) and thyme (*Thymus vulgaris*) are well-known antioxidative substances and therefore they have been widely used as a dietary supplement in poultry nutrition. *R. officinalis* is one of the most important sources of natural antioxidants. The antioxidative activities of rosemary extracts have been reported in many studies. Moreover, it has been demonstrated that antioxidant efficiency of rosemary extracts effectively inhibited hydroperoxide formation (Frankel et al., 1996) due to high content of phenolic compounds (Leung and Foster, 1996). On the other hand, *Thymus vulgaris* is an important Mediterranean herb, it is rich in phenolic compounds with antioxidant and antimicrobial activities (Juuven et al. 1994, Assiri et al. 2016). Thyme plants belonging to different species and ecotypes are widely used in agriculture and animal nutrition as a natural antioxidant substance (Miura and Nakatani 1989, Bolukbası et al., 2006, Ghasemi et al. 2010)

This research was conducted to determine the effects of essential oils of rosemary, and thyme, which are common essential oils in broiler nutrition, on small intestine contractility.

### **Materials and Methods**

Samples of small intestines of ten broiler chickens were collected about 15 min after exsanguinations and transported on ice to the laboratory within 30 min. Samples then were placed in a dissecting Petri dish containing Krebs' solution (KS) (NaCl, 118 mmol/l; KCl, 4.7 mmol/l; CaCl<sub>2</sub>, 2.5 mmol/l; MgSO<sub>4</sub>, 1 mmol/l; KH<sub>2</sub>PO<sub>4</sub>, 1 mmol/l; glucose 11, mmol/l; NaHCO<sub>3</sub>, 25 mmol/l) in an atmosphere of 95% O<sub>2</sub> and 5% CO<sub>2</sub>. Five millimeter wide longitudinal smooth muscle strips were dissected from the middle portions of the excised samples and incised parallel to the long axis of the gut to obtain 5 × 2 mm strips. Longitudinal smooth muscle strips were isolated

carefully and one edge of each tissue preparation was fixed by 2:0 silk ligatures to platinum ring electrodes. The opposite edge of the tissue was connected to a force-displacement transducer by 2:0 silk ligatures (model 10-A; MAY; Commat, Ankara, Turkey). Isolated strips were placed in a four chamber organ bath (IOBS 99 Isolated Tissue Bath Stand Set; Commat) filled with 20 ml KS (pH 7.4) in an atmosphere of 95% O<sub>2</sub> and 5% CO<sub>2</sub> at 39° C. The isometric smooth muscle activity of the intestine samples was monitored and recorded by computer using the force transducer and an acquisition system (model MP30 WSW with Biopac Student Lab, PRO Software, Biopac Systems; Commat).

### **Recording Isometric Duodenum, Jejunum And Ileum Contractility**

Small intestine samples in the organ baths were kept in KS for at least 1 h before the recordings to permit the tissues to adapt to the environment; the solution was refreshed at 15 min intervals. The appropriate resting tension for the muscle strips was determined by preliminary experiments. The strips were placed under progressive increments of tension. Optimal tension relationships for the strips were achieved with resting tensions of 1 g to stimulate maintenance of the physiological contractile activity of the tissue. Therefore, a resting tension of 1 g was applied to the tissues. After the 30 min baseline period, contractions of longitudinal strips for each portion of small intestine for each animal were recorded to determine normal spontaneous contractions. The muscle strips then were treated with 0,1, 0,3, 1, 3, 10, 100, 300 and 1000 µg/ml rosemary and thyme essential. Maximal effective doses of essential oils were repeated with Acetylcholine and EFS. All treatments were performed on the same samples.

### **Results and Discussion**

In this study, it was determined that cumulative and individual application of 0,1-1000 µg/ml concentrations of rosemary and thyme essential oils did not create a notable response on small intestine tissue, except for the 1000 µg/ml concentration, and those normal (phasic) contractions in tissue were prevented upon application of the signified concentrations. Also, it was detected that contractions resumed after washing. It is known that acetylcholine is an important neurotransmitter for parasympathetic innervation in the gastrointestinal system and that it causes smooth muscle contraction by stimulating muscarinic receptors. The M2 and M3 subtypes of muscarinic receptors are found in the smooth muscles of the gastrointestinal canal (Giraldo et al., 1987 and 1988). While the M3 receptors function through phosphoinositide hydrolysis and calcium release, the M2 receptors function by preventing sAMP accumulation. The effect of M2 receptors have on sAMP levels shows the indirect role of these receptors (Ehlert et al. 1999). Endogenous acetylcholine can activate M2 receptors to prevent the

laxative effects of the beta-adrenoceptor activation in M3-mediated contractions (Zholos et al. 1997) In this study, growth in amplitudes for all three tissues was observed as a consequence of the increase in acetylcholine concentrations.

Electrical field stimulation neuronally induces biphasic contractions in the small intestines. At the same time, it is reported that neurotransmitter materials released from NANC nerves mediate formation of the contraction (Ekbald and Sundler 1997). In keeping with previous reports, the severity of contractions increased with EFS in the three tissues in this study.

### Conclusion

In the present study, it was found that both essential oils totally inhibited spontaneous contractions at a dose of 1000 µg/ml, while the effect of this oils decreased in tissue stimulated by acetylcholine or EFS. In this context and in consideration of how acetylcholine displays activity on muscarinic receptors and EFS does so on neurotransmitters released from NANC nerves, it is asserted that rosemary and thyme essential oils inhibit contractions outside of the NANC mechanism.

### References

- FRANKEL, E.N., HUANG, S.W., AESCHBACH, R., PRIOR, E. (1996) Antioxidant activity of rosemary extract and its constituents, carnosic acid, carnosol, and rosmarinic acid, in bulk oil and oil-in water emulsion. *Journal of Agricultural and Food Chemistry* 44, 131-135.
- ASSIRI, A.M., ELBANNA, K., ABULREESH, H.H., RAMADAN, M.F. (2016) Bioactive Compounds of Cold-pressed Thyme (*Thymus vulgaris*) Oil with Antioxidant and Antimicrobial Properties. *Journal Oleo Science* 65, :629-640.
- MIURA K. and NAKATANI N. (1989) Antioxidative activity of biphenylic compounds from thyme (*Thymus vulgaris* L.). *Chemistry Express* 4, 237-240.
- JUVEN, B.J., KANNER, J., SCHVED, F. WEISSLOWICZ, H. (1994) Factors that interact with the antibacterial action of thyme essential oil and its active constituents. *Journal of Applied Bacteriology* 76, 626-631.
- GHASEMI, R., ZAREI, M., TORIKI, M. (2010) adding medicinal herbs including garlic (*Allium sativum*) and thyme (*Thymus vulgaris*) to diet of laying hens and evaluating productive performance and egg quality characteristics. *American Journal of Animal and Veterinary Sciences* 5, 151-154.
- BOLUKBASI, S.C., ERHAN, M.K., OZKAN, A. (2006) Effect of dietary thyme oil and vitamin E on growth, lipid oxidation, meat fatty acid composition and serum lipoproteins of broilers. *South African Journal of Animal Science* 36:189-196.

- GIRALDO, E., MONFERINI, E., LADINSKY, M., HAMMER, R. (1987). Muscarinic receptor heterogeneity in kobay intestinal smooth muscle: binding studies with AFDX 116. *European Journal of Pharmacology* 141, 475-477.
- GIRALDO, E., VIGANO, M.A., HAMMER, R., LADINSKY, H. (1988). Characterization of muscarinic receptors in kobay ileum longitudinal smooth muscle. *Molecular Pharmacology*, 33, 617-625.
- EHLERT, F.J., SAWYER, G.W., ESQUEDA, E.E. (1999). Contractile role of M2 and M3 muscarinic receptors in gastrointestinal muscle. *Life Science* 64, 387-394.
- ZHOLOS, A.V., BOLTON, T.B. (1997). Muscarinic receptor subtypes controlling the cationic current in guinea-pig ileal smooth muscle. *British Journal of Pharmacology* 122, 885-893.
- EKBLAD, E., SUNDLER, F. (1997). Motor responses in rat ileum evoked by nitric oxide donors vs. field stimulation: Modulation by pituitary adenylate cyclase activating peptide forskolin and guanylate cyclase inhibitors. *Journal of Pharmacology and Experimental Therapeutics* 283, 23-28.

## Investigation of *Eimeria* species in chickens in Samsun region by Real Time PCR

Çağrı Aslan<sup>a</sup>, Alparslan Yıldırım<sup>a,b</sup>, Önder Düzlü<sup>a,b</sup>, Zuhâl Önder<sup>a,b</sup>, Arif Çiloğlu<sup>a,b</sup>, Gözde Şahingöz Demirpolat<sup>a</sup>, Abdullah İnci<sup>a,b</sup>

<sup>a</sup>Erciyes University, Faculty of Veterinary Medicine, Department of Parasitology, Kayseri, Turkey

<sup>b</sup>Erciyes University, Vectors and Vector-Borne Diseases Implementation and Research Center, Kayseri, Turkey

### Abstract

This study was conducted to determine the molecular prevalence of *Eimeria* species in free-range chicken farms in Samsun district of Turkey. Totally 390 fecal samples were collected from 11 different free-range chicken farms. Two hundred forty (61.5%) out of examined fecal samples were found to be positive with *Eimeria* oocysts. According to the results of Real Time PCR analyses, *E. tenella* was the most prevalent species (95.8%) and this was followed by *E. maxima*, *E. acervulina* and *E. praecox* were 83.3%, 58.3%, 4.1%, respectively. Mix infections were determined in 200 (51.2%) out of the examined samples.

**Key words:** Chicken, Coccidiosis, Molecular prevalence, Real Time PCR, Samsun

### Özet

Bu çalışma, Samsun yöresinde salma tip (free-range) tavuk yetiştiriciliği yapılan işletmelerdeki tavuklarda *Eimeria* türlerinin moleküler prevalansını ortaya koymak amacıyla yürütülmüştür. Toplam 11 farklı salma tip tavuk çiftliğinden 390 adet dışkı örneği toplanmıştır. İncelenen dışkı örneklerinin 240'ı *Eimeria* oocistleri yönünden pozitif bulunmuştur. Real Time PCR analiz sonuçlarına göre en yaygın tür %95,8 ile *E. tenella* olarak belirlenmiş bunu sırasıyla %83,3 ile *E. maxima*, %58,3 ile *E. acervulina* ve %4,1 ile *E. praecox* izlemiştir. İncelemeye alınan 390 dışkı örneğinin 200'ü (%51,2) miks enfekte belirlenmiştir.

**Anahtar kelimeler:** Coccidiosis, Moleküler prevalans, Real Time PCR, Samsun, Tavuk

### Introduction

Coccidiosis is one of the most important disease of intensive poultry industry worldwide (Amer et al., 2010; Gyoörke et al., 2013). The etiological agents

of coccidiosis are apicomplexan protozoan parasites from *Eimeria* genus. In the host, the parasite grows and multiplies intracellular in epithelial cells of the intestine. In the poultry industry, chickens can be infected by seven *Eimeria* species, including *Eimeria tenella*, *E. maxima*, *E. acervulina*, *E. necatrix*, *E. brunette*, *E. mitis* and *E. praecox* (Shivaramaiah et al., 2014). These *Eimeria* species have different pathogenicity, *E. tenella*, *E. necatrix*, *E. maxima*, *E. brunette* and *E. acervulina* are the most pathogenic however *E. praecox* and *E. mitis* are considered as non-pathogenic (Al-Natour et al., 2002; Iacob and Duma, 2009).

### Materials and Methods

This study was financially supported by Erciyes University Research Fund (TYL-2016-6401). Between September 2015 and March 2016, a total of 390 fresh chicken fecal samples were collected from 11 different free-range chicken farms that contain approximately 15000 Hubbard Isa Red Ja chickens. The collected fecal samples were investigated in terms of *Eimeria* oocysts at the laboratory and the oocysts per gram of feces (OPG) were calculated in the positive samples as described elsewhere (Velkers et al., 2010). Real Time PCR analyses were carried out on the genomic DNA isolates (gDNA) from the *Eimeria* oocysts positive faecal samples in order to identification of *Eimeria* species.

### Results and Discussion

Two hundred forty (61.5%) out of examined fecal samples were found to be positive with *Eimeria* oocysts. The infection prevalence may vary from less than 23% to more than 82% in different location of Turkey (Karaer et al., 2012; Güven et al., 2013). Our findings of *Eimeria* species in chicken were in agreement with these conclusions.

In the chicken coccidiosis studies in various region of Turkey (Karaer et al., 2012; Güven et al., 2013), OPG values have been reported to vary between 50 and 952 000. In this study, the OPG values of *Eimeria* oocysts positive fecal samples were determined between 100.00 and 300000.00. These values were recorded as minimum 100 and maximum 300000. The mean OPG values obtained were similar to those of the other study (Güven, 2010) performed in the six region of Turkey (Mediterranean Region, Eastern Anatolia Region, Aegean Region, Central Anatolia Region, Black Sea Region and Marmara Region).

Globally, many studies estimated the seven *Eimeria* species in different breeds and localities (Güven et al., 2013). In our study, four species were detected in gDNA isolates from the fecal specimens of the chickens with Real Time PCR analyses. According to the results of Real Time PCR analyses, *E. tenella* was found to be the most prevalent species with the ratio of 95.8% and this was followed by *E. maxima*, *E. acervulina* and *E. praecox*

with the ratios of 83.3%, 58.3%, 4.1%, respectively. These results clearly showed that four *Eimeria* species are prevalent in free-range chicken flocks. Mix infections were determined in 200 (51.2%) of the 390 fecal samples and 83.3% of positive samples.

In Czechoslovakia, France and Sweden during 1990-1996, seven *Eimeria* species were reported from broiler farms (Kučera, 1990). In Norway, *E. acervulina* (100%), *E. tenella* (77%) and *E. maxima* (25%) were the predominant species (Haug et al., 2008) similar to our study.

### Conclusion

In this study, we identified the *Eimeria* species causing coccidiosis in free-range chicken in Samsun district of Turkey using a molecular technique based on the Real Time PCR and determine the prevalence of coccidian infections in chicken farms. Further epidemiological surveys are needed to explore the risk factors associated with avian coccidiosis and their control and struggle in Turkey.

### References

- AL-NATOUR, M.Q., SULEIMAN, M.M. and ABO-SHEHADA, M.N. (2002) Flock-level prevalence of *Eimeria* species among broiler chicks in northern Jordan. *Prev Vet Med* 53:305-310.
- AMER, M.M., AWAAD, M.H.H., EL-KHATEEB RABAB, M., ABUELEZZ NADIA, M.T.N., SHEREIN-SAID, A., GHETAS, M.M. and KUTKAT, M.A. (2010). Isolation and identification of *Eimeria* from field coccidiosis in chickens. *Journal of American Science* 6:10.
- GÜVEN, E., BECKSTEAD, R.B., KAR, S., VATANSEVER, Z. and KARAER Z. (2013) Molecular identification of *Eimeria* species of broiler chickens in Turkey. *Ankara Üniv Vet Fak Derg* 2013; 60: 245-250.
- GÜVEN, E. (2010) Determination of *Eimeria* spp. Causing Coccidiosis in Broiler Breeding in Turkey. Doctoral Thesis, Ankara University Graduate School of Health Sciences, Ankara, 2010.
- GYÖRKE, A., POP, L. and COZMA, V. (2013) Prevalence and distribution of *Eimeria* species in broiler chicken farms of different capacities. *Parasite* 20:50.
- HAUG, A., GJEVRE, A.G., THEBO, P., MATTSSON, J.G. and KALDHUSDAL, M. (2008) Coccidial infections in commercial broilers: epidemiological aspects and comparison of *Eimeria* species 170.
- IACOB, O.C. and DUMA, V. (2009) Clinical paraclinical and morphopathological aspects in cecal eimeriosis of broilers. *Scientia Parasitologica* 10:43-50.

- KARAER, Z., GÜVEN, E., AKÇAY, A., KAR, S., NALBANTOĞLU, S. and ÇAKMAK, A. (2012) Prevalence of subclinical coccidiosis in broiler farms in Turkey. *Trop Anim Health Prod* 44(3):589-594.
- KUCERA, J. (1990) Identification of *Eimeria* species in Czechoslovakia. *Avian Pathology* 19:59-66.
- SHIVARAMAIAH, C., BARTA, J.R. and HERNANDEZ-VELASCO, X. (2014) Coccidiosis: recent advancements in the immunobiology of *Eimeria* species, preventive measures, and the importance of vaccination as a control tool against these Apicomplexan parasites. *Vet Med Res Rep* 5:23-34.
- VELKERS, F.C., BLAKE, D.P., GRAAT, E.A., VERNOOIJ, J.C., BOUMA, A., DE JONG, M.C. and STEGEMAN, J.A. (2010) Quantification of *Eimeria acervulina* in faeces of broilers: comparison of McMaster ookist counts from 24h faecal collections and single droppings to real-time PCR from cloacal swabs. *Vet Parasitol* 169: 1-7.

SESSION-3  
HEALTH

*INVITED PRESENTATION*

## Foodborne Diseases and Poultry Production

Hafez Mohamed Hafez<sup>a</sup>, Hosny El-Adawy<sup>b</sup>

<sup>a</sup> Institute of Poultry Diseases, Free University Berlin, Germany

<sup>b</sup> Friedrich-Loeffler-Institut, Institute of Bacterial Infections and Zoonoses, Jena, Germany

### Abstract

In spite of significant improvement in technology and hygienic practices in developed countries at all stages of poultry production accompanied with advanced improvement in public sanitation foodborne diseases remain a persistent threat to human and animal health. Beside the current legislations, the main strategy to control microbial food borne hazards should include Good Animal Husbandry Practices (GAHPs) at the farm level through sound hygienic measures, which should be applied to poultry houses and environment and the feed. In addition, reducing colonization by using feed additives, competitive exclusion treatment or vaccines is a possibility during transport and slaughtering. In all cases agent surveillance and monitoring programmes must be adapted and followed strictly in aim to allow early intervention. In addition, the development of antibiotic resistant bacteria will also be a continuous public health hazard

The present paper describes the general the main strategy to control food borne infections in poultry, with special attention to European legislations toward safe poultry meat.

### Introduction

In spite of significant improvements in technology and hygienic practices at all stages of poultry production in developed countries, accompanied by advanced improvement in public sanitation, foodborne diseases remain a persistent threat to human and animal health. Food borne diseases are still big issues of major concern in those countries. In developing countries, the need to produce sufficient food to meet the requirements of population increases, accompanied by bad economic situations often overshadow the need to ensure safe food products. Regardless of this fact, safe food is a fundamental requirement for all consumers, rich or poor. Food safety is not a discovery of recent times; it is a natural basic instinct of human survival. During human evolution, several approaches were adopted to achieve safety of food. One of the most famous approaches was practiced by several kings which would employed official and well trusted „tasters“ that served as food safety sentinels for the kings and royal family members. Food safety and quality of food are currently big issues of major concern.

Many reports during recent years have shown that *Salmonella* and *Campylobacter* spp. are the most common causes of human foodborne bacterial diseases linked to poultry. In some areas also verotoxin producing *Escherichia coli* 0157:H7 (VTEC), *Listeria* and *Yersinia* have surfaced as additional foodborne pathogens causing human illness. Several other toxicogenic bacterial pathogens, such as *Staphylococcus aureus*, *Clostridium perfringens*, *Clostridium botulinum* and *Bacillus cereus* can also enter the human food chain via contaminated poultry carcasses. In addition, the development of antibiotic resistance in bacteria, which are common in both animals and humans, such as Methicillin Resistant *Staphylococcus aureus* (MRSA) and Extended-spectrum beta-lactamase (ESBL) bacteria, are also an emerging public health hazard.

### ***Salmonella* infection**

*Salmonella* infections in poultry are distributed worldwide and result in severe economic losses when no effort is made to control them. In poultry, the genus *Salmonella* of the family Enterobacteriaceae, which include more than 2500 serovars, can roughly be classified into three categories or groups as follow: *Salmonella* can also be divided into three groups based on their host specificity and invasiveness (Hafez, 2013). Invasive salmonellas have the capability to “invade” the body from the intestinal lumen and thus infect organs, causing more serious disease. **Group 1** contains serovars, which are highly host adapted and invasive. Examples are *S. Gallinarum* and *S. Pullorum* in poultry or *S. Typhi* in humans. **Group 2** contains non-host adapted and invasive serovars. *Salmonella* in this group are of most concern regarding public health, since some of them are capable to infect humans and food producing animals and especially poultry can serve as reservoirs. There are approximately 10 – 20 serovars in this group. Currently, the most relevant serovars of them are *S. Typhimurium*, *S. Enteritidis*, *S. Heidelberg*, *S. Hadar* as well as *S. Arizonae*. **Group 3** contains non-host adapted and non-invasive serovars, which are harmless for animals and humans. Most serovars of the genus *salmonella* belong to this group. Some serovars may be predominant for a number of years in a region or country. Then, they disappear and replaced by another serovars (Hafez and Hauck, 2016). The infection can be transmitted vertically through contaminated eggs laid by infected carriers as well as horizontally spread (lateral). Hatcheries are one of the major sources of early horizontal transmission. Horizontal spread of *Salmonella* occurring during the hatching was shown in chickens, when contaminated and *Salmonella*-free eggs were incubated together. *Salmonella* can also spread through the hatchery by means of contamination of ventilation ducting, belt slots or door seals within hatchers, but may also result from infection and contamination that continuously recycles between hatchers, hatched birds, dust and crate washing equipment. During rearing

the infection is transmitted horizontally (laterally) by direct contact between infected and uninfected flocks, and by indirect contact with contaminated environments through ingestion or inhalation of *Salmonella* organisms. Subsequently, there are many possibilities for lateral spread of the organisms through live and dead vectors. Transmission frequently occurs via faecal contamination of feed, water, equipment, environment and dust in which *Salmonella* can survive for long periods. Failure to clean and disinfect properly after an infected flock has left the site can result in infection of the next batch of birds. Significant reservoirs for *Salmonella* are man, farm animals, pigeons, waterfowl and wild birds. Rodents, pet's insects and litter beetles (*Alphitobius diaperinus*) are also potential reservoirs and transmit the infection to birds and between houses (Roche *et al.*, 2009). Probably one of the most common sources for lateral spread of the organisms is feed. Nearly every ingredient ever used in the manufacture of poultry feedstuffs has been shown at one time or another to contain *Salmonella*. The organism occurs most frequently in protein from animal products such as meat and bone meal, blood meal, poultry offal, feather meal and fishmeal. Protein of vegetable origin has also been shown to be contaminated with *Salmonella* (Hafez *et al.*, 1997; Dutta *et al.*, 2010).

Since November 2003, several regulations from the European Parliament Council Regulation on the control of salmonella and other specified food-borne zoonotic agents were passed. This regulation covers the adoption of targets for the reduction of the prevalence of specified zoonosis in animal populations at the level of primary production, including breeding flocks (Chickens and turkeys), layers, broiler and turkey flocks. Food business operators must have samples taken and testing for the zoonosis and zoonotic agents especially *Salmonella* (Table 1) as summarized by Hafez (2010).

Table 1: The minimum sampling requirements

Zoonoses or zoonotic agent	Animal population	Time of Sampling by food business operators
<b><i>Breeding flocks of Gallus gallus (EC, 2005)</i></b>		
<i>S. Enteritidis</i> , <i>S. Typhimurium</i> <i>S. Hadar</i> <i>S. Infantis</i> <i>S. Virchow</i>	- rearing flocks	- day-old chicks - four-week-old birds - two weeks before moving to laying phase or laying unit at the holding or at the hatchery
	- adult flocks	- every second week during the laying period
<b><i>Laying hens (EC, 2006a)</i></b>		
<i>S. Enteritidis</i> ,	- rearing flocks	- day-old chicks

<i>S. Typhimurium</i>		- pullets two weeks before moving to laying phase or laying unit
	- laying flocks	- every 15 weeks during the laying phase
<b>Broilers (EC, 2007b)</b>		
<i>S. Enteritidis</i> , <i>S. Typhimurium</i>	- broilers	- within three weeks before the birds are moved to the slaughterhouse
<b>Turkey breeders (EC, 2008)</b>		
<i>S. Enteritidis</i> , <i>S. Typhimurium</i>	- rearing flocks	- day-old chicks - four-week-old birds - two weeks before moving to laying phase or laying unit
	- adult flocks:	- at least every third week during the laying period at the holding or at the hatchery
<b>Fattening turkeys (EC, 2008)</b>		
<i>S. Enteritidis</i> , <i>S. Typhimurium</i>	- turkeys	- within three weeks before the birds are moved to the slaughterhouse

### **Campylobacters**

Thermophilic campylobacters are the most common bacterial cause of diarrhoea in humans worldwide. Enteric diseases caused by the thermophilic species *C. jejuni*, *C. coli*, *C. lari*, and *C. upsaliensis* range from asymptomatic infections to severe inflammatory bloody diarrhoea. The natural habitat of thermophilic *Campylobacter* is the intestinal tract of healthy birds and raw meat that can be contaminated during the slaughtering process (EFSA, 2015). It is estimated that as many as 90% of broilers and turkeys may harbour *Campylobacter* while showing little or no clinical signs of illness (Sahin *et al.*, 2002). Poultry and poultry products remain the most common source of foodborne human campylobacteriosis. The major route for *Campylobacter* infection in poultry appears to be the horizontal transmission from the environment. Specific flocks that become infected show rapid rate of intra-house transmission and a high isolation rate from caecal swabs, water and litter. *Campylobacter* spp. are widespread in poultry not only during the growing period, but also on the poultry meat during slaughter and during processing of poultry products. Horizontal transmission is the most important mode of the introduction of *Campylobacter* into poultry flocks. However, the ability of *Campylobacter* to spread is limited by their relatively low tenacity, which can vary between strains. Especially dry

environments kill *Campylobacter* within one or two hours (Evans and Sayers, 2000).

### **Antibiotic resistant**

The development of antibiotic resistance in bacteria, which are common in both animals and humans, is an emerging public health hazard. Controlling these foodborne organisms requires a broader understanding of how microbial pathogens enter and move through the food chain, as well as the conditions that promote or inhibit growth for each type of organism.

Multi-resistant bacteria are increasingly posing a hazard to human and animal health worldwide, impeding successful antibacterial treatment (Arias *et al.*, 2010; EFSA, 2017). In addition, the development of novel antibiotics does not keep step with the emergence of antimicrobial resistance in bacteria (García-Rey, 2010).

Among multi-resistant bacteria, vancomycin-resistant enterococci (VRE) have been estimated as one of the most common bacteria causing a rise in cases of nosocomial infections in humans in the last few years (Arias *et al.*, 2010). The prevalence of vancomycin-resistant enterococci (VRE) in 20 turkey flocks reared in the southwest of Germany was investigated. Enterococci were tested on the presence of the vancomycin resistance genes *vanA*, *vanB* (B1/B2/B3), and *vanC* (C1/C2/C3). Vancomycin-resistant enterococci were detected in 15 (75%) of the 20 turkey flocks investigated. In a total 68 isolates were isolated from birds and dust samples, enterococci bearing *van*-genes were detected. Of these, 12 isolates carried the *vanA* gene (17.6%) and 56 isolates carried the *vanC1* gene (82.6%). Neither *vanB* (B1, B2, B3) genes nor the *vanC2* or *vanC3* genes could be detected (Sting *et al.*, 2013).

In addition, Livestock-associated methicillin-resistant *Staphylococcus aureus* (LA-MRSA) have been isolated from a number of livestock species and persons involved in animal production. Turkey meat was also showed to be contaminated with MRSA (de Boer *et al.*, 2009). Richter *et al.* (2012) investigated the prevalence of LA-MRSA in fattening turkeys and people living on farms that house fattening turkeys. Eighteen (90%) of 20 investigated flocks were positive for MRSA. All female flocks were positive, while 8 male flocks were positive. On 12 of the farms 22 (37.3%) of 59 persons sampled were positive for MRSA. None of them showed clinical symptoms indicative of an MRSA infection. People with frequent access to the stables were more likely to be positive for MRSA. In most flocks MRSA clonal complex (CC) 398 were detected. In five flocks MRSA of spa-type t002 were identified, which was not related to CC398. Moreover,

other methicillin-resistant *Staphylococcus* spp. were detected on 11 farms and in 8 people working on the farms. Similar results were about MRSA in turkeys were published by El-Adway *et al.* (2016).

Maasjost *et al.* (2015) investigated the antimicrobial susceptibility patterns of *Enterococcus faecalis* and *Enterococcus faecium* isolated from poultry flocks in Germany and they found that high resistance rates were identified in both *Enterococcus* species for lincomycin (72%–99%) and tetracycline (67%–82%). Half or more than half of *Enterococcus* isolates were resistant to gentamicin (54%–72%) and the macrolide antibiotics erythromycin (44%–61%) and tylosin-tartrate (44%–56%). *Enterococcus faecalis* isolated from fattening turkeys showed the highest prevalence of antimicrobial resistance compared to other poultry production systems.

El- Adway *et al.* (2012) investigated 76 *C. jejuni* isolates were recovered from 67 epidemiologically unrelated meat turkey flocks in different regions of Germany in 2010 and 2011. Only one isolate was sensitive to all tested antibiotics. The numbers of isolates that were sensitive to streptomycin, erythromycin, neomycin, and amoxicillin were 69 (90.8%), 61 (80.2%), 58 (76.4%), and 44 (57.9%), respectively. The emergence of a high resistance rate and multidrug resistance to three or more classes of antimicrobial agents were observed. The resistance against sulphamethoxazole/trimethoprim, metronidazole, ciprofloxacin, naladixic acid, and tetracycline was 58 (76.3%), 58 (76.3%), 53 (69.7%), 51 (67.1%), and 42 (55.3%), respectively. Multidrug resistance to three or more classes of antimicrobial agents was found and ranged from 3.9% to 40.8%. Similar results were also found by examination of isolates collected from different free-range turkey flocks in Germany (El-Adway *et al.*, 2015).

### **General approaches to control food borne infections**

To control the food borne organisms, information is required to understand more fully, how microbial pathogens enter and move through the food chain, and the conditions, which promote or inhibit growth for each type of organism. In general, the main strategy to control food borne infections in poultry should include monitoring, cleaning the production chain from the top, especially for vertically transmitted microorganism such as *Salmonella* by culling infected breeder flocks, hatching egg sanitation and limiting introduction and spread of infections at the farm level through effective hygiene measures (Hafez, 1999, 2005, Mueller-Doblies *et al.*, 2010). An intensive and sustained rodent control is essential and needs to be well planned and routinely performed and its effectiveness should be monitored. In addition, reducing bacterial colonization by using feed additives such as short chain organic acids (formic acid, propionic acid), carbohydrates

(lactose, mannose, galactose, saccharose), probiotics, competitive exclusion (Schneitz, 2005, Vicente *et al.*, 2007) or use of vaccines are further possibilities. Live and inactivated vaccines are used to control Salmonella in poultry (Gast, 2013). Generally, vaccination alone is of little value, unless it is accompanied by improvements in all aspects of management and biosecurity. In addition, further attention must be paid to the development of efficient vaccines against campylobacter infections.

Since the success of any disease control programme depends on the farm and personal sanitation, it is essential to incorporate education programmes about micro-organisms, modes of transmission as well as awareness of the reasons behind such control programmes by people involved in poultry production. In addition, effective education programmes must be implemented to increase public awareness of the necessary measures to be taken for protection against bacteria in food products from poultry.

Furthermore, in spite of significant improvement in technology and hygienic practices at all stages of food production accompanied with advanced improvement in public sanitation food borne infections remains a persistent threat to human and animal health. The failure of the human population to apply hygienically acceptable food handling and cooking practice, and the fact that the processing plants are not able to reduce the level of pathogenic bacteria in poultry products, mean that every effort must be made to reduce the Salmonella contamination of the live birds before despatch to processing plants. New approaches to the problem of contamination must be adopted and the discussion on the decontamination of the end product must be re-evaluated carefully and without emotion. In addition, research must continue to find additional control and preventive means. Furthermore, the long term, development of poultry lines that are genetically resistant to some pathogens should be progressed.

### **Conclusions**

Toward food safety in the EU several legislations are into force and their aims can be summarized according to Mulder (2011) as follows:

- 1) Safety (consumer health): by new methods to reduce the use of antibiotics /medicines; improve disease resistance; zoonosis control; traceability of animals and products
- 2) Safety (product safety): stimulate and control hygienic processing, traceability of products and materials intended to come into contact with food
- 3) Animal welfare: animals kept according to rules/systems
- 4) Product quality: improved quality and composition; quality and chain control systems; traceability of animals and products.

- 5) Environment: reducing environmental contamination, Nitrogen and Phosphorous. There is a critical look at the use of by-products of human food production. The re-use of by-products for non-food applications (feathers) should be encouraged.
- 6) Rural impact, economic effects and bio-diversity

## References

- Arias, C.A., Contreras, G.A. and Murray, B.E. (2010). Management of multidrug-resistant enterococcal infections. *Clinical Microbiology and Infection* 16:555–562.
- De Boer, E., Zwartkruis-Nahuis, J.T.M., Wit, B., Huijsdens, X.W., de Neeling, A.J., Bosch, T., van Oosterom, R.A.A., Vila, A. and Heuvelink, A.E. (2009). Prevalence of methicillin-resistant *Staphylococcus aureus* in meat. *International Journal of Food Microbiology* 134: 52–56.
- Dutta, T.K., Roychoudhury, P. and Bandyopadhyay, S. (2010). Molecular epidemiology and virulence properties of *Salmonella* Enteritidis isolated from an outbreak of gastroenteritis in turkeys. *Indian Journal of Animal Sciences* 80: 391-397.
- EFSA- European Food Safety Authority “EFSA” and European Centre for Disease Prevention and Control “ECDC” (2017). The European Union summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2015. *EFSA Journal* 2017; 15(2): 4694 [212 pp.].
- EFSA: The European Union Summary (2015). Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2012. *EFSA Journal* 2015 12:3547. relating to machinery. Official Journal, 1989; L 183: 9-32.
- El-Adawy, H., Ahmed, M., Hotzel, H., Tomaso, H., Tenhagen, B., Hartung, J., Neubauer, H. and Hafez, H. (2015). Antimicrobial susceptibilities of *Campylobacter jejuni* and *Campylobacter coli* recovered from organic turkey farms in Germany. *Poultry Science*, 11:2831-2837.
- El-Adawy, H., Ahmed, M., Hotzel, H., Monecke, S. Schulz, J., Hartung, J., Ehrlich, R., Neubauer H. and Hafez, H.M. (2016). Characterization of Methicillin-Resistant *Staphylococcus aureus* isolated from healthy turkeys and broilers using DNA Microarrays. *Frontier in Microbiology*, 19 December 2016 | <https://doi.org/10.3389/fmicb.2016.02019>.
- El-Adawy, H., Hotzel, H., Düpre, S., Tomaso, H., Neubauer, H. and Hafez, H. M. (2012). Determination of antimicrobial sensitivities of *Campylobacter jejuni* isolated from commercial turkey farms in Germany. *Avian Diseases*, 56:685–692.
- Evans, S. and Sayers, A. (2000). A longitudinal study of *campylobacter* infection of broiler flocks in Great Britain. *Preventive Veterinary Medicine*, 46(3):209-223.

- García-Rey, C. (2010) The role of the pharmaceutical industry. Why are new antibiotics not being marketed? . *Enfermedades Infecciosas Y Microbiologia Clinica*, 28:45-49
- Gast, R.K. (2013). Paratyphoid infections. In *Diseases of Poultry*, D.E. Swayne, J.R. Glisson, L.R. McDougald, L.K. Nolan, D.L. Suarez and V. Nair, eds. (Ames, Iowa: Iowa State Press), pp. 693–706.
- Hafez, H.M. (1999) Poultry meat and food safety: pre- and post-harvest approaches to reduce food borne pathogens. *World's Poultry Science Journal*, 5: 269-280.
- Hafez, H.M. (2013). Salmonella infections in Turkeys. In: PA Barrow, P.A. and Methner, U. (Ed). *Salmonella in domestic animals*. CABI Publishing ISBN 13: 978 1 84593 902 1. pp.193-220.
- Hafez, H.M. and Hauck, R. (2016). Salmonellosis. In: Hafez, H.M. and Hauck R (Ed). *Main Diseases in poultry farming - Bacterial infection*. Publisher Grupo Asís Biomedica, S.L.-Spain. ISBN: 978-84-16818-39-6. pp. 11-23.
- Hafez, H.M., Stadler, A. and Kösters, J. (1997). Surveillance on Salmonella in Turkey Flocks and Processing Plants. *Deutsche Tierärztliche Wochenschrift*, 104, 33-35.
- Hafez, H.M. (2005). Governmental regulations and concept behind eradication and control of some important poultry diseases. *World's Poultry Science Journal*, 61:569-582.
- Hafez, H.M. (2010). Salmonella Infections in Poultry: Control approaches in the European Union. *Turkiye Klinikleri J Vet Sci*; 1(2):80-88.<https://doi:10.2903/j.efsa.2017.4694>.
- Maasjost, J., Mühldorfer, K. Cortez de Jäckel S. and. Hafez, H. M. (2015) Antimicrobial Susceptibility Patterns of *Enterococcus faecalis* and *Enterococcus faecium* isolated from poultry flocks in Germany. *Avian Diseases*, 59:143–148.
- Mueller-Doblies, D., Carrique-Mas, J.J., Sayers, A.R. and Davies, R.H. (2010). A comparison of the efficacy of different disinfection methods in eliminating Salmonella contamination from turkey houses. *Journal of Applied Microbiology*, 109: 471-479.
- Mulder, R. (2011). Current EU regulations for the production and processing of (safe) poultry meat. <http://en.engormix.com/MA-poultry-industry/health/articles/current-regulations-production-processing-t1774/165-p0.htm>.
- Richter, A., Sting, R., Popp, C., Rau, J., Tenhagen, B.A., Guerra, B., Hafez, H.M. and Fetsch A. (2012) Prevalence of types of methicillin-resistant *Staphylococcus aureus* in turkey flocks and personnel attending the animals. *Epidemiology and Infection*, 140, 2223- 2232.
- Roche, A.J., Cox, N.A., Richardson, L.J., Buhr, R.J., Cason, J.A., Fairchild, B.D., and Hinkle, N.C. (2009). Transmission of Salmonella to broilers by

- contaminated larval and adult lesser mealworms, *Alphitobius diaperinus* (Coleoptera: Tenebrionidae). *Poultry Science*, 88: 44-48.
- Sahin, O., Morishita, T., Zhang, Q (2002). *Campylobacter* colonization in poultry: sources of infection and modes of transmission. *Animal Health Research Reviews*, 3(02):95-105.
- Schneitz, C.: (2005) Competitive exclusion in poultry-30 years of research. *Food Control*,2005; 16: 657-667.
- Sting, R., Richter, A., Popp, C. and Hafez, H.M. (2013). Occurrence of vancomycin-resistant enterococci in turkey flocks. *Poultry Science*, 92:346–351.
- Vicente, J., Higgins, S., Bielke, L., Tellez, G., Donoghue, D., Donoghue, A., and Hargis, B. (2007). Effect of probiotic culture candidates on salmonella prevalence in commercial turkey houses. *Journal of Applied Poultry Research*, 16:471-476.

# **SESSION-3**

# **HEALTH**

## **SHORT ORAL PRESENTATIONS**

## Molecular Investigation of *Atoxoplasma* Spp. in Free-Range Chickens Along with Some Findings on Migrating Avian Species from Sultan Marshes in Turkey

Mübeccel Okur<sup>a</sup>, Alparslan Yıldırım<sup>a,b</sup>, Önder Düzlü<sup>a,b</sup>, Arif Çiloğlu<sup>a,b</sup>, Zuhâl Önder<sup>a,b</sup>, Arzu Gürsoy Ergen<sup>c</sup>, Bilal Dik<sup>b,d</sup>, Gamze Yetişmiş<sup>a</sup>, Abdullah İnci<sup>a,b</sup>

<sup>a</sup>Erciyes University Faculty of Veterinary Medicine Parasitology Department, Kayseri, Turkey

<sup>b</sup>Erciyes University, Vectors and Vector-Borne Diseases Implementation and Research Center, Kayseri, Turkey

<sup>c</sup>Ondokuz Mayıs University, Faculty of Science, Department of Biology, Samsun, Turkey

<sup>d</sup>Selçuk University, Faculty of Veterinary Medicine, Department of Parasitology, Konya, Turkey

### Abstract

Our former molecular analyses on the blood samples of some migrating avian species (The material was collected formerly under the TUBİTAK project, 114 O 646) revealed some *Atoxoplasma* spp. lineages in migrating avian species from Sultan Marshes in Central Anatolia, Turkey. Thus, we have decided to perform this investigation on free-range chickens that were sharing the same ecosystem in order to explore risk factors for the *Atoxoplasma* spp. infections. gDNA were extracted from blood samples from totally 65 adult domestic chickens from different hencoops. Nested-PCR analyses targeting the 18S rRNA gene of *Atoxoplasma* spp. revealed no infections in female and male free-range chickens.

**Key words:** *Atoxoplasma*, Chicken, Nested-PCR, Sultan Marshes

### Özet

Türkiye’de İç Anadolu Bölgesinde bulunan Sultan Sazlığı’ndaki çeşitli göçmen kuş türlerinin kan örnekleri (Materyal daha önceden 114 O 646 nolu TUBİTAK projesi kapsamında toplanmıştır) üzerinde yapmış olduğumuz önceki moleküler analizler bazı türlerde *Atoxoplasma* spp. nesillerinin varlığını ortaya çıkarmıştır. Bu açıdan çalışmamızda aynı ekosistemi paylaşan serbest gezen tavuklarda *Atoxoplasma* spp. enfeksiyonları için risk faktörlerini ortaya çıkarmak amaçlanmıştır. Farklı kümeslerde bulunan toplam 65 ergin evcil tavuktan alınan kan örneğinden gDNA izolasyonu yapılmıştır. *Atoxoplasma* spp. 18S rRNA gen bölgesini hedefleyen Nested-PCR analizleri, serbest gezen dişi ve erkek tavuklarda enfeksiyon olmadığını ortaya koymuştur.

**Anahtar Kelimeler:** *Atoxoplasma*, Nested-PCR, Sultan Sazlığı, Tavuk

## Introduction

*Atoxoplasma* spp. is a coccidian parasite that also causes systemic isosporosis. Therefore, it can infect several bird species. Birds become infected after ingesting sporulated oocysts (Adkesson et al., 2005). The asexual reproduction occurs in intestinal and blood-circulating cells and the sexual stage, gametogony, takes place in the enterocytes of the duodenum. Clinical signs are non-specific; however, that may include depression, anorexia, diarrhea, hepatomegaly, and dilated gut loops, which may be visualized through the skin (Mohr et al., 2017, Done et al., 2011) *Atoxoplasma* spp. infections have been diagnosed using histopathologic examination of tissue samples, buffy coat smears, impression smears of organs, transmission electron microscopy, and polymerase chain reaction (PCR) analysis (Adkesson et al., 2005). It is not possible to distinguish between oocysts of *Atoxoplasma* spp. and *Isospora* by microscopic examination of feces: Oocysts from both *Atoxoplasma* spp. and *Isospora* spp. contain two sporocysts that have four sporozoites. *Atoxoplasma* spp. infections birds have been observed in a wide variety of passerine birds including canaries, sparrows, finches, mynahs, starlings, and thrushes. It was assumed that *Atoxoplasma* spp. exhibit some degree of host species specificity, but some current findings (Adkesson et al., 2005, Sánchez-Cordón et al., 2007) indicated some evidence for generalist characteristic of the parasites.

## Materials and Methods

This study was planned after obtaining some molecular findings on *Atoxoplasma* spp. in some migrating bird species in the Sultan Marshes national park ecosystem. Some gDNA isolates of blood samples from different kinds of avian species that had been already collected by means of a TUBITAK project (114 O 646; “Sultan Sazlığı Ekosisteminde Haemosporidialarının Moleküler Ekolojisi”) were investigated for *Atoxoplasma* spp. infections. Totally two gDNA isolates from *Sturnus vulgaris* and *Acrocephalus melanopogon* species were found to be positive for *Atoxoplasma* spp. DNA in 18S rRNA Nested-PCR analyses. The *Atoxoplasma* spp. identifications were further confirmed by sequence analyses of the related gene region. Afterwards totally 65 blood samples (30 female, 35 male) were collected from free ranging chickens sharing the same ecosystem in October 2017 in order to explore *Atoxoplasma* spp. transmission between wild and domestic bird species in the area. The blood samples were placed into the tubes containing set buffer solution previously prepared in the laboratory. Genomic DNA (gDNA) was extracted from blood samples using the GeneJET Genomic DNA Purification Kit (Thermo Fisher Scientific, USA) according to the manufacturer’s protocol. The extracted gDNAs were stored at -20°C until molecular analyses.

The Nested-PCR analyses targeting the 18s rRNA gene of *Atoxoplasma* spp. were utilized on gDNA isolates with the primers EIMFAtox (5'-ACCATGGTAATTCTATG-3') and 990Atox (5'-TTGCCTYAAACTTCCTT-3') in the first PCR. In the second PCR, primers EIMRAtox (5'-CTCAAAGTAAAAGTTCC-3') and 989Atox (5'-AGTTTCTGACCTATCAG-3') were used to amplify 457 bp gene fragment of 18S rRNA. The amplification products were separated by 1.5% agarose gel electrophoresis and visualized using Gene Snap from Syngene analysis program (UVP INC Uplant, CA). In the nested-PCR method, *Atoxoplasma* spp.

### Results and Discussion

Atoxoplasmosis is a poorly understood disease. This lack of understanding has led to a great deal of confusion regarding the pathogenesis of infection and the classification of the causative organism (Levine, 1982). It is thought that the sexual stages of the coccidian reproduction occur in the intestines and that the asexual merozoite stages are able to infect cells of the immune system and cause systemic infection.

Diagnosis of *Atoxoplasma* spp. infection is difficult because symptoms are non-specific and parasites are difficult to be identified by light microscopy because of their small size. Atoxoplasma-like infections have been reported in several species of passerine birds, including greenfinches (*Carduelis chloris*), house sparrows (*Passer domesticus*), Bali mynahs (*Leucopsar rothschildi*), bullfinches (*Pyrrhula pyrrhula*) and canaries (*Serinus canaria*) mainly from their internal tissues and feces. The lesions in passerine species have been variably described as inflammatory, atypical lymphoproliferative, and neoplastic (Cushing et al., 2011).

The portion of the 18s rRNA gene amplified in the nested PCR to diagnose atoxoplasmosis is common to all species of *Eimeria*, *Isospora*, and *Atoxoplasma*. *Eimeria* spp. and *Isospora* spp., which do not invade extraintestinal sites, are not expected to be present in blood and somatic tissues. Thus, samples of blood and tissues from which the 18s rRNA gene was successfully amplified were considered positive for atoxoplasmosis (Mohr et al., 2017). There were limited data on the presence of *Atoxoplasma* spp. in avian blood. However, it has been mentioned that some development stages could also invade lymphocytes and monocytes in blood stream. Our previous analyses on *Atoxoplasma* spp. infecting some migrating avian species revealed the presence of two lineages in macrophages of *Sturnus vulgaris* and *Acrocephalus melanopogon* species. The lineage AtoxSMTurkey1 from *Sturnus vulgaris* was identical to the lineage reported from Southern cape sparrow (*Passer melanurus melanurus*) from USA. The lineage AtoxSMTurkey2 was a new unique haplotype for *Atoxoplasma* spp. and it exhibited highest identity (99.3%) to same haplotype Southern cape sparrow from USA.

In this study, no amplification was detected among the examined gDNAs from totally 65 free ranging chickens. The lineages characterized from *Sturnus vulgaris* and *Acrocephalus melanopogon* were used as positive controls in all analyses and they were produced specific amplifications on agarose gel electrophoresis specific 457 bp bands of *Atoxoplasma* spp. The current studies (Adkesson et al., 2005, Sánchez-Cordón et al., 2007) on the host specificity of Atoxoplasmosis have provided evidence on the generalist characteristic of the parasite. Thus, we hypothesed that Sultan Marshes serve suitable conditions for several transmissions of kind of pathogens between wild and domestic avian species. However, this preliminary study did not provide any evidence whether *Atoxoplasma* spp. infects free ranging chickens.

### Conclusion

This study serves the first molecular epidemiological approach in terms of research into domestic chickens in Turkey. Given the importance of Atoxoplasmosis further studies are needed in a broader epidemiological perspective in different regions of Turkey. We think that our result could contribute for the future works. *Atoxoplasma* spp. shows similar clinical symptoms with *Isospora* species that also threaten poultry healthy.

### References

- ADKESSON, M.J., ZDZIARSKI, J.M. and LITTLE, S.E. (2005) Atoxoplasmosis in tanagers. *J Zoo Wildl Med* 36 (2): 265-72.
- MOHR, F., BETSON, M. and QUINTARD, B. (2017) Investigation of The Presence of *Atoxoplasma* Spp. In Blue-Crowned Laughingthrush (*Dryonastes Courtoisi*) Adults and Neonates. *J Zoo Wildl Med* 48(1):1-6.
- DONE, L.B., CASE, J.T., MAZET, J.A. and ZICCARDI, M. (2011) Assessment of the quality of multi-institutional data for population-based epidemiological studies: a case study of atoxoplasmosis in *Bali mynahs* (*Leucopsar rothschildi*). *J Zoo Wildl Med* 42(2):228-35.
- SÁNCHEZ-CORDÓN, P.J., GÓMEZ-VILLAMANDOS, J.C., GUTIÉRREZ, J., SIERRA, M.A., PEDRERA, M. and BAUTISTA, M.J. (2007) Atoxoplasma spp. infection in captive canaries (*Serinus canaria*). *J Vet Med A Physiol Pathol Clin Med* 54(1): 23-6.
- LEVINE, N.D. (1982) The genus atoxoplasma (Protozoa, Apicomplexa). *J Parasitol* 68(4):719-23.
- CUSHING, T.L., SCHAT, K.A., STATES, S.L., GRODIO, J.L., O'CONNELL, P.H. and BUCKLES, E.L. (2011) Characterization of the host response in systemic isosporosis (atoxoplasmosis) in a colony of captive American goldfinches (*Spinus tristis*) and house sparrows (*Passer domesticus*). *Vet Pathol* 48(5):985-92.

## Antagonistic Activity of Intestinal Lactobacteria against *Salmonella enterica* isolated from chicken and turkey.

E. V. Yerlituerk (Dudareva)<sup>a</sup>, V. N. Afonyushkin<sup>a, b</sup>, M. L. Filipenko<sup>b</sup>, E. A. Khrapov<sup>b</sup>

<sup>a</sup>Institute of Experimental Veterinary of the Siberia and Far East, Krasnoobsk, Novosibirsk Region; Russia.

<sup>b</sup>Institute of Chemical Biology and Fundamental Medicine, Siberian Division of the Russian Academy of Sciences, Novosibirsk, Russia.

*Address for correspondence:* ligasa1@gmail.com., E. V. Yerlituerk (Dudareva)

### Abstract

If Lactobacteria are characterized by the wide spectrum of positive properties, why do we regularly isolate Salmonellas from the intestine of animals, birds, and humans? In this study our aim was to determine whose biological variability (Salmonella or Lactobacteria) are most critical for suppression of Salmonella growth by Lactobacteria. Co-culturing of Lactobacteria and Salmonellas was performed on 56 field isolates of Lactobacterium and Salmonellas cultures from the intestine of domestic fowl. Antagonistic activity of Lactobacteria from the intestinal microbiocenosis of domestic flows in co-culturing tests is shown to be the more significant factor comparing to strain features of *Salmonella enterica*.

**Key Words:** *Lactobacteria; Salmonellas; antagonistic activity; gastrointestinal microbiota; real-time polymerase chain reaction*

### Introduction

Lactobacteria are used like producers of antioxidants, substances reducing activity of lipid peroxidase, stimulating growth of Lactobacterium and Bifidobacterium flora. These microorganisms have anti-tumor activity and stimulate various compounds of immune system, and reveal pronounced viricide effect due to production of highly active hydrogen peroxide (Gorskaya et al 1992). Oral bacterial therapy with Lactobacteria prevents development of diarrheas related to antibiotic therapy of children. Antibiotic and probiotic activities of Lactobacteria are related to the effects of produced bacteriocins and organic acids, alcohols, peroxides, and other metabolites accumulated by these bacteria during their growth and development (Gorskaya et al 1992; Lykova, 2000). The data of the spectrum of antibiotic resistance of Lactobacteria from the intestine of domestic fowl enable empirical search of antibiotics, which are not damaging the normobiota, and a rise in the efficiency of antibiotic defense from salmonellosis and reduction of risk of contamination in humans (Afonyushkin et al., 2007). However, if

Lactobacteria are characterized by the wide spectrum of positive properties (Afonyushkin et al., 2016), why do we regularly isolate Salmonellas from the intestine of animals, birds, and humans?

Our aim was to determine whose biological variability (Salmonella or Lactobacteria) are most critical for suppression of Salmonella growth by Lactobacteria.

### Materials and methods

Experiments were performed on 56 field isolates of Lactobacterium cultures from the intestine of domestic fowl. Lactobacteria and partly Enterococci and Weissella from intestinal contents were isolated in MRS medium (Rogosa and Sharpe medium). Verification of *Lactobacillus* species was performed using cultural, morphological, and biochemical criteria (Pikina et al., 1999; Milteva et al., 2001) Isolated cultures were identified by sequencing of the gene fragment of ribosome 16S RNA by the Sanger method (Lykova, 2000). Species identification was based on PCR RFLP (Afonyushkin et al., 2010; Milteva et al., 2001). The obtained nucleotide sequences were analyzed using NCBI software and databases. Restriction endonucleases *RsaI*(GT<sup>^</sup>AC), *Tru9I* (T<sup>^</sup>TAA),and *Sse9I* (<sup>^</sup>AATT) (SibEnzyme) were used in the investigation (Afonyushkin et al., 2010).

Scheme of Salmonella isolation consisted of inoculation to selenite broth for 6 h, after this - transference and incubation (24h) on Endo-agar with subsequent transference of pale-pink colonies on «XLT4 medium» agar and incubation for 24-48h. Then application to bismuth sulphite agar and «Uriselect 4» - for confirmation of hydrogen sulfide production and exclusion of tryptophan deaminase activity, respectively. Then the isolates with cultural and tinctorial parameters of Salmonellas were defined by immunochemical, biochemical methods and PCR.

Co-culturing of Lactobacteria and Salmonellas was performed as follows. The following Lactobacteria isolates were chosen for the study (Table 1). Cultures were inoculated to Eppendorf tubes containing fluid TCS medium and incubated at 37°C for 24 h; then various Salmonella strains (fresh cultures cultivated onTCS medium till stationary growth stage) were inoculated to these tubes at a ratio of 1:10. Samples for DNA isolation and microscopy were taken after 72 h. At the same time, the samples were controlled: samples of Salmonellas without Lactobacteria and Lactobacteria without Salmonellas were prepared. Salmonella content was checked by real time PCR at the moment of inoculation and after 72 h. Each Salmonella strain (*n*=5) was co-cultured with Lactobacteria strain (*n*=7). Cultures were also examined by microscopy of gram stained smears.

Testing of samples for the presence of Salmonellas did not show total suppression of Salmonella growth. Gram-negative and gram-positive cells were found in gram-stained smears. Bacteria with cultural used the

qualitative real time PCR with Taqman probe developed in the Institute of Chemical Biology and Fundamental Medicine (Afonyushkin et al., 2008).

## Results and Discussion

Cultures used for PCR RFLP analysis served as representatives of normal intestinal microflora of domestic fowl (chickens, turkeys, quails, and ducks). Some cultures were identified in accordance with the results of sequencing of intergenic spacer 16-23s ribosomal RNA; these results coincided with PCR-RFLP. However, some Lactobacteria from quails, ducks, and turkeys were not attributed to a certain species due to absence of information about these microorganisms in international databases. In accordance to our data *Weissella thailandensis* was firstly isolated from the gastrointestinal tract of the turkey.

Cultures were also examined by microscopy of gram stained smears. Testing of samples for the presence of Salmonellas did not show total suppression of Salmonella growth. Gram-negative and gram-positive cells were found in gram-stained smears. Bacteria with cultural signs similar to Salmonellas and Lactobacteria were inoculated from the tubes to bismuth sulfite agar and MRS, respectively. Real-time PCR revealed genome DNA of Salmonella enterica in all tubes where co-culturing took place.

**Table 1.** Strains of *Lactobacillus* spp. Used for Co-Culturing Tests

Strain	Isolation region	Poultry type	Microorganism type
Okt	Novosibirsk	<i>Gallus gallus</i>	<i>L. reuteri</i>
NB1140	Iskitim	<i>Gallus gallus</i>	<i>L. reuteri</i>
NBP1	Iskitim	<i>Gallus gallus</i>	<i>Lactobacillus</i> spp.
NBP181	Iskitim	<i>Gallus gallus</i>	<i>Lactobacillus</i> spp.
LGK2710	Kargat	<i>Gallus gallus</i>	<i>L. salivarius</i>
2SGI 8037	Kemerovo	<i>Meleagris gallopavo</i>	<i>L. salivarius</i>
3SGI8037	Kemerovo	<i>Meleagris gallopavo</i>	<i>L. reuteri</i>

Co-culturing with Lactobacteria was followed by an increase in the concentration of most Salmonella cultures, but a decrease by 3-4.5 log<sub>10</sub> was observed a smaller part. The distribution curve was characterized by a significant transgression with the formation of two groups of cultures. Grouping of dataset by Salmonella strains and Lactobacteria strains indicated the presence of significant differences depending on a strain taking part in co-culturing.

**Table 2.** Dispersion Analysis (ANOVA) of Results of Co-Culturing of *Salmonella enterica* and Various Strains of *Lactobacillaceae*

Effect	SS	Degree of freedom	MS	F	p	Power (alpha=0.05)
Intercept	4.34×10 <sup>9</sup>	1	4.34×10 <sup>9</sup>	312.1992	0.000000	1.000000
Lactobacillaceae	2.13×10 <sup>9</sup>	6	3.55×10 <sup>8</sup>	25.566	0.000000	1.000000
Salmonella	4.83×10 <sup>8</sup>	4	1.21×10 <sup>8</sup>	8.6932	0.000174	0.995569
Error	3.33×10 <sup>8</sup>	24	1.39×10 <sup>8</sup>			

ANOVA showed lower dispersion if structuring of set of co-culturing data was performed by Salmonella strains comparing to Lactobacteria strains. For example, Fisher's criterion (F) used for the estimation of equality of dispersions of two samples has higher value in the sample grouped by a factor "Lactobacteria strain" comparing to a factor "Salmonella strain". Thus, such factor as Lactobacteria had greater importance comparing a factor "strain differences of Salmonellas". Fisher's criterion is used in dispersion analysis for estimation of significance of factors and their interactions. Particularly, Fisher's criterion was higher for Lactobacteria than for Salmonellas.

However, strain differences of Salmonellas may also have significant effect on these differences ( $p < 0.001$ ). Taking into account the fact that Salmonellas and Lactobacteria were isolated from the gastrointestinal tract of domestic fowl, we made the following suggestion. As Salmonellas can constantly live in gastrointestinal tract of domestic fowl, it can be expected that they are resistant to antagonistic activity of bacteria. At the same time a strain significantly suppressing Salmonella growth, and other strain not affecting this parameter were found among 2SGI 8037 and 3SGI8037 Lactobacteria strains isolated from turkeys.

Thus, the concentration of salmonella in chickens depends more on the properties of lactobacteria than on the properties of salmonella. Characteristics of strains of Lactobacillus in domestic chickens have a greater effect on Salmonella infection, than the properties of these Salmonella. Therefore, there is no reasonable basis for speculations about the resistance of indigenous intestine microbiota with pathogenic potential to microbiocides of Lactobacteria with identical hostile specificity.

### **Conclusion and References**

Antagonistic activity of Lactobacteria from the intestinal microbiocenosis of domestic flows in co-culturing tests is shown to be the more significant factor comparing to strain features of *Salmonella enterica*.

"This work is supported by the basic project of the PFRI GAN for 2017-2020. (VI.55.1.1, 0309-2016- 0002) "Biology of bacterial-viral communities"

## REFERENCES

- AFONYUSHKIN V, DUDAREVA EV, MALAKHEEVA L, FROLOVA O, SHKRED O, FILIPPENKO M. (2008) Modern methods of control of salmonellosis. *Ptitsevodstvo* 9:43-44.
- AFONYUSHKIN, V.N., DUDAREVA, E.V., FILIPPENKO, M.L., (2007) Improvement of the mechanisms for diagnostic, prediction, and correction of postantibiotic dysbacteriosis in chickens and turkeys under the poultry industry conditions. *Vestn. Biotekhnol. Fiz.-Khim. Biol.* 3(4):14-18.
- AFONYUSHKIN, V.N., TITOVA, A.M., KOPTEVVYU, SHKIL' N.A., FILIPPENKO M.L., DUDAREVA, E.V. (2010) PCR-RFLP genotyping of microorganisms of the Lactobacillaceae family of Streptococcus, Lactococcus, Enterococcus, Weissella genera. *Vestn. Biotekhnol. Fiz.-Khim. Biol.* 6(4):13-18.
- GORSKAYA EM, LIZKO NN, LENZHER AA, BONDARENKO VM, SOKOLOVAKYA, LIKHACHEVA AYU. (1992) Biological characteristics of eubiotic candidate Lactobacillus strains. *Zh. Mikrobiol., Epidemiol. Immunol.* (3):17-20.
- LYKOVA EA. (2000) Antibiotic resistance of strains, components of probiotic preparations. *Mikrobiol. Zh.* (2):63-65.
- PIKINA A.P, SMEIANOV VV, EFIMOV BA, BAĀNOV NA, BROOK I, REEVES G, KORSHUNOV VM. (1999) The primary screening of bifidobacteria and lactobacilli strains to develop effective probiotic preparations based on them. *Zh. Mikrobiol., Epidemiol. Immunol.* (6):34-38.
- JENSEN MA, WEBSTER JA, STRAUS N. (1993) Rapid identification of bacteria on the basis of polymerase chain reaction-amplified ribosomal DNA spacer polymorphisms. *Appl. Environ. Microbiol.* 59(4): 945-952.
- MILTEVA V, BOUDAKOV I, IVANOVA-STOYANCHEVA G, MARINOVA B, MITEV V, MENGAUD J. (2001) Differentiation of lactobacillus delbrueckii subspecies by ribotyping and amplified ribosomal DNA restriction analysis (ARDRA). *J. Appl. Microbiol.* 90(6): 909-918.
- AFONYUSHKIN V. N., TROMENSHLEGER I. N., FILIPPENKO M. L., KHRAPOV E. A., AND DUDAREVA E. V. (2016) Antagonistic Activity of Intestinal Lactobacteria from Domestic Fowl against Clinical Isolates of Salmonella enteric Bulletin of Experimental Biology and Medicine, Vol. 161, No. 6, October, 2016, P 801-803

**SESSION-4**  
**NUTRITION II**

**INVITED PRESENTATION**

## Effect of PhytoGenics on Heat Tolerance

Jan Dirk van der Klis, Andreas Müller

Delacon Biotechnik GmbH, Weissenwolfstrasse 14, 4221 Steyregg, Austria  
[jandirk.vanderklis@delacon.com](mailto:jandirk.vanderklis@delacon.com)

### Abstract

Heat stress causes major economic losses to the poultry industry as it reduced production performance and decreases product quality. Heat stress not only results in reduced body weight gain by limiting feed intake, but also has many indirect effects via increased oxidative stress and changed expression of pro- and anti-inflammatory cytokines. PhytoGenics (plant-derived bio-active compounds) exert a wide variety of biological responses in poultry to counteract negative effects of heat stress in birds. Tested ginsenosides improved heat tolerance of nematodes and cellular repair mechanisms of Caco2 cells during heat stress. These *in vitro* data corroborated with improved broiler performance during heat stress.

### Introduction

As the major part of the global expansion area for poultry meat and egg production lies in (sub)tropical countries, economic consequences of heat stress will increase accordingly. Also, in more temperate zones, weather conditions become more extreme, resulting in an increasing number of days per year with high ambient temperatures. Heat stress is already considered as one of the major stressors associated economic losses to the poultry industry (Rimoldi *et al.*, 2015), as it adversely effects bird performance, meat and egg quality, digestion and post-absorptive utilization of nutrients, intestinal integrity, and immunocompetence (Van der Klis and Vinyeta, 2015).

Improving heat tolerance of birds is essential to reduce its economic impact. Although birds are partially able to adapt to high ambient temperatures (either or not in combination with a high relative air humidity), their adaptive capacity is reduced with genetic selection for increased production performance (e.g. Soleimani *et al.*, 2011), further aggravating the physiological consequences of heat stress. However, a higher heat tolerance in slow versus fast growing broilers could not be demonstrated by Rimoldi *et al.* (2015).

Although reduced feed intake of broilers during heat stress was thought to be the main cause for reduced production performance, it 'only' accounts for max. 35% of lower body weight gain (Bonnet *et al.*, 1997). Apparently other metabolic effects of heat stress are more important. Some recent studies were focused on understanding the underlying mechanisms of heat stress response: Quinteiro-Filho *et al.* (2017) showed that increased corticosterone

levels during heat stress impaired the host resistance to *Salmonella* induced infections, which was corroborated by changes in the mRNA expression of pro- and anti-inflammatory cytokines, avian  $\beta$ -defensins, and toll-like receptor 2. As a consequence, they found increased *Salmonella* invasions in the spleen, liver and bone marrow during heat stress. Balhadj Slimen *et al.* (2016) concluded in their review that the steady state concentration of intracellular free radicals is disturbed during heat stress, resulting in mitochondrial and cellular oxidative damage. Reduction of oxidative stress due to high ambient temperatures has been an important mode of action developing effective feed additives to improve heat tolerance.

### **Potential of phytochemicals counteracting heat stress**

Phytochemicals compounds are plant-derived natural bioactive compounds, which comprise essential oils, botanicals and herbal extracts. Positive effects of dietary supplementation with phytochemical actives have been shown on animal growth and health and a wide variety of different modes of action have been described in literature, like improved nutrient digestion (Amad *et al.*, 2010), reduced cellular oxidative stress (Müller *et al.*, 2012), improved intestinal integrity (Placha *et al.*, 2014) and immunocompetence (Zhai *et al.*, 2014). As such, phytochemicals might counteract many of the adverse effects of heat stress that are described above. Understanding their modes of action helps designing a new category of effective feed additives, reducing the impact of heat stress in meat and egg-producing birds.

### ***In vitro* screening**

In our laboratory, we are screening phytochemical actives *in vitro* for their efficacy to improve heat tolerance, based on the survival rate of the heat-stressed nematode *C. elegans* and response of heat-exposed Caco2 cells.

Prior to the heat-stress period, *C. elegans* worms in the L1 larval stadium were incubated at 20°C in 96-wells plates for 3 days. After reaching maturity, graded levels (0, 52.5, 85 and 170 mg/L) of ginseng extract were added to the incubation medium. Forty-eight hours later, the worms were exposed to heat stress (37°C) and their survival rate was evaluated every 30 min until all worms died. The result of the intermediate concentration of ginseng extract is given in Figure 1. Supplementation of ginseng extract extended the life span of *C. elegans* significantly ( $P < 0.001$ ) during heat stress with all dosed levels. Follow-up studies with *C. elegans* showed that ginseng extract increased the nuclear translocation of DAF-16, which indicated an improved cellular anti-oxidant response and expression for several heat shock proteins.

Next, the effect of graded levels of ginseng extract was evaluated in heat-stressed human Caco2 cells, using heat shock protein 70 (HSP70) and the tight junction protein Claudin-1 as response parameters. After completion of

the differentiation of the Caco2 cells, these cells were incubated at 37°C with graded levels (0, 52.5, 85 and 170 mg/L) of the same ginseng extract. Fifteen hours later, the temperature was increased to 41°C and the mRNA expression for HSP70 and Claudin-1 was determined by rtPCR. The mRNA expression of HSP70 during heat stress was significantly upregulated with increasing ginseng extract dose levels, whereas it was downregulated at normal temperatures. mRNA expression of Claudin-1 was downregulated by heat stress, an effect that could be prevented by the ginseng extract. However, total expression of mRNA of Claudin-1 was reduced with increasing ginseng extract dose levels with and without heat stress.

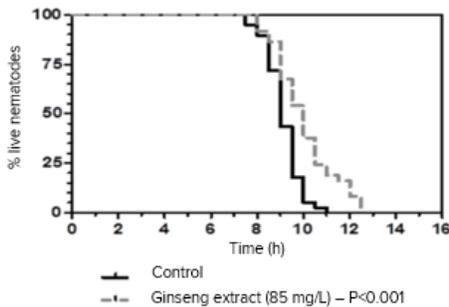


Figure 1. The effect of ginseng extract on the heat-tolerance of *C. elegans* (Müller et al., 2017)

These data confirmed that ginseng extract improved heat tolerance of nematodes and improved cellular repair mechanisms of Caco2 cells during heat stress.

### ***In vivo* validation with broilers**

One hundred and eighty one-day old male Cobb 500 broilers were allocated to four experimental treatments based on body weight (average body weight 43.3±1.3g). Broilers were housed in floor pens (15 broilers per pen, 3 pens per treatment) on wood shavings. Broilers had free access to feed (corn/wheat/soya diet) and drinking water. Treatments comprised an unsupplemented negative control, a positive control with 1.0 g/kg Actibeet® (Agrana, Tulln, Austria), containing 50% natural betain from suger beet, and 1.0 and 2.0 g/kg ginseng extract (4.5% Ginsenosides, MB-Holding, Vestenberggreuth, Germany), resulting in a ginsenosides dose level of 45 and 90 mg/kg. Ginsenosides are triterpene saponins from ginseng. During the second half of the production period, a daily cyclic heat stress was applied (34°C from 9 am till 5 pm and 26°C from 7 pm till 7 am. The remaining 2h periods were used to increase or decrease the ambient temperature to day and night levels). Daily light schedule consisted of 16h light alternated with 8h darkness. Results are given in Table 1.

Table 1. Production performance of Cobb 500 broilers for 42 days. Broilers were challenged by a cyclic daily heat stress in the second half of the production period (day 21 to 42) (Müller et al., 2017).

	Negative control (no additive)	ActiBeet® 1000 mg/kg	Ginsenosides 45 mg/kg	Ginsenosides 90 mg/kg
Body weight d 42 (g)	1966±74.9	2034±48.0	2082±53.1*	2062±58.2*
Average daily gain (g/d)	45.8±1.78	47.4±1.11	48.5±1.23*	48.1±1.38*
Daily feed intake (g/d)	65.4±1.47	65.7±1.43	66.2±1.08	65.1±1.89
FCR (g/g)	1.429±0.038 <sup>a</sup>	1.387±0.026 <sup>ab</sup>	1.364±0.014 <sup>b</sup>	1.354±0.006 <sup>b</sup>

<sup>a,b</sup> Different superscript letters indicate significant differences between treatment means (P<0.05); \* Tendency for difference to the negative control (P<0.10)

Ginseng extract improved production performance of heat-stressed broilers over the negative control, as shown by feed conversion ratio (P<0.05) and average daily gain (P<0.10). Response in the ginseng extract treated groups was not significantly higher than the positive control. Addition of ginger root powder to diets of heat-stressed broilers increased superoxide dismutase contents in the liver and reduced fatty acid oxidation in serum and liver (Habibi *et al.*, 2014).

### Conclusions

Phytogenics (plant-derived bio-active compounds) exert a wide variety of biological responses in poultry. Many of those effects can potentially counteract negative effects of heat stress in birds, via increasing anti-oxidant capacity, improved immunocompetence and nutrient digestion and utilization, thus reducing the economic impact of high ambient temperatures on production performance and product quality. Ginsenosides improved heat tolerance of nematodes and cellular repair mechanisms of Caco2 cells during heat stress. These *in vitro* data corroborated with improved broiler performance during heat stress.

### References

- Amad, AA, K Männer, KR Wendler, K Neumann and J Zentek (2011). Effects of a phytogenic feed additive on growth performance and ileal nutrient digestibility in broiler chickens. *Poultry Sci* 90: 2811–2816.
- Bonnett, S, PA Geraert, M Lessire, B Carré and S Guillaumin (1997). Effect of high ambient temperature on feed digestibility in broilers. *Br. Poultry Sci.* 76: 857-863.

- Müller, K, NM Blum, H Kluge and AS Müller (2012). Influence of broccoli extract and various essential oils on performance and expression of xenobiotic-and antioxidant enzymes in broiler chickens. *Br. J. Nutr.* 108: 588-602.
- Müller, AM, X Zhou, E Vinyeta, T Aumiller and JD van der Klis (2017). Ginseng extract ameliorates negative physiological effects of heat stress by supporting heat shock response and improving intestinal barrier integrity. In: Proc. of the 14<sup>th</sup> Tagung Schweine- und Geflügelernährung, November 2017, Wittenberg, Germany.
- Placha, I, J Takacova, M Ryzner, K Cobanova, A Laukova, V Strompfova, K Venglovska, and S Faiz (2014). Effect of thyme essential oil and selenium on intestine integrity and antioxidant status of broilers. *Br. Poultry Sci* 55: 105-114.
- Rimoldi, S, E Lasagna, FM Sarti, SP Marelli, MC Cozzi, G Bernardini and G Terova (2015). Expression profile of six stress-related genes and productive performances of fast and slow growing broiler strains reared under heat stress conditions. *Meta Gene* 6: 17-25.
- Belhadj Slimen, I, T Najjar, A Ghram and M Abdrrabba (2016). Heat stress effects on livestock: molecular, cellular and metabolic aspects, a review. *Anim. Physiol. Anim. Nutr.* 100: 401-412.
- Soleimani, AF, I Zulkifi, AR Omar and AR Raha (2011). Physiological responses of three chickend breeds to acute heat stress. *Poultry Sci* 90: 1435-1440.
- Quinteiro-Filho, WM, AS Calefi, DSG Cruz, TPA Aloia, A Zager, CS Astolfi-Ferreira, JA Piantino Ferreira, S Sharif and J Palermo-Neto (2017). Heat stress decreases expression of the cytokines, avian  $\beta$ -defensins 4 and 6 and Toll-like receptor 2 in broiler chickens infected with *Salmonella enteritidis*. *Vet. Imm* 186: 19-28.
- Van der Klis, JD and E Vinyeta (2015). Effects of heat stress on production performance, intestinal integrity and meat quality in broilers and potential nutritional interventions. In: Proc. of the 3<sup>rd</sup> International Poultry Meat Congress, April 2015, Antalya, Turkey, pp 169-173.
- Zhai, L, Y Wang, J Yu and S Hu (2014). Enhanced immune responses of chickens to oral vaccination against infectious bursal disease by ginseng stem-leaf saponins. *Poultry Sci.* 93: 2473-2481.

**SESSION-4**  
**NUTRITION II**

**SHORT ORAL PRESENTATIONS**

## Predicting the Weights of The Body Parts of Two Strains of Growing Turkeys Using Allometry

R.M. Gous<sup>a</sup>, C. Fisher<sup>b</sup>, E. Tumova<sup>c</sup>, V. Machander<sup>d</sup>

<sup>a</sup>University of KwaZulu-Natal, Private Bag X01, Scottsville, 3209, South Africa.

<sup>b</sup>EFG Software, Edinburgh, Scotland, U.K.

<sup>c</sup>University of Life Sciences Prague, Czech Republic.

<sup>d</sup>International Testing Station Ústřašice, Czech Republic

### Abstract

Using weights of breast, breast skin, drum, drum skin, thigh, thigh skin and wing-plus-skin and the protein content of each bird obtained on nine occasions during growth to 20 w the allometric relationships between these components and body protein of male and female BUT and Hybrid Converter turkey strains were examined. These equations enable the accurate prediction of the weights of these physical components given the weight of body protein. The proportions of the body of the turkey have not been modified by genetic selection: differences in body lipid content account for the observed differences at a given protein weight.

**Key Words:** *Body protein, Breast, Drum, Thigh, Wing*

### Introduction

A general problem in growth analysis is to be able to predict the effects of genotype, feed and environment on the yield of body components such as breast, thigh, drum and wing meat. Such predictions may be accomplished directly, using a growth function specific to each component (for an example in broilers see Goliomytis *et al.*, 2003), or indirectly, by predicting the growth of the component as a proportion of body protein growth. The general case for using feather-free body protein as a predictor was made by Emmans and Fisher (1986). What is needed for each genotype is a description of the potential rates of growth of body protein and of the different components of the body so that the allometric relationships between the components and body protein can be determined. Differences in the allometric relationships between genotypes, or those brought about through nutritional or environmental manipulation, would enable these effects to be modelled.

Knowledge of these relationships would be invaluable for predicting the weights of the commercially important physical components of a turkey, as it means that only the weight of body protein needs to be predicted, after which the weights of all the remaining chemical and physical components of the body can be calculated using the appropriate allometric coefficients. Such relationships have been published for broilers (e.g. Danisman & Gous,

2011; 2013) but there are few data for turkeys. Emmans (1989) related several commercial components e.g. white and dark meat to body bone weight.

In the trial reported here the relationships between body protein and some important components of the body in two turkey strains and two sexes were determined. No other such data have been found to exist for direct comparison.

### **Materials and Methods**

A growth trial in which males and females of BUT and Hybrid Converter turkeys were reared separately was conducted at the Mezinardni Testovani Drubeze, Tobor, Czech Republic. Six males and six females from each strain were removed for carcass evaluation at 0, 1, 2, 3, 5, 8 and 11 w, with further samples of males being taken at 17 and 20 w, and females at 18 w of age. The birds sampled were fasted overnight, each bird was then weighed before being stunned electrically, exsanguinated (blood was collected and weighed), dipped in hot water around 65°C for 1 min, and then defeathered. Birds were re-weighed before being eviscerated and dissected. The thigh, drum, wing and breast from the hot carcass was weighed and recorded. Skin was removed from the breast, thigh and drum and weighed separately. Whereas both feet, drums, thighs and wings were weighed, the mean of these two weights was used in determining the allometric relationships between these parts and body protein weight.

After all separate parts were weighed individually, all the parts other than the feathers were gathered together, minced, and then sampled for chemical analysis. Each composite sample was analysed for water (freeze-dried), protein (as N using the Dumas method on a LECO N analyser, AOAC, 2003), ash (AOAC, 2003), body lipid (Soxhlett extraction, AOAC, 2003) and gross energy (GE) using an adiabatic bomb calorimeter.

Data were subjected to statistical analysis using analysis of variance for calculation of treatment means, and simple linear regression of the form  $\ln Y = a + b \ln X$  using natural logarithms ( $\ln$ ) of both the component (Y) and body protein (X) weights to determine the allometric coefficients. Main effects and two-way interactions between strain and sex were compared using linear regression with groups (GenStat, VSN International 2017).

### **Results**

Allometric coefficients (constant term and regression coefficient) with standard errors (s.e.) relating the  $\ln$  of the individual weights of the seven physical parts of male and female BUT and Hybrid Converter turkeys to the  $\ln$  of body protein content are given in Table 1. There were instances where the regressions differed significantly between either the strains or the sexes and these are shown in the table. For example, both the constant term and regression coefficient differed between male and female turkeys in

describing breast skin weight in terms of body protein weight, with females having a higher constant term and steeper slope than males, whereas in the case of drum and wing weights only the female Hybrid turkeys differed, in each case having a lower constant term and a steeper regression coefficient than the other three genotypes.

Table 1. Allometric coefficients (constant term and regression coefficient) with standard errors (s.e.) relating the *ln* of the individual weights of seven physical parts of male and female BUT and Hybrid Converter turkeys to the *ln* of body protein content

BP		Constant term		Regression coefficient		R <sup>2</sup>
		Mean	s.e.	Mean	s.e.	
Breast <sup>1</sup>		-0.6473	0.052	1.0916	0.0079	0.992
BS	M	-3.4590	0.173	1.0369	0.0285	0.959
	F	-3.2715	0.089	1.2812	0.0890	
Drum	M and F BUT	-1.5206	0.054	1.0124	0.0089	0.995
	Female Hybrid	-1.7335	0.082	1.0504	0.0141	
DS		-4.2860	0.101	0.9763	0.0163	0.953
Thigh		-1.4987	0.039	1.0359	0.0067	0.992
TS	Males	-4.8470	0.220	1.0599	0.0343	0.954
	F BUT	-5.5150	0.329	1.1922	0.0536	
	F Hybrid	-5.8710	0.034	1.2629	0.0558	
WS	M and F BUT	-1.4405	0.073	1.0064	0.0120	0.992
	Female Hybrid	-1.6785	0.110	1.0473	0.0191	

BP: Body part, BS: Breast skin, DS: Drum skin, TS: Thigh skin, WS: Wing and skin, M: Males, F: Females, <sup>1</sup> data for days 0 and 7 excluded

Mean feather-free body protein weights differed significantly ( $P < 0.001$ ) between strains, sexes and ages at sampling. Hybrid males and females had heavier body protein weights than BUT turkeys up to 56 d after which BUT turkeys were heavier at each age. Body protein weights of males were consistently heavier than those of females.

All body parts other than breast weight were allometrically related to body protein weight, but an exponential equation best fitted the relationship between *ln* breast weight and *ln* body protein weight when all the data were included. By excluding breast weights at day-old and at 7 d the remaining points produced an acceptable allometric relationship (see Table 1:  $R^2 = 0.992$ ). Thigh weight could be predicted for all strain x sex combinations using one allometric equation, as could drum skin weight. Breast skin and thigh skin weights differed between males and females, with thigh skin weight also differing between the females of the two strains, thereby yielding three allometric equations to describe this component. Females of the Hybrid Converter strain exhibited heavier drum and wing-plus-skin weights at a given body protein weight than the other three strain x sex combinations. These differences in both the constant term and regression coefficient in the allometric equations between genotypes are probably due

to differences in the amount of lipid that is deposited in these tissues. Support for this hypothesis is provided by the higher body lipid content of Hybrid Converter females at 126 d of age than in the other strain x sex combinations.

Whereas the allometric relationship for breast weight is improved by excluding data from days 0 and 7, when all the data are included the following exponential equation fitted the data better ( $R^2 = 0.989$ ) than an allometric equation ( $R^2 = 0.952$ ):

$$\ln \text{ Breast weight} = 11.82 (\pm 0.305) - 18.307 (\pm 0.151) * 0.82296 (\pm 0.0071) ^ \ln \text{ Body protein weight}$$

## Discussion

The weights of all the components measured in this trial differ largely between males and females, and in some cases the components up to 56d are heavier in one strain than the other but then become lighter than in the other strain as the birds age. These differences are important commercially as they represent saleable parts of the body when the birds are harvested and further-processed. Being able to predict the weights of these components at any given age is therefore a useful goal when modelling the growth of turkeys.

The allometric relationships described here enable the weights of the commercially important physical parts of the body to be described in terms of the body protein weight of the turkey at any stage during the growth of the bird. Such relationships are useful when modelling the growth of turkeys as it is necessary only to simulate the growth of feather-free body protein to be able then to predict the weights of these saleable parts of the turkey. The relationships and discrepancies presented here are similar to those addressed by Danisman & Gous (2011; 2013): in many cases there were no differences in the allometric relationships between males and females of the two strains used, but where differences existed these could be explained by the females having deposited greater amounts of lipid in the tissues thereby increasing the weight of the component at a given body protein weight; and the observation that breast weights fell below the anticipated linear regression in the early part of the growing period.

It is interesting to speculate as to the reason for the lower than expected breast weights during the early growing period. It is possible that either energy or protein is lacking during the latter part of incubation and that the breast becomes the supplier of the limiting resources. Only once the chick or poult has hatched and received sufficient nourishment to enable the breast tissue to be replenished is the allometric relationship between breast and body protein weight established. Noy & Sklan (1998) and Halevy et al. (2000) have shown that breast meat weights at day-old are heavier when chicks have had access to food prior to being removed from the incubator, which suggests that the breast muscle may be used to supply nutrients to the body during this period.

## Conclusion

In spite of considerable effort having been applied by geneticists to increase the breast meat yield of turkeys the allometric relationship between breast weight and body protein weight is the same for males and females of the two strains used in this trial. Similarly, with few exceptions that can be accounted for, the weights of the other physical components of the body, namely, drum, thigh and wing, are also related to the body protein content of the turkey. Differences in the rate of deposition of lipid in the tissues of the body between strains account for these anomalies. This means that genetic selection has not changed the relative proportions of the components of the turkey, and that single equations may, in most cases, be used to describe the growth of these components in terms of the body protein content at a time.

## References

- ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS (AOAC) (2004) Official methods of analysis, volume 2, 18th edition. AOAC, Arlington, VA, USA.
- DANISMAN, R. and GOUS, R.M. (2011) Effect of dietary protein on the allometric relationships between some carcass portions and body protein in three broiler strains. *South African Journal of Animal Science* 41: 194 - 208.
- DANISMAN, R. and GOUS, R.M. (2013) Effect of dietary protein on performance of four broiler strains and on the allometric relationships between carcass portions and body protein. *South African Journal of Animal Science* 43: 25 – 37.
- EMMANS, G.C. (1989) The growth of turkeys, in: Nixey, C., Grey, T.C. (Eds) *Recent Advances in Turkey Science*, pp. 135-166 (Butterworths, London).
- EMMANS, G.C. and FISHER, C. (1986). Problems in Nutritional Theory. In: Fisher, C. and Boorman, K.N (Eds) *Nutrient Requirements of Poultry and Nutritional Research*, pp. 9 - 40 (Butterworths, London).
- GOLIOMYTIS, M., PANOPOULOU, E. and ROGDAKIS, E. (2003) Growth curves for body weight and major component parts, feed consumption, and mortality of male broiler chickens raised to maturity. *Poultry Science* 82: 1061–1068.
- HALEVY, O., GEYRA, A., BARAK, M., UNI, Z. and SKLAN, D. (2000) Early posthatch starvation decreases satellite cell proliferation and skeletal muscle growth in chicks. *Journal of Nutrition* 130: 858 – 864.
- NOY, Y. and SKLAN, D. (1998) Yolk utilisation in the newly hatched poultry. *British Poultry Science* 39: 446-451.
- VSN INTERNATIONAL (2017) *GenStat. Release 18.1*. Rothamsted Experimental Station. (Clarendon Press: Oxford, UK).

## Diet Ca and P levels affect early bone development of broilers without any deterioration in growth performance

Canan Kop-Bozbay<sup>a</sup>, Ahmet Akdağ<sup>b</sup>, Helin Atan<sup>a</sup>, Lütfi Bayyurt<sup>b</sup>

<sup>a</sup>Eskisehir Osmangazi University, Animal Science Department, Eskisehir, Turkey

<sup>b</sup>Ondokuz Mayıs University, Animal Science Department, Samsun, Turkey

### Abstract

Study was conducted to evaluate the effects of calcium (Ca) and nonphytate phosphorus (P) concentration on growth performance with some blood and bone parameters of broilers in starter (1-21d) period. After the first 21-day feeding period, no differences were observed for body weight (BW) but feed intake (FI) and feed conversion ratio (FCR) were higher in group having higher Ca and P ( $P<0.05$ ). Different Ca and P level had a significant effect on tibia and sternum weight ( $P<0.05$ ). It can be concluded that 6.2 g/kg Ca and 3.1 g/kg P can be used for starter period without any deterioration on growth performance.

**Keywords:** Blood, Bone, Broiler, Performance, Starter

### Özet

Rasyon Ca ve P içeriği başlangıç döneminde etlik piliçlerin büyüme performansını etkilemeksizin kemik gelişimini etkiler Bu çalışma etlik piliç başlangıç karmalarının kalsiyum (Ca) ve fitin formunda olmayan fosfor (P) konsantrasyonunun 1-21 günler arasındaki büyüme performansı ile bazı kan ve kemik parameterleri üzerine etkisini incelemek amacıyla yürütülmüştür. Başlangıç döneminin sonunda karma Ca ve P seviyesi canlı ağırlığı etkilemezken ( $P>0.05$ ), yem tüketimi ve yemden yararlanma oranı üzerine etkisi önemli olmuştur ( $P<0.05$ ). Ayrıca tibia ve sternum ağırlıkları yem Ca ve P seviyesinden etkilenmiştir ( $P<0.05$ ). Çalışmanın sonuçları göre etlik piliç başlangıç yemlerinde büyüme performansında gerileme olmaksızın 6.2 g/kg Ca ve 3.1 g/kg P seviyelerinin kullanılabileceğini göstermiştir.

**Anahtar kelimeler:** Başlangıç Dönemi, Etlik Piliç, Kan, Kemik, Performans

### Introduction

A number of studies have reported that Ca/P ratio and level are both essential for bone development and growth performance of broilers (Driver et al., 2005; Rama Rao et al., 2006; Selle et al., 2009; Han et al., 2016). The majority of plant sourced P is present in the form of phytate and %28.2 of the total P is called nonphytate P (NPP) in plants (Ravindran et al., 1995).

Poor solubility causes the low absorption of phytate by broilers (Wilkinson et al., 2014a). Limestone and dicalcium phosphate are the main supplements for providing Ca and P, respectively. Acid binding capacity of the limestone induces poor gizzard solubility of proteins and P (Walk et al., 2012). Decreasing of P from 4.5 g/kg to 3.0g/kg has led to a development in P availability in 0-18 period P retention had a %13 improvement at 32 days of age. This development can be explain with the ability of broilers to adaptation of early diet mineral restrictions (Yan et al., 2005).

The present study was conducted to determine the effect of five different Ca and P levels for starter period on growth performance, bone development with some serum parameters.

### **Material and methods**

A total of 600 feather-sexed one-day-old Ross 308 broilers were randomly allocated to 5 dietary treatments with 5 replicates for a 21-d study. Corn-soybean meal based diets were consisted of five different Ca and P concentrations for starter period. Higher, high, medium, low and lower Ca and P levels in starter period were 9.5-4.75, 8.5-4.27, 7.7-3.85, 6.9-3.45 and 6.2-3.1 g/kg, respectively. Birds were checked 4 times in a day and mortalities were recorded. On day 9 and 13 birds were vaccinated against infectious bursal disease and Newcastle disease, respectively. Mortalities were considered while FCR was calculating. At day 21, 10 chicks, representing the average weight of the group (1 male-1 female from each replicate) were slaughtered from each group. Blood samples were collected and centrifuged at the same time. Left tibias and sternums were collected. Bones were waited at 4°C for 24 h. After 24 h, bones were dried at 105 °C for 3 h to clean the residues. Bone weights were determined after cleaning and one more drying process.

### **Results**

The effects of different Ca and P levels on growth performance were presented in Table 1. Calcium and P levels had no significant effect on body weight ( $P>0.05$ ). Feed intake of 21 days of age were effected from Ca and P levels ( $P<0.05$ ), the highest FI was obtained from group fed higher Ca and P. Different Ca and P had no significant effect on mortality ( $P>0.05$ ). Feed conversion ratio of 21 days of age had a significant difference among treatments ( $P<0.05$ ) and the worst FCR values were obtained from the group which was fed with higher Ca and P.

Serum Ca and P concentrations and ALP and AST enzyme activity values were presented in Table 1. There were no treatment differences in serum parameters ( $P>0.05$ ). The effects of different Ca and P levels on bone development are presented in Table 1. There were significant differences in tibia and sternum weights ( $P<0.05$ ). Tibia weight decreased in proportion

with Ca and P level. The lowest tibia weight was obtained from group fed with lower Ca and P. Sternum weight was the highest in high group ( $P < 0.05$ ).

**Conclusion**

From the data of the current experiment, it can be concluded that 6.2 g/kg Ca and 3.1 g/kg P can be used for starter period without any deterioration on growth performance. Cost of DCP, potential problems of P reserves, enviromental pollution existing from fecal P and economic reasons can be an incentive factor for researchers to finding ways to decrease Ca and P levels in broiler diets.

The possiblities of decreasing Ca and P levels with or without any enzyme supplementation, adaptation abilibty of broilers to early restrictions and interaction between bone development and enzyme activities and grower period reactions to early mineral restrictions should be subjects of new researches.

Table 1. Body weight, feed intake, feed conversion ratio, serum calcium-phosphorus concentration and aspartate transaminase, alkaline phosphatase enzyme activities, tibia and sternum weights of broilers fed diets having different Ca and P levels in starter period.

		Ca- P level of diets						
		Higher	High	Medium	Low	Lower	SEM <sup>1</sup>	P
BW <sup>2</sup> , g		753.66	753.85	769.09	770.63	767.91	5.45	0.777
FI <sup>3</sup> , g		1102.1 <sup>a</sup>	1045.8 <sup>b</sup>	1051.2 <sup>b</sup>	1059.2 <sup>ab</sup>	1044.2 <sup>b</sup>	7.74	0.039
FCR <sup>4</sup>		1.46 <sup>a</sup>	1.39 <sup>b</sup>	1.37 <sup>b</sup>	1.37 <sup>b</sup>	1.36 <sup>b</sup>	0.01	0.015
S	Ca	10.935	10.950	10.883	10.716	11.333	0.12	0.626
	P	8.400	8.933	9.000	8.450	7.883	0.17	0.280
	ALP <sup>5</sup>	3989.3	4446.0	4657.0	3919.0	3889.0	243.06	0.823
	AST <sup>6</sup>	172.50	214.16	242.83	189.50	194.50	12.61	0.481
TW		1.668 <sup>a</sup>	1.457 <sup>b</sup>	1.423 <sup>b</sup>	1.321 <sup>bc</sup>	1.193 <sup>c</sup>	0.03	<0.001
SW		0.653 <sup>ab</sup>	0.687 <sup>a</sup>	0.579 <sup>b</sup>	0.569 <sup>b</sup>	0.595 <sup>b</sup>	0.01	0.028

S: Serum, TW: Tibia weight (g), SW: Sternum weight (g), <sup>a, b</sup>Values within a column not sharing the same superscript are different at  $P < 0.05$ , SEM<sup>1</sup> =Standart error of means, BW<sup>2</sup> = Body weight, FI<sup>3</sup> =Feed intake, FCR<sup>4</sup>= Feed conversion ratio, ALP<sup>5</sup>=Alkaline phosphatase, AST<sup>6</sup>=Aspartate transaminase

**References**

DELEZİE, E., BİERMAN, K., NOLLET, L., MAERTENS, L. (2015). Impact of calcium and phosphorus concentration, their ratio and phytase supplementation level on growth performance, food pad lesions and hock burn of broiler chickens. J Appl Poultry Res, 24:115-126.

HAN, J., WANG, J., CHEN, G., QU, H., ZHANG, J., SHÍ, C., YAN, Y., CHENG, Y. (2016). Effects of calcium to non-phytate phosphorus ratio and different sources of vitamin D on growth performance and bone mineralization in broiler chickens. Rev Bras Zootecn, 45(1):1-7, (2016).

- RAMA RAO, S.V., RAJU, M.V.L.N., REDDY, M.R., PAVANI, P. (2006). Interaction between dietary calcium and non-phytate phosphorus levels on growth, bone mineralization and mineral excretion in commercial broilers. *Anim Feed Sci Technol*, 131:135– 150.
- RAVINDRAN, V., KORNEGAY, E.T., POTTER, L.M., OGUNABAMERU, B.O., WELTEN, M.K., WILSON, J.H., POTCHANAKORN, N. (1995). An Evaluation of Various Response Criteria in Assessing Biological Availability of Phosphorus for Broilers, *Poultry Sci*, 74(11): 1820-1830.
- SELLE, P. H., COWIESON, A.J., RAVINDRAN, V. (2009). Consequences of calcium interactions with phytate and phytase for poultry and pigs. *Livestock Sci*, 124:126-141.
- WALK, C. L., ADDO-CHIDIÉ, E.K., BEDFORD, M.R., ADEOLA, O. (2012). Evaluation of a highly soluble calcium source and phytase in the diets of broilers chickens, *Poultry Sci*, 91:2255–2263.
- WILKINSON, S.J., SELLE, P.H., BEDFORD, M.R., COWIESON, A.J. (2014a). Separate feeding of calcium improves performance and ileal nutrient digestibility in broiler chicks. *Anim Prod Sci*, 54:172-178.
- YAN F., ANGEL, R., ASHWELL, C., MITCHELL, A., CHRISTMAN, M. (2005). Evaluation of broiler's ability to adapt to an early moderate deficiency of phosphorus and Calcium. *Poultry Sci*, 84:1232-1241.

## Supplementary Polyphenols Improved the Welfare of Heat Stressed Broilers Under Different Protein Matrix

Gopi, M<sup>a</sup>., Dutta, N<sup>b</sup>., Jaydip, J.R<sup>c</sup>, Gautham, K<sup>d</sup>.,  
Khillare, G.S<sup>e</sup>, Mohan J<sup>f</sup>.

<sup>a,c,d</sup>Scientist, <sup>b,f</sup>Principal Scientist, <sup>e</sup>PhD., Scholar  
ICAR-Central Avian Research Institute, Izatnagar, India – 243 122

### Abstract

Polyphenols on stress indicators and immune response under heat stress condition in broilers fed with different protein sources was described in the present study. 160 broiler chicks were allocated to four groups and reared under hot-humid environment. The first group was fed the broken rice-sorghum-soybean meal diet with polyphenol supplementation (PP) (T1). T2 =T1+ fish meal, T3=T2+50ppm PP and T4=T2+100ppm PP. The corticosterone, HL ratio and erythrocyte osmotic fragility (EOF%) was reduced ( $P<0.01$ ) in T1, T3 and T4 groups. PP supplementation improved ( $P<0.01$ ) the immune response in heat stressed broilers. PP supplementation improved the welfare of heat stressed broilers.

**Key words:** *Broilers, Heat Stress, Polyphenols, Protein Matrix, Welfare.*

### Introduction

To maintain the gut health of birds numerous dietary additives are being tried worldwide. Uses of probiotics, prebiotics, synbiotics, acidifiers, etc. are being used alone or in combination from time to time for the betterment of gut health. The use of polyphenols in animal production system is gaining importance over the recent years. Polyphenols (PP) are exhibit wide range of biological functions *viz.*, antioxidant, antimicrobial, gut modifying potential, etc. The PP are mostly derived from various sources – fruits, seed, peel, pomace, etc. The PP are mainly concentrated in the outer layer or pericarp of fruits/seeds. However, the studies revealed an inconsistent responses with regard to PP influence on the performance, immunity and gut health improved.

Similarly, the pomegranate (*Punica granatum*) is a deciduous shrub, widely cultivated in India. Pomegranate peels possess anti-oxidant, anti-inflammatory, anti-carcinogenic property and also promote wound healing. They also acts as potent inhibitor to the number of pathogenic organism like *Listeria monocytogenes*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella enteritidis*, etc. (Al-Zoreky, 2009). The exceptional antioxidant potential and strong medicinal properties of pomegranate peels led the

international scientific community to initiate intensive research in the last decade to further investigate its role in human health (Lansky and Newman, 2007).

Spatially, poultry production in tropical region is becoming a difficult activity with the increasing in surface temperature which leads to poor feed conversion efficiency, production of free radicals, immune insufficiency, several derangements in synthesizing antioxidant enzymes and corticosterone, imbalance in electrolyte balance and expression of heat shock proteins.

The polyphenols having the above said properties in addition to its anti-microbial activity could be exploited for improving the performance of birds especially under higher environmental temperature. However, few studies on the use of polyphenols extracted from different sources showed varied results in terms of production performance which might be due to variability in quality and quantity of polyphenols, level of incorporation, presence of nutritional matrix, variability in ingredients usage (with their respective polyphenols) and method of extraction used. In this regard, very few studies on the use of polyphenols from pomegranate peels were carried out in chicken.

### **Materials and Methods**

Pomegranate peels were collected from nearby juice shops in Bareilly, Uttar Pradesh. Peels were dried for one week in sun light or in hot air oven at temperature below 40° C. After proper drying, the sizes of peels were reduced in mortar and pestle and subsequently grinded to fine powder. This powder was stored in air tight containers. Polyphenol extraction was done as per the method given by Althunibat *et al.* (2010). About 50 g of the grounded material was taken and shaken in 500ml of absolute methanol for 24 hours at room temperature (27-30°C), followed by filtration through four layers of gauze. This filtrate was centrifuged at 8000rpm for 15min and the clear supernatant was collected and the methanol was evaporated in an oven at 45°C or below. The dried powder was stored at 4°C in an air tight container.

160 broiler chicks were randomly allocated to four groups and reared for 42 d under hot-humid environment (Temp: 29-36°C; RH: 69-80%). The first group was fed the broken rice-sorghum-soybean meal diet with PP supplementation at 50ppm (T1). Second group fed rice-sorghum-soybean-fishmeal diet without PP supplementation (T2); third group fed T2+50ppm PP (T3) and fourth group was fed T2+100ppm PP (T4). The total phenolic content (TPC) of the extracts was determined by the colorimetric method of Cam *et al.* (2010). The haematological parameters (erythrocytes and leukocytes) were estimated by auto-blood analyzer (Abacus Junior Vet 5, USA). Packed cell volume (PCV) is the percentage of RBC mass to original

blood volume. PCV of whole blood was estimated with the help of microhaematocrit capillary centrifuge. Serum corticosterone assay was done using ELISA Kits purchased from Labor Diagnostika Nord (LDN), Nordhorn, Germany. The corticosterone ELISA Kit is a solid phase enzyme-linked immunosorbent assay (ELISA), based on the principle of competitive binding. The microtiter wells are coated with a polyclonal antibody directed towards an antigenic site on the corticosterone molecule. Erythrocyte osmotic fragility (EOF) was determined by Dacie's method (Buffenstein *et al.*, 2001) with following modification: Fresh heparinized blood (10 ml) was added to tubes containing 5 ml of 0.1, 0.5 and 0.9 per cent phosphate-buffered saline. The tubes were mixed and incubated at room temperature (24oC) for 30 min. After mixing, the suspension was centrifuged at 530 rpm for 5 min. The supernatant was measured colorimetrically at 540 nm with a spectrophotometer (Molecular Devices), using the blood in 0.9% saline as a blank.

EOF was expressed as: Haemolysis rate (%) = (OD value at 0.5% saline/OD value at 0.1% saline) X 100.

The heterophil lymphocyte ratio (HL ratio) was measured by counting the number of heterophils (analogue to neutrophils in mammals) and lymphocytes in freshly collected EDTA anticoagulant added blood (16 per treatment) at 42 d of age. The CMI response to PHA-P mitogen was evaluated by the method of Cheng and Lamont (1988). PHA-P (1mg/ml of PBS) was injected intra-dermally in the left foot web of 6 birds/groups. Right foot web of the same birds received 0.1 ml sterile PBS and thus served as control. The skin thickness of foot webs (right and left) of injected birds of each group was measure by a micrometer at 0 and 24h after injection of mitogen. The foot web swelling will be calculated by subtracting the skin thickness at 24 hours from that of 0h of injection of both foets. Foot web index (FWI) was calculated by subtracting the difference in thickness at 0 and 24h of mitogen injected foot web with the difference in thickness of control foot web at 0 and 24h. Humoral immune response was carried out to find the serum antibody concentration against NewCastle disease virus vaccine. At 7th of age all birds in the replicate were administered with NDV vaccine through ocular route. Blood collection was carried out on day 7 and 14 post-inoculation to assess the serum antibody concentration against NDV by enzyme linked immunosorbent assay (ELISA). The results were subjected to ANOVA single factor

## Results and Discussion

The MCH level was found to be significantly ( $P<0.05$ ) higher in birds fed T3 and T4 diets whereas MCHC was significantly ( $P<0.01$ ) higher in T3 diet at

28d of age. The differential leukocyte count and the monitoring of its changes in relation to effects of heat stress are an important part of the hematological profile of broilers (Ahmad and Sarwar, 2005). In this study, we also observed significantly ( $P<0.05$ ) higher concentration of hematological parameters (erythrocytes and leukocytes attributes) in birds fed with T3 and T4. Tehrani et al. (2012) observed that feeding fish meal improved the PCV, MCV, MCH, Lymphocytes and TP were more than control group. However, no effect of PPE supplementation on hematological parameters was evident.

The effects of different protein sources and PPE levels on heat stress indicators was assessed in term of HL ratio, serum corticosterone and Erythrocyte Osmotic Fragility % which is presented in Table 4.58. The HL ratio was found to be significantly ( $P<0.01$ ) higher in T2 (0.25) diet fed group as compared to T1 (0.17), T2 (0.13) and T4 (0.15) diet fed groups. Similarly, serum corticosterone level ( $\mu\text{g/L}$ ) was also found to be higher ( $P<0.01$ ) in birds fed with T2 (140.43) diet as compared to T3 (100.62), T1 (91.91) and T4 (75.73) diets. The erythrocyte osmotic fragility (%) was significantly ( $P<0.01$ ) decreased in PPE supplemented groups than un-supplemented groups (33.06, 32.21 31.10 vs 38.19). The heat stress indicators (HL ratio, serum corticosterone concentration and EOF %) were significantly ( $P<0.01$ ) lower in the supplemented groups (T1, T3 and T4) as compared to T2. The positive effects due to supplementation might be attributed to anti-oxidant activity of polyphenols. El-Damrawy (2014) fed 100 and 200ppm grape seed extract to heat stressed broilers and observed significant reduction in the circulating levels of HL ratio an indicator for extent of heat stress. Similarly, Mahmoud *et al.* (2015) revealed a significant decrease in the serum corticosterone levels in heat stressed broilers after supplementation of polyphenols derived from Propolis. EOF%, an indicator of oxidative stress in the erythrocyte membranes was reduced in present study might be due to antioxidant property of PPE as reported by Geng *et al.* (2004) who fed CoQ10, a lipophilic antioxidant to broilers.

The 24h post-injection CMI response (absolute and relative) was significantly ( $P<0.01$ ) higher in T3 and T4 (0.93, 0.90mm and 123.39, 122.74%) followed by T1 (0.85mm and 106.00%) and T2 (0.79mm and 94.29%), respectively. NDV antibody value at 14d was significantly ( $P<0.01$ ) higher value in T1 (2.00) and T4 (1.98) followed by T3 (1.51) and T2 (1.24), respectively. At 21d, significantly ( $P<0.05$ ) higher value was observed in T4 (2.46) and T3 (2.27) as compared to T1 (2.04) and T2 (1.88). Heat stress has been reported to affect both cell-mediated and humoral immunity in chickens (Niu *et al.*, 2009). However, the protein sources not influenced the HI response. The cell mediated immune response was significantly improved after dietary supplementation of PPE to the stressed broilers. Our results are in concurrence with Ross *et al.* (2001) who found

that 100ppm of *Punica granatum* fruit rind powder (PGFRP) stimulate the cell-mediated and humoral immune response and increasing antibody titer to typhoid-H antigen rabbits and PGFRP also exhibited *in vitro* antimicrobial activity.

Table 1. Effect of different protein sources and PPE levels on heat stress indicators in heat stressed broilers

P	Groups				SEM	P-value
	T1	T2	T3	T4		
HL	0.27 <sup>b</sup> ± 0.04	0.35 <sup>a</sup> ± 0.01	0.13 <sup>b</sup> ± 0.02	0.15 <sup>b</sup> ± 0.01	0.00	0.000
C	91.91 <sup>b</sup> ± 3.71	120.43 <sup>a</sup> ± 7.41	100.62 <sup>b</sup> ± 2.99	95.73 <sup>b</sup> ± 4.62	1.07	0.000
E	32.21 <sup>b</sup> ± 2.39	38.19 <sup>a</sup> ± 3.76	31.10 <sup>b</sup> ± 2.39	33.06 <sup>b</sup> ± 2.34	0.57	0.001

P: Parameters, HL: HL ratio, C: Corticosterone (µg/L), E: EOF (%), <sup>abc</sup>Means within column bearing different superscripts differ significantly (P<0.05), HL ratio: heterophil: lymphocyte ratio, EOF%: Erythrocyte osmotic fragility, %.

### Conclusion

The supplementation of polyphenols derived from pomegranate peels improved the stress indicators, immune response and thereby overall welfare in broilers exposed to heat stress. The effect of polyphenols were more predominant with birds fed with combination of protein (soybean-fishmeal) sources than the plant protein source alone.

### References

- AL-ZOREKY, N. (2009) Antimicrobial activity of pomegranate (*Punica granatum L.*) fruit peels. *International Journal of Food Microbiology* 134: 244-248.
- AHMAD, T. and SARWAR, M. (2005) Influence of varying sources of dietary electrolytes on the performance of broilers reared in a high temperature environment. *Animal Feed Science and Technology* 120(3-4): 277-298.
- ALTHUNIBAT, O.Y., AL-MUSTAFA, A.H., TARAWNEH, K., KHLEIFAT, K.M., RIDZWAN, B. and QARALLEH, H.N. (2010) Protective role of *Punica granatum L.* peel extract against oxidative damage in experimental diabetic rats. *Process Biochemistry* 45: 581-585.
- BUFFENSTEIN, R., MCCARRON H.C.K. and DAWSON, T.J. (2001) Erythrocyte osmotic fragility of red (*Macropus rufus*) and grey (*Macropus fuliginosus* and *Macropus giganteus*) kangaroos and free-ranging sheep of the arid region of Australia. *Journal of Comparative Physiology B* 171: 41-47.
- CHENG, S. and LAMONT, S.J. (1988) Breeding and Genetics: genetic analysis of immunocompetence in White Leghorn chicken line. *Poult. Sci.* 67: 989-995
- EI-DAMRAWY, S.Z. (2014) Effect of grape seed extractions on some physiological changes in broilers under heat stress. *Egyptian Poultry Science* 34: 333-343.
- GENG, A., GUO, Y. and YUAN, J. (2004) Effects of dietary L-carnitine and coenzyme Q10 supplementation on performance and ascites mortality of broilers. *Archives of Animal Nutrition* 58: 473-482.

- LANSKY, E.P. and NEWMAN, R.A. (2007) Punica granatum (pomegranate) and its potential for prevention and treatment of inflammation and cancer. *Journal of Ethnopharmacology* 109: 177–206.
- MAHMOUD, M.A.M., HOSNIA S., ABDEL-MOHSEIN, MOHAMED R.F. and FARGHALI. (2015) Antioxidant properties of chinese propolis in ross broilers exposed to heat stress. *Egyptian Journal of Veterinary Medicine* 5: 197-209.
- NIU, Z.Y., LIU, F.Z., YAN, Q.L. and LI, W.C. (2009) Effects of different levels of vitamin E on growth performance and immune responses of broilers under heat stress. *Poultry Science* 88: 2101–2107.
- ROSS, G.R., SELVASUBRAMANIAN, S. and JAYASUNDARS S. (2001) Immunomodulatory activity of Punica granatum in rabbits-a preliminary study. *Journal of Ethnopharmacology* 78: 85-87.
- TEHRANI, A., JAVANBAKHT, J., ASKARI, S., HASSAN, M.A., SOLATI, A., GOLAMI, S. and AKBARI, H. (2012) Haematological studies on broiler chickens fed with different levels of *Artemia urmiana*. *Journal of Biotechnology and Biomaterials* 2: 4.

## The Use of Potassium Carbonate in The Lysine-Deficient Broiler Diets

E. Andrianova<sup>a</sup>, I. Egorov<sup>a</sup>, A. Shevyakov<sup>a</sup>, E. Grigoryeva<sup>a</sup>,  
A. Kosterev<sup>b</sup>, D. Kuznetsov<sup>b</sup>

<sup>a</sup>All-Russian Research and Technological Institute of Poultry, Sergiev Posad, Russia  
<sup>b</sup>“Pikalyovskaya Soda” Co, Russia

### Abstract

It was found that supplementation of broiler diets with potassium carbonate enhances synthesis of endogenous protein due to the improvements in the digestibility of dietary amino acids. Potassium carbonate can be added to the diets at the doses from 1000 to 3000 ppm to lower the inclusion levels of synthetic lysine; this supplement was found to prevent amino acid imbalance and to improve productive performance and particularly feed conversion ratio in broilers.

**Key words:** *Broiler Chicks, Live Bodyweight, Amino Acids, Livability, Feed Efficiency.*

### Introduction

It is necessary to standardize the contents of certain microelements (calcium, phosphorus, sodium) in the commercial compound feeds for broilers since the ingredients of a diet cannot reliably guarantee the resulting concentrations of the elements in the final diets sufficient for the maintenance of high productive performance. Most broiler diets are sufficient in potassium (K) content and the additives of K salts are used in broiler diets rather for the correction of the electrolytic balance than to prevent its deficiency. Common sources of K in poultry diets are plant-derived feed ingredients, cakes, and meals. The recommended requirements in K to maintain the electrolytic balance are met at the dietary K levels 2.3-4.0 g/kg for growing chicken and 6 g/kg for turkey [1]. The effects of K deficiency are slowed growth, muscular weakness, intestinal atonia, cardiac dysfunctions; the excessive K supplementation promotes excessive water consumption [2].

Potassium plays different physiological roles in all cells of the body: it is an integral part of buffer systems within the body; it maintains normal osmotic pressure; it influences excitability in tissues; it promotes the digestive processes; it is involved in the processes of biosynthesis of proteins and glycogen; it slows the cardiac rhythm; it activates certain enzymes.

Earlier experiments in our Institute proved the efficiency of 2-3 kg/t of potassium carbonate (K<sub>2</sub>CO<sub>3</sub>) as an additive for broiler diets improving productivity: final bodyweight in broilers fed 2 and 3 kg/t K<sub>2</sub>CO<sub>3</sub> was higher by 2.42 and 2.34% compared to control while feed conversion ratio (FCR) was improved by 1.32%. These data are in accordance with other research data concerning positive effects of K additives on the productivity in broilers.

One of the possible mechanisms of this effect involves the alleviation of the antagonism between certain dietary amino acids. It was found that diets with high contents of lysine and arginine chlorides could be supplemented with K<sub>2</sub>CO<sub>3</sub> to alleviate the antagonism between these acids negatively affecting availability. K salts were also reported to affect the catabolism of lysine decreasing muscular lysine/arginine ratio.

The study presented was aimed at the evaluation of the effects of lysine-deficient diets supplemented with different doses of K<sub>2</sub>CO<sub>3</sub> on the productive performance in broilers.

### **Materials and Methods**

The trial was performed on 8 treatments of straight-run cage-housed Cobb-500 broilers (35 birds per treatment in separate section) reared under management conditions recommended by the breeding company (stocking density, feeding/drinking fronts, lighting regime). Treatment 1 (positive control) was fed standard basic diets for starter, grower, and finisher periods (BD) supplemented with synthetic lysine; control treatment 2 (negative control) was fed the same diet without synthetic lysine. Experimental groups were fed BD with the substitution of 2 kg/t of K<sub>2</sub>CO<sub>3</sub> for 20% of synthetic lysine (treatment 3); 2 kg/t of K<sub>2</sub>CO<sub>3</sub> for 40% of lysine (treatment 4); 2 kg/t of K<sub>2</sub>CO<sub>3</sub> for 60% of lysine (treatment 5); 2 kg/t of K<sub>2</sub>CO<sub>3</sub> for 80% of lysine (treatment 6); 1 kg/t of K<sub>2</sub>CO<sub>3</sub> for 20% of lysine (treatment 7); 3 kg/t of K<sub>2</sub>CO<sub>3</sub> for 80% of lysine (treatment 8). BD contained 1.09; 1.03 and 0.96% of total lysine and 0.94; 0.89 and 0.82% of available lysine according to age periods 1-14; 15-21 and 22-35 days of age. Preparation of synthetic lysine was 98% monochloride containing 78.4% of lysine.

### **Results**

Mortality levels were 0% in all treatments (T). Live bodyweight (BW) in T<sub>2</sub> was lower at 14, 21 and 35 days of age by 3.80; 1.97 and 4.2%, respectively, compared to T<sub>1</sub>; FCR at 35 days of age was higher by 5.45%. Comparison of T<sub>3</sub>-T<sub>6</sub> fed 2 kg/t of K<sub>2</sub>CO<sub>3</sub> in diets with different degrees of lysine deficiency showed that the progress of this deficiency gradually slowed growth rate in broilers. This trend was better pronounced at the finisher period when broiler were fed diets without animal-derived ingredients. Live BW at 35 days of age was higher in K<sub>2</sub>CO<sub>3</sub>-supplemented treatments with

lysine deficiency 20 and 40% (T3 and T4) by 9.12 and 3.37% in compare to T1 while in T5 and T6 by 1.63 and 1.36%. Productivity index (EPEF) was also higher in T3 and T4 (332 and 329). At the lowest level of lysine deficiency dose of K<sub>2</sub>CO<sub>3</sub> can be effectively reduced from 2 to 1 kg/t: in T7 live BW at 14, 21 and 35 days of age was higher by 4.59; 4.746 and 12.45%, respectively, compared to T1.

Balance trials at 30-35 days of age confirmed the suggestion that K<sub>2</sub>CO<sub>3</sub> can be effectively used in lysine-deficient diets to alleviate the negative impacts of amino acid imbalance on the productive performance in broilers. Dose of K<sub>2</sub>CO<sub>3</sub> 3 kg/t enhanced metabolic efficiency and improved digestibility and retention of dietary nutrients: protein digestibility in T8 was higher by 1.4% compared to T1; dry matter by 6.42%; fat by 4.94%; fiber by 19.89%. Digestibility of dietary lysine and methionine was improved by 4.1 and 1.5%, respectively; digestibility of protein, dry matter, and methionine was close to T1. The lowest digestibility coefficients were found in negative control (T2).

The data of the balance trial can evidence that supplementation of diets for broilers with 1-3 kg/t of K<sub>2</sub>CO<sub>3</sub> stimulates protein synthesis due to the improvement in the digestibility of amino acids. K<sub>2</sub>CO<sub>3</sub> can be therefore used in lysine-deficient diets for alleviation of amino acid imbalance.

### **Conclusion**

Supplementation of diets for broilers with 1-3 kg/t of K<sub>2</sub>CO<sub>3</sub> stimulates protein synthesis due to the improvement in the digestibility of amino acids and can be recommended for the reduction of dietary level of synthetic lysine.

### **References**

- LENKOVA T.N., OKOLELOVA T.M., IGNATOVA G.V. *et al.* SERGIEV POSAD (2014). Optimization of Diet Receipts for Poultry /I.A. Egorov, , 119 pp. (*in Russian*)
- I.A. EGOROV, V.A. MANUKYAN, И T.N. LENKOVA, T.M. OKOLELOVA, E.N. ANDRIANOVA *et al.* SERGIEV POSAD (2015.) Manual on Poultry Nutrition/, 199 pp. (*in Russian*)

## The Effect of Different Levels Of Lentil Byproduct On Growth Performance, Carcass Traits And Egg Production In Quail (*Coturnix Coturnix Japonica*)

Tugay Ayaşan<sup>a</sup>, Bünyamin Söğüt<sup>b</sup>, Hakan İnci<sup>b</sup>

<sup>a</sup>Eastern Mediterranean Agricultural Research Institute, Adana, Turkey

<sup>b</sup>Department of Animal Science, Faculty of Agriculture, Bingöl University, Bingöl, Turkey

### Abstract

The subject of this study was to figure out the effects of lentil by product (LP) on growth performance, carcass traits and egg production of quails. The groups were received 0, 5, 10, 15 and 20% lentil by product. The highest live body weights were observed 3<sup>rd</sup> (195.5 g) groups. Similar results were observed in carcass traits, as well. The best feed conversion ratio (FCR) was noted in 2<sup>nd</sup> and 3<sup>rd</sup> groups (P<0.05). The least feed intake was observed in 2<sup>nd</sup> group. The highest (90.78 %) and the lowest (66.57 %) egg production percentage were in 3<sup>rd</sup> and 5<sup>th</sup> groups (P<0.01). Linear increments were observed in yolk color when lentil by product increased in the diet. Lentil by product could be added into quail diets up to 15% with no negative effect on quail production.

**Key words:** Lentil byproduct, quail, fattening, egg production, yolk color, carcass

### Farklı Düzeyde Mercimek Yan Ürünleri Katkısının Japon Bildircinlarının (*Coturnix Coturnix Japonica*) Büyüme Performansı, Karkas Özellikleri ve Yumurta Verimi Üzerine Etkisi

### Özet

Bu çalışmada mercimek yan ürününün (MYÜ) japon bildircinlarının büyüme performansı, karkas özellikleri ve yumurta verimi üzerine etkilerini belirlemek amaçlanmıştır. Mercimek yan ürünü her deneme grubunun rasyonlarına % 0, % 5, %10, %15 ve %20 oranlarında katılmış ve en yüksek canlı canlı ağırlık %10 oranında mercimek yan ürünü katılan grupta 195.5 g olarak saptanmıştır. Karkas özellikleri bakımından değerlendirme yapıldığında da benzer sonuçlar gözlenmiş ve en yüksek ortalama %10 grubunda saptanmıştır. En iyi yemden yararlanma oranları %5 ve % 10 gruplarında (P <0.05) gözlenirken en düşük yem tüketimi % 5 grubunda gözlenmiştir. En yüksek yumurtlama oranı % 90.78 ile %10 grubunda, en düşük yumurtlama oranı ise % 66.57 ile %20 lik grupta (P <0.01)

görülmüştür. Rasyanlara katılan mercimek yan ürünü oranı arttıkça sarı renginin de arttığı gözlenmiştir. Sonuç olarak mercimek yan ürününün, bıldırcın yetiştiriciliğinde rasyonlara % 15'e kadar eklenebileceği söylenebilir.

**Anahtar kelimeler:** *Mercimek yan ürünü, bıldırcın, besi, yumurta üretimi, sarık rengi, karkas*

## **Introduction**

It is a fact that feed is the single greatest cost of poultry production. In non-ruminant diet, soybean meal and corn have been used widely as protein and energy sources. However, the price of soybean meal as a main source of protein is doubled over the last 7 year (Woyengo and Zijlstra, 2014). Therefore a need exists of alternative feedstuffs for reducing the cost of diet and to replace animal meal concentrate during period of soybean shortage (Leeson and Summer, 1997; Robinson and Singh, 2001; Defang et al., 2008).

Lentil (*Lens culinaaris L.*) is one of legume grain and important source of protein; it has been used in ruminants and non-ruminant diets such as in poultry (Mavromichalis, 2013; Çabuk et al., 2014; Woyengo and, 2014), and relatively tolerant to drought and grown in all over the world. The nutritive value of lentil depends upon the processing methods and amount of present antinutritional factors (Xu and Chang, 2010). Lentil seed have relatively high protein (27%) and energy content (3570 kcal/kg ME) and low digestive inhibitors (Gorgulu, 2010). There is little information available about lentil byproduct on quail so far. The subject of this study was to figure out the effect of different levels of lentil byproduct on quail growth performance, carcass traits, egg production.

## **Materials and Methods**

Two experiments were conducted in this study. The first one was to figure out the effect of lentil byproduct (LP) on growth performance and carcass traits and the second one was on egg yield and egg quality of quails. The birds were fed by *ad libitum* and fresh water was provided through experiment. All diets were balanced with energy and protein and formulated to contain adequate nutrient levels as defined by the National Research Council (1994). At the end of the first experiment (at 42 days), 10 male and 10 female birds were bled, defeathered and eviscerated by hand. Carcasses were pre-chilled then aged in water-ice for 5 h and then separated for the parts as carcass yield, breast, legs (thighs and drumsticks) liver and heart. The experiment lasted 3 months to calculate egg yields. Eggs were collected daily. Every month 30 eggs in each group were weighted then was broken to figure out egg quality traits as egg yield (%), egg weight (g), yolk index, haugh unit (HU) (Kaya and Aktan, 2011) , internal quality unit (IQU) and

yolk color. The egg yolk color was measured visually by using of La Roche scale (today also named as DSM Yolk Color Fan).

### **Results and Discussion**

The studies about the effect of lentil byproduct (LP) on egg yield and growth performance of quails are still not clear so far. This is the experiment conducted to evaluate the impact of LP on fattening performance, carcass traits (CT), performance parameters (feed intake (FI), FCR), egg yield and egg quality traits of Japanese quails (*Coturnix coturnix Japonica*). Lentil byproduct could be easily found in some countries such as Canada, India and Turkey, which they lead in production of lentil in the world. This by product mostly used in ruminant diets, not in poultry in such countries mentioned above. Because lentil byproduct in the diet up to 15 % didn't have adverse effect on BW, carcass traits and FCR, it could be used easily in the diet of quails to reduce cost of feed. Since yolk color is one of the important factors for consumer demands, Lentil byproduct could be used to increase yolk color. More research is needed to figure out the effects of different kinds of lentil byproduct on the performance of quail and other poultry breeds. As in other leguminous, some tannin is present in lentil and it has not been eliminated.

### **Conclusion**

These tannins could affect animal physiology, and it may decrease utilization of nutrients by enzyme inhibitor (Arora, 1983; South & Miller 1998; Kaya et al. 1999). For that reason, the effect of lentil byproduct on poultry may be investigated after heat process. As a result of this study, Lentil by product could be added into quail diets up to 15% with no negative effect on quail production.

### **References**

- ARORA S.K. (1983) Chemistry and Biochemistry of Legumes. Edward Arnold Limited. 42 Bedford Square. London.
- ÇABUK M, ERATAK S, MALAYOĞLU H. B. (2014) Effects of dietary inclusion of lentil by product on performance and oxidative stability of eggs in laying quail. Scientific World Journal, <http://dx.doi.org/10.1155/2014/742987>. 1-5.
- DEFANG, H. F., AWAH-NDUKUM A. T. J., KENFACK A., NGOULA, F., METUGE F. (2008) Performance and carcass characteristics of broilers fed boiled cowpea (*Vigna unguiculata* L Walp) and or black common bean (*Phaseolus vulgaris*) meal diets. African Journal of Biotechnology. 7(9):1351-1356.

- Görgülü M. (2010) Ingredient of nutrients.  
<http://www.muratgorgulu.com.tr/altekran.asp?id=79>.
- KAYA S, YARSAN E and ÖZDEMİR M. (1999) Major items may cause growth retardation, yield decreasing and poisoning in poultry. International Poultry Fair And Congress. June 3-6. İstanbul, 366-379.
- KAYA E., AKTAN S. (2011) Flock age and duration of hatching egg storage of Japanese quails: 1. Effects on thick albumen characteristics. Suleyman Demirel University Journal of the Faculty of Agriculture. 6 (2):30-38.
- LEESON S, SUMMER J. (1997) Commercial poultry nutrition, 2 nd edition. University books. Antarior, Canada.
- MAVROMICHALIS, L. (2013) El papel de los antioxidantes en la nutrición porcina. Suis, ISSN 1699-7867. 6-8.
- NRC. (1994) Nutrient Requirements of Poultry. 9th ed. Washington: National Academy Press.
- ROBINSON D, SINGH DN, (2001) Rural Industries Research and Deve. Corporation, Queensland Poultry Research and Deve. Centre, March Publication NDAQ- 241
- SAS.(1998) Sas Instutite Inc., Sas User's Gide: Statistics Edition. Cary, NC. USA.
- South PK, Miller DD. (1998) Iron binding by tannic acid: Effects of selected ligands. Food Chemistry; 63(2):167-172.
- WOYENGO, T. A., E. BELTRANENA, AND R. T. ZIJLSTRA. (2014) Controlling feed cost by including alternative ingredients into pig diets: A review. J. Anim. Sci. 92:1293-1305. doi:10.2527/jas(2014)-7169.
- XU B, CHANG SKC. (2010) Phenolic substance characterization and chemical and cell-Based antioxidant activities of 11 lentils grown in the Northern United States, Journal of Agricultural and Food Chemistry, 58(3):1509-1517.

## Effects of Fermented Sour Cherry (*Prunus cerasus*) Kernel with *Aspergillus niger* under Solid State Fermentation on Performance, Digestibility and Cecal Microflora in Broiler Chicks\*

Emrah Güngör, Güray Erener

Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun, Turkey

\*This study has been summarized from Emrah Güngör's master's thesis (Project no: PYO.ZRT.1904.17.016)

### Abstract

The effects of unfermented (UCK) and fermented (FCK) sour cherry kernel (0,1,2,4%) with *Aspergillus niger* (ATCC 200345) under solid state fermentation on performance, digestibility and cecal microflora in broiler chicks were investigated in this study. UCK did not affect ( $P>0.05$ ) growth performance and digestibility at 1% but decreased ( $P<0.05$ ) at 2 and 4%. Cecal microflora was not affected ( $P>0.05$ ) by UCK inclusion. FCK improved ( $P<0.05$ ) growth performance and cecal microflora at 1%, did not change ( $P>0.05$ ) at 2% and decreased ( $P<0.001$ ) performance at 4%. Digestibility was not affected ( $P>0.05$ ) by FCK addition. In conclusion, using of FCK in poultry diets at 1% is recommended.

**Key words:** *Aspergillus Niger*, Broiler, *Prunus Cerasus*, Sour Cherry Kernel

### Introduction

World meat demand is supposed to be increased by 60-70% in 2050 (FAO, 2011). Poultry meat is crucial to fulfilling meat demand in Turkey. It is only possible to fulfill meat demand by increasing production. The world population is expected to rise to more than 9 billion by 2050 (Cohen, 2003). Increased production and growing population will make a pressure on cereal, grains etc. that are consumed by both human beings and animals. Therefore, feedstuffs that are not using in human nutrition should be used much more in poultry nutrition.

Feed costs that constitute 70-80% of total costs affect the profitability of poultry production considerably. Feed cost can be reduced by using agricultural residues in poultry diets. Therefore, agricultural residues should be made available for poultry nutrition.

Kernels are a by-product that separated from sour cherry by seed separating machines in factories (Korlesky et al., 2016). It contains 25-37% crude protein (CP), 18-42% ether extract (EE), 6-31% crude fiber (CF) and 2-5% ash (Lazos, 1991, Yilmaz, 2013, Eryilmaz, 2016, Güngör et al., 2017). Sour cherry kernel can be used in broiler diets but it remains at limited level due

to being weak in methionine and threonine (Yilmaz, 2013), having some antinutritional components such as amygdalin, tannin, phytic acid and hydrocyanic acid (El-Adawy et al., 1994, Bolarinwa et al., 2014).

Solid state fermentation can be used to improve nutritional composition, reduce CP content and eliminate antinutritional components of agricultural residues (Zhang et al., 2006). *Aspergillus niger* is preferred in solid state fermentation because of suitable for growing in the low-water environment (Raimbault, 1998). The effects of unfermented and fermented sour cherry kernel with *A. niger* under solid state fermentation on performance, digestibility and cecal microflora in broiler chicks were investigated in this study.

### Materials and Methods

Two different trials were conducted in the study. In trial I, unfermented sour cherry kernel (UCK) was given at increasing levels (0, 1, 2, and 4%) to broiler chicks, while in trial II, fermented sour cherry kernel (FCK) was given. In trial I, 196 one-day-old Ross-308 male broiler chicks were divided into 4 groups with 7 replicates consisting of 7 animals each. Chicks were fed with diets containing 0, 1, 2, and 4% UCK for 42 days. In trial II, 196 one-day-old Ross-308 male broiler chicks were divided into 4 groups each consisting of 7 animals and fed with feed containing 0, 1, 2, and 4% FCK until 42 days of age. Birds and feed were weighed weekly on a pen basis and live weight gain (LWG), feed intake (FI) and feed conversion ratio (FCR) were calculated. Cecal *Lactobacillus acidophilus*, *Enterococcus faecalis* and *Escherichia coli* count determined as described by Arda (1985). Digestibility trial is operated with acid insoluble ash method as described by Emami et al. (2012).

Sour cherry kernel fermented with *A. niger* (ATCC 200345) at  $10^5$  spores/kg kernel. Fermentation was conducted according to Güngör et al. (2017). Differences between treatments were tested with using ANOVA and Duncan's multiple range test (SPSS 21.0 Statistics). The level of statistical significance was declared at  $P \leq 0.05$ .

### Results and Discussion

In trial I, UCK did not affect ( $P > 0.05$ ) LW, LWG, and FI at 1% but decreased ( $P < 0.001$ ) at 2% and 4% compared to control group. Similar findings have been obtained from the studies on apricot kernel (Arbouche et al., 2012), palm kernel (Ezieshi and Olomu, 2008, Abdollahi et al., 2016), mango kernel (Diarra and Usman, 2008) and date kernel (Masoudi et al., 2011). UCK addition decreased ( $P < 0.05$ ) FCR at 1% but not changed at 2% and 4%. This result showed that UCK represented positive effect on FCR at 1% even though it did not improve other performance parameters.

Dry matter (DM), organic matter (OM) and CP digestibility were affected negatively by UCK addition. DM, OM, and CP digestibility were not changed ( $P>0.05$ ) by 1% UCK addition while decreased ( $P<0.05$ ) at 2% and 4%. Nevertheless, EE digestibility was not affected by UCK inclusion. Negative effects on nutrient digestibilities may be due to high CF content and antinutritional factors of UCK (Cowieson et al., 2006).

Cecal *L. acidophilus*, *E. faecalis* and *E. coli* counts were not changed ( $P>0.05$ ) by UCK addition. Kołodziejczyk et al. (2013) reported that sour cherry kernel has antimicrobial effect. Nevertheless, UCK did not affect bacterial counts that are investigated. It is assumed that inclusion quantity of UCK not enough to change cecal microflora.

Crude protein, crude fat and ash content increased ( $P<0.001$ ) CF, neutral detergent fiber, acid detergent fiber, nitrogen-free extract decreased ( $P<0.01$ ) in UCK by *A. niger* solid state fermentation. Similar findings were obtained from the study on palm kernel (Iluyemi et al., 2006).

In trial II, LW and LWG ( $P<0.001$ ) were increased by 1% FCK inclusion but remained the same ( $P>0.05$ ) with control at 2% and decreased ( $P<0.001$ ) at 4%. FI was not affected ( $P>0.05$ ) by any FCK dosage. FCR decreased ( $P<0.001$ ) by 1% FCK inclusion but not changed ( $P>0.05$ ) at 2% and increased ( $P<0.001$ ) at 4% compared to control. Similar results have been reported at the studies in which LW increased by fermented feedstuff compared to control group on shea nut (Dei et al., 2008) and palm kernel (Lawal et al., 2010). *A. niger* is used in poultry diets as a probiotic that has positive effects on growth performance (Mountzouris et al., 2007). Improvement in LW and FCR by 1% FCK inclusion may be due to probiotic effect of *A. niger*.

DM, OM, CP and EE digestibility were not changed ( $P>0.05$ ) by FCK addition. Antinutritional factors can be eliminated by solid state fermentation (Chang and Zhang, 2012). This result indicates that negative effect of UCK inclusion on nutrient digestibility is resolved by fermentation because of eliminating antinutritional factors or decreasing CF content of UCK possibly.

Cecal *L. acidophilus* increased ( $P<0.05$ ) by 1% FCK addition. However, cecal *E. faecalis* and *E. coli* counts were not changed ( $P>0.05$ ) by FCK inclusion. Similarly, it has been reported that *A. niger* can improve cecal microflora by its probiotic effect (Mountzouris et al., 2007).

## Conclusion

Unfermented sour cherry kernel can be used up to 1% in broiler diets without negative effect on performance and also has positive effect on feed conversion ratio at 1%. *Aspergillus niger* solid state fermentation improved nutritional composition of sour cherry kernel. Fermented sour cherry kernel increased live weight, live weight gain, improved feed conversion ratio and

increase cecal *Lactobacillus acidophilus* count without affecting feed intake and dry matter, organic matter, crude protein and ether extract digestibility at 1%. Using of fermented sour cherry kernel at 1% in broiler diets is recommended.

## References

- ABDOLLAHI, M., HOSKING, B., NING, D. and RAVINDRAN, V. (2016) Influence of palm kernel meal inclusion and exogenous enzyme supplementation on growth performance, energy utilization, and nutrient digestibility in young broilers. *Asian-Australasian Journal of Animal Sciences* 29: 539-548.
- ARBOUCHE, R., ARBOUCHE, F., ARBOUCHE, H. and ARBOUCHE, Y. (2012) Effets sur les performances de croissance de l'incorporation du tourteau d'amandes d'abricots dans la ration des poulets de chair. *Revue de Medecine Veterinaire* 163: 475-479.
- ARDA, M. (1985) Genel Mikrobiyoloji (1. Basım) (Ankara, Ankara Üniversitesi Veteriner Fakültesi Yayınları).
- BOLARINWA, I. F., ORFILA, C. and MORGAN, M. R. (2014) Amygdalin content of seeds, kernels and food products commercially-available in the UK. *Food Chemistry* 152: 133-139.
- CHANG, J. and ZHANG, Y. (2012) Catalytic degradation of amygdalin by extracellular enzymes from *Aspergillus niger*. *Process Biochemistry* 47: 195-200.
- COHEN, J. E. (2003) Human population: the next half century. *Science* 302: 1172-1175.
- COWIESON, A., ACAMOVIC, T. and BEDFORD, M. (2006) Phytic acid and phytase: implications for protein utilization by poultry. *Poultry Science* 85: 878-885.
- DEI, H., ROSE, S., MACKENZIE, A. and AMAROWICZ, R. (2008) Growth performance of broiler chickens fed diets containing shea nut (*Vitellaria paradoxa*, Gaertn.) meal fermented with *Aspergillus niger*. *Poultry Science* 87: 1773-1778.
- DIARRA, S. and USMAN, B. (2008) Growth performance and some blood variables of broiler chickens fed raw or boiled mango kernel meal. *International Journal of Poultry Science* 7: 315-318.
- EL-ADAWY, T., RAHMA, E., EL-BADAWEY, A., GOMAA, M., LASZTITY, R. and SARKADI, L. (1994) Biochemical studies of some non-conventional sources of proteins Part 7. Effect of detoxification treatments on the nutritional quality of apricot kernels. *Molecular Nutrition & Food Research* 38: 12-20.
- EMAMI, N. K., SAMIE, A., RAHMANI, H. and RUIZ-FERIA, C. (2012) The effect of peppermint essential oil and fructooligosaccharides, as alternatives to virginiamycin, on growth performance, digestibility, gut morphology and immune response of male broilers. *Animal Feed Science and Technology* 175: 57-64.
- ERYILMAZ, H. S. (2016) Valorization of functional protein from a plant based food waste: sour cherry kernel, and its physicochemical characteristics. Yüksek Lisans Tezi, İstanbul Teknik Üniversitesi.

- EZIESHI, E. V. and OLOMU, J. M. (2008) Nutritional evaluation of palm kernel meal types: 2. Effects on live performance and nutrient retention in broiler chicken diets. *African Journal of Biotechnology* 7: 1171-1175.
- FAO (2011) World livestock 2011-livestock in food security (Food and Agriculture Organization of the United Nations (FAO)).
- GÜNGÖR, E., ALTOP, A., ÖZTÜRK, E. and ERENER, G. (2017) Nutritional changes of sour cherry (*Prunus cerasus*) kernel subjected to *Aspergillus niger* solid-state fermentation. *Journal of Tekirdag Agricultural Faculty*: 99-103.
- ILUYEMI, F., HANAFI, M., RADZIAH, O. and KAMARUDIN, M. (2006) Fungal solid state culture of palm kernel cake. *Bioresource Technology* 97: 477-482.
- KOŁODZIEJCZYK, K., SÓJKA, M., ABADIAS, M., VIÑAS, I., GUYOT, S. and BARON, A. (2013) Polyphenol composition, antioxidant capacity, and antimicrobial activity of the extracts obtained from industrial sour cherry pomace. *Industrial Crops and Products* 51: 279-288.
- KORLESKY, N. M., STOLP, L. J., KODALI, D. R., GOLDSCHMIDT, R. and BYRDWELL, W. C. (2016) Extraction and characterization of montmorency sour cherry (*Prunus cerasus* L.) pit oil. *Journal of the American Oil Chemists' Society* 93: 995-1005.
- LAWAL, T., IYAYI, E., ADENIYI, B. and ADARAMOYE, O. (2010) Biodegradation of palm kernel cake with multienzyme complexes from fungi and its feeding value for broilers. *International Journal of Poultry Science* 9: 695-701.
- LAZOS, E. S. (1991) Composition and oil characteristics of apricot, peach and cherry kernel. *Grasas y Aceites* 42: 127-131.
- MASOUDI, A., CHAJI, M., BOJARPOUR, M. and MIRZADEH, K. (2011) Effects of different levels of date pits on performance, carcass characteristics and blood parameters of broiler chickens. *Journal of Applied Animal Research* 39: 399-405.
- MOUNTZOURIS, K., TSIRTSIKOS, P., KALAMARA, E., NITSCH, S., SCHATZMAYR, G. and FEGEROS, K. (2007) Evaluation of the efficacy of a probiotic containing *Lactobacillus*, *Bifidobacterium*, *Enterococcus*, and *Pediococcus* strains in promoting broiler performance and modulating cecal microflora composition and metabolic activities. *Poultry Science* 86: 309-317.
- RAIMBAULT, M. (1998) General and microbiological aspects of solid substrate fermentation. *Electronic Journal of Biotechnology* 1: 26-27.
- YILMAZ, C. (2013) Vişne çekirdeği atıklarının gıda ingrediyesi olarak değerlendirilmesi. Yüksek Lisans Tezi, Hacettepe Üniversitesi.
- ZHANG, W.-J., XU, Z.-R., SUN, J.-Y. and YANG, X. (2006) Effect of selected fungi on the reduction of gossypol levels and nutritional value during solid substrate fermentation of cottonseed meal. *Journal of Zhejiang University-Science B* 7: 690-695.

## Effect of Oregano Essential Oil and Carob Extract Mixture on Egg Quality Traits of Laying Hens

Mahmut Kaliber<sup>a</sup>, Gökhan Filik<sup>b</sup>, Ayşe Gül Filik<sup>b</sup>, Savaş Sarıözkan<sup>c</sup>, Yusuf Konca<sup>a</sup>

<sup>a</sup>Erciyes University Faculty of Agriculture Department of Animal Science Kayseri Turkey,

<sup>b</sup>Ahi Evran University Faculty of Agriculture Department of Animal Science Kırşehir Turkey,

<sup>c</sup>Erciyes University Faculty of Veterinary Department of Animal Science Kayseri Turkey

### Abstract

The effect of oregano essential oil and carob extract mixture (OCM) inclusion to a total 72 laying 56 week old White Lohmann hens diets on egg quality traits was evaluated. Dietary treatments were, a control and three diets containing 5, 10 and 20 g/kg of OCM. There were significant effects of dietary treatments on albumen length, pH, width (P<0.01), height (P<0.05, linear); yolk width, b\* value (P<0.01) and index (P<0.05, linear), and also Haugh unit (P<0.05, linear). Other examined parameters of egg quality did not influenced by dietary treatment (P>0.05). The highest values within the affected parameters were observed in the 20 g/kg of OCM supplemented group; except egg yolk index and b\* value.

**Key words:** *Ceratonia siliqua*, Egg yolk, Haugh unit, Poultry, White Lohmann.

### Kekik Esansiyel Yağı ve Keçiboynuzu Özütü Karışımının Yumurtacı Tavuklarda Yumurta Kalite Özellikleri Üzerine Etkisi

#### Özet

56 haftalık yaşta 72 adet Beyaz Lohmann yumurtacı tavuk rasyonuna kekik esansiyel yağı ve keçiboynuzu özütü karışımı (KKK) ilavesinin yumurta kalite özellikleri üzerine olan etkisi araştırılmıştır. Muameleler bir kontrol ile 5, 10 ve 20 g/kg düzeyinde KKK içeren rasyonlardan oluşturulmuştur. Muamelenin, ak genişliği, pH'ı, uzunluğu (P<0.01) ve yüksekliği (P<0.05, linear); sarı genişliği, b\* değeri (P<0.01) ve indeksi (P<0.05, linear) ile Haugh birimi (P<0.05, linear) üzerindeki etkisi önemli bulunmuştur. Yumurta kalitesine dair incelenen diğer parametreler muameleden etkilenmemiştir (P>0.05). Sarı indeksi ve b\* değeri hariç muameleden etkilenen diğer parametreler bakımından en yüksek değerler 20 g/kg düzeyinde KKK ilave edilen grupta gözlenmiştir.

**Anahtar kelimeler:** *Beyaz Lohmann, Ceratonia Siliqua, Haugh Birimi, Kümes Hayvanları, Yumurta Sarısı.*

## **Introduction**

Many antibiotics are used in animal and poultry feeds as growth promoters to improve the health and wellbeing of animals and as a prophylactic agent for promoting growth. Recently the concerns for usage of antibiotics residue and resistance have aroused great caution in the usage of the antibiotics and inorganic additives in the poultry residue. European Community has banned the use of antibiotics as growth promoter since 2006 (Dhama *et al.*, 2014). Taking into account the current consumer's demands for animal products with high quality standards, new practices have been adopted in order to guarantee better welfare condition of birds, higher food safety while reducing the environmental impact of the farms (Minelli *et al.*, 2007). The research is now shifted towards the alternative option in the form of organic additives/supplements from the plant-based compounds/extracts. Herbal based feed additives and supplements have been in poultry industry since several years. It has been reported that use of the herbal supplements improves the growth, production, immunity and several other beneficial effects in poultry (Sunder *et al.*, 2013). There are various reasons why these phytochemical compounds have attracted much research. First, the number of antimicrobial agents increases each year due to the limited effective lifetime of antibiotics. Second, there has been an increased awareness by the public for excessive and unnecessary use of commercial antimicrobial agents. Therefore, new sources including plants and their alternative forms have become popular over the last decade (Cowan, 1999). Eggs are among the most nutritious foods and can be part of a healthy diet. However, they are perishable, just like raw meat, poultry and fish (Caner and Cengiz, 2008). For many years the most important external and internal egg quality traits have been shown to be egg weight, egg shape, shell thickness, breaking strength, specific gravity, air cell, albumen height and weight, and yolk index (Samli *et al.*, 2005). Albumen quality is not only an important indicator for egg freshness, but it is also important for the egg breaking industry because albumen and yolk have different markets (Ahn *et al.*, 1997). Visual appearance of the albumen has also been used extensively to describe egg quality (Hunton, 1987). Therefore, the aim of the present study was to examine effects of oregano essential oil and carrob extract mixture (OCM) supplementation to diet on egg quality in laying hens.

## **Materials and Methods**

A total 72 laying 56 week old White Lohmann hens were distributed into 4 treatment groups with 6 replicates and 3 hens per cage. The treatments were as follows: the first group was fed only with the standard diet which

contained no OCM and was called as control group (OCM0). The second (OCM5), third (OCM10) and fourth (OCM20) groups were fed with diets containing 5, 10 and 20 g/kg OCM, respectively. The basal diet was based on maize-soybean and formulated on a similar level of nutrient composition to NRC (1994) recommendations. The experimental diets were offered to respective animal for 8 weeks. The hens were kept in a poultry house which provided controlled environmental conditions. The lighting schedule was a 16 h light and 8 h dark photoperiod. Feed and water were provided *ad-libitum*. On the last consecutive 3 days of each 14 day period (4 times in total) all eggs were collected and for each group and 30 eggs (a total of 120 eggs) were selected randomly from these eggs, then egg weight, width and length; albumen pH, weight, height, width and length; yolk weight, height, width, L\*, a\* and b\* values; eggshell strength, weight and thickness were determined. Also, shell, yolk and albumen indexes and ratios, and Haugh units were calculated from these data. All data were subjected to analysis of variance by using the statistical analyses system, SPSS (1999). Linear, quadratic and cubic polynomial contrasts were used to evaluate treatment effects. If appropriate, post-hoc analyses were carried out using the Duncan's test for multiple comparisons. Statements of statistical significance are based on  $P < 0.05$ .

## Results and Discussion

The effects of supplemental dietary OCM on egg weight, width and length; albumen pH, weight, height, width, length, index and ratio; yolk weight, height, width, index, ratio, L\*, a\* and b\*; eggshell strength, weight, thickness, index and ratio, and Haugh unit values are shown in Table 1.

As seen on Table 1, there were no significant effects of dietary treatment on egg weight, height, width, length and Haugh unit; shell strength, thickness, weight, index and ratio; yolk height, weight, ratio, L\* and a\* values; albumen weight, ratio and index ( $P > 0.05$ ). But, there was a linear effect of OCM supplementation on albumen height ( $P < 0.05$ , linear), width, length and pH ( $P < 0.01$ , linear); and the highest values were observed in OCM20 group for these four parameters, whilst OCM0 group had the lowest values for the same parameters. Such an increase in albumen pH has been reported by extending the storage time from 2 to 30 d (Samli *et al.*, 2005). Increasing supplemental OCM increased yolk width ( $P < 0.01$ , linear) and Haugh unit ( $P < 0.05$ , linear) values (Table 1) of the egg. The yolk width values of OCM0, OCM5, OCM10 and OCM20 groups were 45.45, 45.90, 46.15 and 47.78 cm, respectively. The Haugh unit values were 88.44, 90.06, 90.18 and 91.78, in the same order. Also, yolk index value differed among treatment groups ( $P < 0.05$ , linear), and while the highest value obtained from OCM0 group, the lowest yolk index value was observed in OCM20 group for egg yolk index. Additionally, we investigated linear and quadratic effects of

dietary treatment on b\* (yellowness) value of egg yolk (P<0.01). While, OCM0 (control) group had the lowest b\* value with 38.43, b\* value (39.61) of group OCM10 was the superior.

Table 1. The effects of dietary treatments on egg quality traits of experimental laying hens

P	Treatment Groups				SEM	Statistical Contrasts		
	OCM0	OCM5	OCM10	OCM20		Linear	Quadratic	Cubic
EW	67.18	67.46	67.46	67.26	0.336	0.937	0.728	0.979
EWD	44.25	44.85	45.42	44.98	0.215	0.154	0.226	0.600
EL	59.91	60.33	59.90	59.93	0.166	0.799	0.562	0.368
ES	4089.8	4428.60	4202.9	3966.2	75.51	0.377	0.060	0.412
AH	8.19 <sup>b</sup>	8.48 <sup>ab</sup>	8.51 <sup>ab</sup>	8.79 <sup>a</sup>	0.091	0.027	0.966	0.533
AW	77.33 <sup>b</sup>	78.79 <sup>b</sup>	79.58 <sup>b</sup>	84.01 <sup>a</sup>	0.529	0.000	0.163	0.365
AL	93.65 <sup>c</sup>	97.27 <sup>b</sup>	96.08 <sup>bc</sup>	101.52 <sup>a</sup>	0.511	0.000	0.373	0.014
YH	19.19	19.16	19.32	19.36	0.090	0.406	0.845	0.681
YW	45.45 <sup>b</sup>	45.90 <sup>b</sup>	46.15 <sup>b</sup>	47.78 <sup>a</sup>	0.160	0.000	0.068	0.269
ApH	8.30 <sup>b</sup>	8.39 <sup>a</sup>	8.41 <sup>a</sup>	8.41 <sup>a</sup>	0.013	0.005	0.106	0.618
L*	71.59	72.22	71.54	71.63	0.131	0.637	0.305	0.080
A*	20.27	20.11	20.44	20.17	0.145	0.992	0.861	0.400
B*	38.43 <sup>b</sup>	39.45 <sup>a</sup>	39.61 <sup>a</sup>	39.35 <sup>a</sup>	0.118	0.007	0.009	0.681
ESW	7.12	7.06	7.21	7.03	0.038	0.751	0.463	0.113
YWG	18.11	18.64	18.49	18.36	0.120	0.577	0.169	0.508
ET	0.402	0.408	0.423	0.398	0.006	0.989	0.171	0.332
EI	73.88	74.39	75.85	75.07	0.375	0.137	0.388	0.344
YI	42.29 <sup>a</sup>	41.76 <sup>ab</sup>	41.89 <sup>ab</sup>	40.53 <sup>b</sup>	0.245	0.021	0.399	0.326
AI	6.19	6.21	6.27	6.14	0.070	0.860	0.576	0.711
HU	88.44 <sup>b</sup>	90.06 <sup>ab</sup>	90.18 <sup>ab</sup>	91.78 <sup>a</sup>	0.495	0.025	0.989	0.499
YR	26.97	27.68	27.42	27.30	0.180	0.652	0.252	0.489
ER	10.60	10.47	10.70	10.46	0.053	0.690	0.650	0.086
AWG	41.95	41.76	41.76	41.87	0.291	0.923	0.787	0.974
AR	62.43	61.85	61.89	62.24	0.193	0.755	0.232	0.865

P: Parameter, Egg Weight (g), EWD: Egg Width (cm), EL: Egg Length (cm), ES: Eggshell Strength (kg/m<sup>3</sup>), AH: Albumen Height (cm), AW: Albumen Width (cm), AL: Albumen Length (cm), YH: Yolk Height (cm), YW: Yolk Width (cm), ApH: Albumen Ph, L\*: L\* value, A\*: a\* value, B\*: b\* value, ESW: Eggshell Weight (g), YWG: Yolk Weight (g), ET: Eggshell Thickness (mcm), EI: Eggshell Index, YI: Yolk Index, AI: Albumen Index, HU: Haugh Unit, YR: Yolk Ratio (%), ER: Eggshell Ratio (%), AWG: Albumen Weight (g), AR: Albumen Ratio (%), OCM0: Control, 0 g/kg OCM; OCM5: 5 g/kg OCM; OCM10: 10 g/kg OCM; OCM20: 20 g/kg OCM; SEM: Standart error of mean; L\*: Lightness; a\*: Redness; b\*: Yellowness.

### Conclusion

The results of the present study showed that dietary OCM supplementation, particularly at 20 g/kg, had some beneficial effects on egg quality traits of laying hens; like albumen volume and pH, and also Haugh unit.

### References

AHN, D.U., KIM, S.K. and SHU, H. (1997) Effect of egg size and strain and age of hen on the solids content of chicken eggs. *Poultry Science* 76: 914-919.

- CANER, C. and CANSIZ, Ö. (2008) Chitosan coating minimises eggshell breakage and improves egg quality. *Journal of the Science of Food and Agriculture* 88: 56-61.
- COWAN, M.M. (1999) Plant products as antimicrobial agents. *Clinical Microbiology Reviews* 12: 564-582.
- DHAMA, K., TIWARI, R., KHAN, R.U., CHAKRABORTY, S., GOPI, M., KARTHIK, K., SAMINATHAN, M., DESINGU, P.A. and SUNKARA L.T. (2014) Growth promoters and novel feed additives improving poultry production and health, bioactive principles and beneficial applications: The trends and advances - A Review. *International Journal of Pharmacology* 10: 129-159.
- HUNTON, P. (1987) Laboratory evaluations of egg quality, in: WELSS, R.G. & BELYAVIN C.G. (Eds) *Egg Quality: Current Problems and Recent Advances*, pp. 87-102 (London, Butterworths).
- MINELLI, G., SIRRI, F., FOLEGATTI, E., MELUZZI, A. and FRANCHINI, A. (2007) Egg quality traits of laying hens reared in organic and conventional systems. *Italian Journal of Animal Science* 6: 728-730.
- NATIONAL RESEARCH COUNCIL (1994) Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.
- SAMLI, H.E., AGMA, A. and SENKOYLU, N. (2005) Effects of storage time and temperature on egg quality in old laying hens. *Journal of Applied Poultry Research* 14: 548-553.
- SPSS INC. (1999) SPSS base 9.0 applications guide. SPSS Inc. Headquarters, Chicago, Illinois, p. 233.
- SUNDER, J., JEYAKUMAR, S., SUJATHA, T. and KUNDU, A. (2013) Effect of feeding of morical: a herbal based supplement on production and egg quality in Japanese quail. *Advances in Animal and Veterinary Sciences* 1: 157-160.

**SESSION-5**  
**GENETICS AND GENOMICS**  
**INVITED PRESENTATIONS**

## Poultry Genetic Resources

Martino Cassandro

Department of Agronomy, Food, Natural resources, Animals and Environment (DAFNAE),  
University of Padova, viale dell'Università, 16 – 35020, Agripolis, Legnaro (PD), Italy

### Abstract

Aim of this review is to describe the domestic poultry genetic resources in the world. In the livestock world, two poultry production systems coexist: a commercial production system, with varying levels of integration and industrialization, and a village or backyard system. Commercial hybrids are used by the commercial system, while the village system makes use of indigenous or local breeds. Considering the diversification of market, changing of production conditions and the new habits of consumers, are pushing the breeders to be interested in high resilient animals, which can maintain a good level of production and quality products, with sustainable systems with a low environmental impact and antibiotic free.

### Regional distribution of avian breeds

According to *The State of the World's Animal Genetic Resources for Food and Agriculture*, published by FAO (FAO, 2007), there are 1,644 local, 85 regional transboundary and 157 international transboundary avian breeds reported in the Domestic Animal Diversity Information System (DAD-IS). In Figure 1 is showed the distribution of the world's avian breeds by species, where chicken breeds make up the vast majority (63%) of the total number of avian breeds, followed by ducks (11 % – excluding Muscovy ducks), geese (9 %) and turkeys (5 %).

The Europe and the Caucasus region accounts for 52 % of the world's local avian breeds, while Asia accounts for 25%, Africa for 9 %, Latin America and the Caribbean for 8 % and North America accounts for less than 2 % of the total (FAO, 2007). The large number of breeds in Europe and Caucasus is partly a result of the fact that in this region breeds are more likely to be recognized as separate entities. It also reflects the more advanced state of breed recording and characterization in this region. Molecular studies of European chicken breeds show they are not particularly closely related; they are genetically distinct, but harbour moderate to low within-breed diversity, because the populations are of limited genetic size. Indigenous chicken breeds are widely distributed, but their contribution varies between regions: very limited in the developed world (Europe and North America), but still important in the developing world. In many of the developing countries of Africa and Asia, the estimated average proportion of indigenous birds in the population is close to 80 percent (Guèye, 1998). Given the level of

productivity of indigenous birds, their relative contribution to meat and egg production is, however, likely to be very much lower than their numerical contribution. Predictions of the extent of this contribution are subject to a high degree of error. The very approximate estimates produced by Pym et al. (2006) suggest that the contribution of indigenous genotypes to egg production is probably quite low in most countries, but that the contribution to meat production is likely to be quite substantial. Ducks are also found in all regions; however, they are less numerous and show a less even distribution than chickens. Domestic ducks have a long history of domestication, and were kept in ancient Egypt, Mesopotamia, China and the Roman Empire. However, production is now concentrated in China, which has 70 percent of the world's domestic duck population. Other major producers are Viet Nam, Indonesia, India, Thailand and other countries in Southeast Asia. Among European countries, France and Ukraine have large numbers of ducks. The Muscovy or Barbary duck (or Criollo duck in Latin America) is a unique duck species that belongs to a group of waterfowl that can reproduce without water. Geese and turkeys have a relatively narrow distribution. This can be explained by tradition and consumer preferences rather than by agro-ecological conditions. Nearly 90 percent of the world's domestic geese are found in China. Turkeys originated in Central America, and were brought to Europe shortly after their discovery by colonists; many breeds were developed in the latter region. The chicken not only accounts for the vast majority of poultry genetic diversity, but is also the economically dominant species.

### **Poultry production systems**

In the livestock world, two poultry production systems coexist: a commercial production system, with varying levels of integration and industrialization, and a village or backyard system. These two systems use different breeds of poultry. Commercial hybrids are used by the commercial system, while the village system makes use of indigenous or local breeds. Over the past 50 years, poultry meat and egg production from individual birds in commercial flocks of broilers and layers has increased enormously, largely owing to genetic selection in the nucleus breeding flocks of poultry breeding companies and the rapid transfer of these gains to commercial cross-bred progeny.

With increasing urbanization, the contribution of commercial breeds to overall poultry meat and egg consumption is growing evermore rapidly, while indigenous breeds continue to make large contributions to poultry meat and egg consumption in the rural regions of most countries. Therefore, is possible to say that local or indigenous breeds make up most of the world's poultry genetic diversity, while at the contrary commercial hybrids make up most of the world's poultry amount of products in terms of meat

and eggs yield. In figure 2 is described the genetic pyramid used in a commercial production intensive system, that can be assume as the gene flow from pedigree to broiler, what need from 4 to 5 years of work.

Figure 1. Distribution of the world's avian breeds by species (Avian species with more than 50 recorded breeds are displayed separately; the remaining avian species are aggregated as others – FAO 2007)

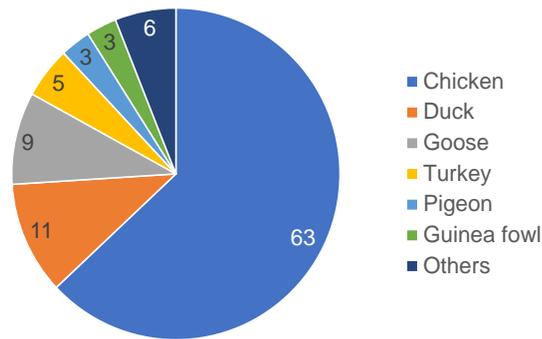
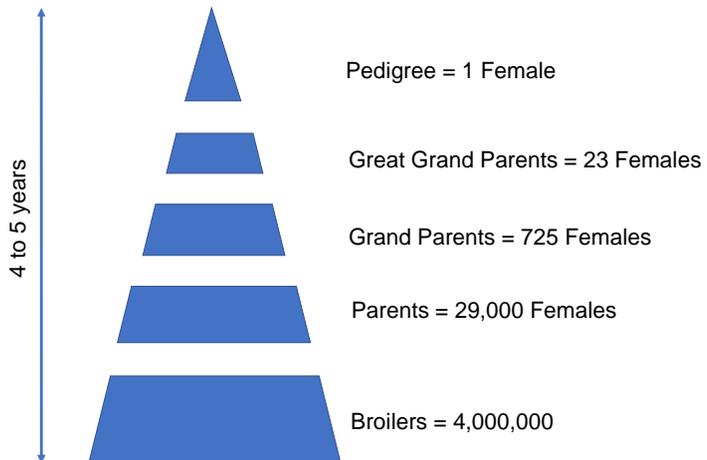
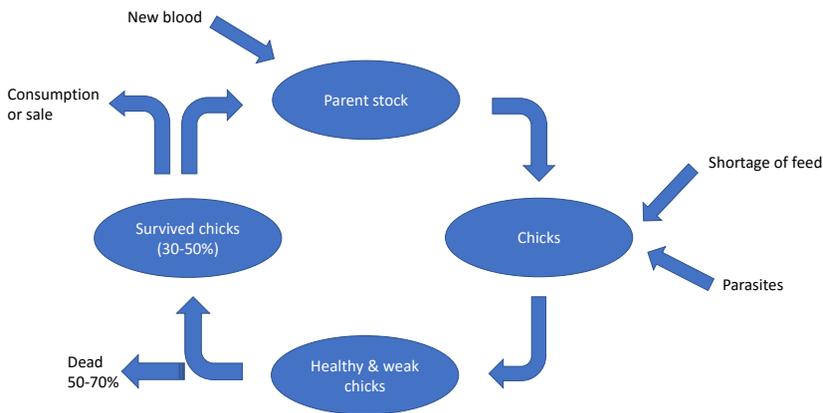


Figure 2. Genetics pyramid of commercial production intensive system.



The village or backyard indigenous chickens production system is summarized in Figure 3, where a parent stock is substituted every year (Choprakarn et al., 1983). In a village or backyard indigenous chickens production system, the parent stocks are used up to 2–3 years old depending on their performance. The next generation of chickens may descend from the same flock or be introduced from within or outside the village. Recommendations for parent-stock selection are, for males, high body weight and long legs, and for females, good maternal ability, i.e. producing at least 9 eggs/clutch, good behaviour during incubation and when taking good care of her broods. Another important criterion for parent stock is no cannibalism of their own chicks (Klinhom et al., 2005; Laopaiboon and Jitpraneechai, 1999; Namdaeng, 1991). The survival rate of village or backyard production system, from one-day old to marketable size, is 30-50 percent. Therefore, a typical hen can produce 10–15 market-sized birds annually (Choprakarn et al., 1983; Choprakarn et al., 1984; Namdaeng, 1991).

Figure 3. A village or backyard indigenous chickens production system



The village or backyard indigenous chickens production system dominates the rural poultry sector of most African countries, and the domestic fowl (*Gallus domesticus*) is the most common species. The term village chicken best describes the scavenging chickens because of the effect of the village socio-economic and biophysical environment on the production and health status of the chickens. The human settlement pattern, communal housing of chickens, exchange of live chickens and chicken products affect production performance, breeding pattern and disease epidemiology.

The focus on gender is adopted in the study on the assumption that improving the village chicken production systems in rural Africa will result in increased opportunities and more equitable distribution of food and

income within and among households in rural Africa. This school of thought is supported by the following facts about the production system:

- the management of village chickens can easily be combined with other activities because of the proximity of the chickens to homesteads (Bradley, 1992);
- chicken products are among the few agricultural products directly accessible to women in rural areas and increased food production from chickens will improve household food security;
- village chicken production is not strongly linked to land resource, which is one of the main production constraints among the disadvantaged members of the community.

Finally, for village chicken improvement programmes to have a positive impact on household economies and gender equity, women's concerns should be integrated in the programmes as a gender variable. This would require a more explicit understanding of gender issues in village chicken production systems through gender analysis. Gender refers not to women or men per se, but to the relations between them, both perceptual and material. Gender is not determined biologically, as a result of sexual characteristics of either women or men, but is constructed socially. It is a central organizing principle of societies and often governs the processes of production and reproduction, consumption and distribution. Gender roles are the “social definition” of women and men, and vary among different societies and cultures, classes and ages, and during different periods in history. Gender-specific roles and responsibilities are often conditioned by household structure, access to resources, specific impacts of the global economy, and other locally relevant factors such as ecological conditions.

In table 1 are showed the differences between the two main poultry production system in the world: intensive commercial system and village or backyard system. Breed and flock size, housing, feed resource, health programme, markets, infrastructure, product storage and processing as technology and information are the characteristics that change more than others between the two main production systems.

### **Market demands for future**

Economic development and globalization, changing market demands, environmental impacts including climate change, and trends in science and technology are the major drivers that will change influencing the management of poultry genetic resources. Until now, globalization has favour intensive production systems and the use of a narrow range of genetic resources. However, market demands are changing, mainly in the developed world; this could constitute an opportunity for local poultry populations. Therefore, local or indigenous breeds make up most of the world's poultry genetic diversity, at the contrary commercial hybrids make up most of the world's poultry amount of products. Monitoring poultry genetic resources is not always a priority for certain countries, but characterization activities

remain an important research activity because of includes collection of data on population size and structure, geographical distribution, production systems in which the breed is found, phenotypic attributes (physical features, performance levels and any unique features), historical development of the breed (crossbreeding, selection). Such data can be available for standardized breeds and experimental lines, but are generally confidential for commercial lines and difficult to record for village chickens. However, these information are a treasure for whole human society and need to be support with national and international funds.

Table 1. Characteristics of poultry production systems

<b>Characteristic</b>	<b>Intensive commercial system</b>	<b>village or backyard system</b>
Breed and flock size	Specialized breeds: 500–5 000	Local indigenous type: <50
Housing	Modern housing, generally with concrete walls and regulated internal environment	Specific poultry houses are rare
Feed resource	Commercially compounded feeds	Scavenging and occasional feeding with home grains and household refuse
Health programme	Standard and regular animal health programme	No regular health programme of disease control measures in place
Markets	Cold chain system for input-output distribution	No formal marketing channels
Infrastructure	Water, electricity and communication available	Underdeveloped infrastructure
Product storage and processing	Products refrigerated; dressed birds and table eggs refrigerated	No refrigeration, sales of live birds and eggs
Technology/information	Formal training, extension services available - information disseminated through producer and consumer associations	Local knowledge, with moderate or no extension services

The present hot topics to improve in the global poultry sector are based on animal welfare, gut health, leg health, antibiotic free production, on disease robustness and resilience aspects, genotype-by-environmental interaction, water efficiency, feed conversion rate in contrasting environments, on social, environmental and economic sustainability, on new habit and consumer preferences and perceptions, on muscle myopathies as white striping and wooden breast, on new scientific development and applicative perspectives of genomic approaches, sequencing and in particular on gene editing.

### **Conclusion and References**

In conclusion, the phenotypes to be correlated with genomic information will determine future success of the poultry genetic resources. Considering the diversification of market, changing of production conditions and the new habits of consumers, all these perspectives are pushing the breeders may be interested in high resilient animals, which can maintain a good level of production and quality products, without antibiotic used and across a range of different environments. If breeding companies succeed in providing such genotypes, able to produce much better than local populations in harsh environments, then indigenous genetic resources are likely to disappear rapidly, or in the best-case scenario local commercial chickens would drive the local indigenous ones out of the market. Yet, it should be recalled that local chickens not only provide meat and eggs, but are also maintained for their cultural and historical values, therefore poultry genetic resources need to be appreciated, valorized and preserved not only for economic scopes, but also for social and historical-traditional aims, using financial support as commonly used for a social services.

Bradley, F.A. 1992. A historical review of women's contributions to poultry production and the implications for poultry development processes. In Proceedings, 19th World Poultry Congress, Amsterdam, the Netherlands, 20-24 September 1992, p. 693–696.

Choprakarn, K., Thammabutr, S. & Suriyachantratong, W. 1983. Problems and approach relating to improving of Thai indigenous chickens. In Proceedings of the First Seminar on Thai Indigenous Chickens, pp. 60–67. Khon Kaen, Thailand Northeastern Regional Office of Agriculture. (original in Thai).

Choprakarn, K., Thammabutr, S., uppatum, n. & Suriyachantratong, W. 1984. A study on survival rate and growth rate of Thai indigenous chickens. In Abstracts of the Animal Science Research, 22nd Annual Conference, Kasetsart University. Bangkok, Thailand. (original in Thai).

FAO. 2007. The State of the World's Animal Genetic Resources for Food and Agriculture, edited by B. Rischkowsky & D. Pilling. Rome.

- Guèye, E.F. 1998. Village egg and fowl meat production in Africa. *World's Poultry Science Journal*, 54(1): 73–86.
- Klinhom, u., Wongsaman, c., kanhareing, S., Treemane, S., Suekaew, P., utarask, P. & Pimdee, k. 2005. Native chicken production and management by using indigenous knowl- edge in the northeast of Thailand. Technical report submitted to Thailand Research Fund. 70 pp. (original in Thai, English abstract).
- Laopaiboon, B., & Jitpraneechai, S. 1999. Study on native chickens production in the villages of Amphur Muang, Changwat Khon Kaen. (original in Thai, English abstract).
- Namdaeng, P. 1991. Factor contributing to mortality of indigenous chicken raising in Northeast Thailand. Khon Kaen University, Thailand. (Master's thesis, original in Thai, English abstract).
- Pym, R.A.E., Guerne Bleich, E. & Hoffmann, I. 2006. The relative contribution of indigenous chicken breeds to poultry meat and egg production and consumption in the developing countries of Africa and Asia. In *Proceedings of the XII European Poultry Conference*, 10–14 September, 2006, Verona, Italy. CD Rom.

## Antioxidant Supplementation and Its Effect on Alleviation of Negative Effects of Stress: Molecular and Genetic Basis

Kazim Sahin<sup>a\*</sup>, Cemal Orhan<sup>a</sup>, Mehmet Tuzcu<sup>b</sup>, Nurhan Sahin<sup>a</sup>

<sup>a</sup>Department of Animal Nutrition, Faculty of Veterinary Science, Firat University, Elazig, Turkey

<sup>b</sup>Department of Molecular Biology, Faculty of Science, Firat University, Elazig, Turkey

### Abstract

Heat stress is one of the main causes of production and profit loss in the poultry industry. In particular, productivity and feed efficiency, growth rate, egg production and egg quality are suppressed as a result of heat stress. Heat stress has been associated with decreased nutrient utilization and protein retention, and increased lipid accumulation. High temperatures also lead to oxidative stress associated with a reduced antioxidant status in the bird *in vivo*, as reflected by increased oxidative damage and lowered plasma concentrations of antioxidants. Heat stress adversely affect the structure and physiology of the cell, causing impairment of transcription, RNA processing, translation, oxidative metabolism, and membrane structure and function. Several methods are currently available to alleviate the negative effects of high environmental temperature on the performance of poultry. In terms of reducing the negative effects of environmental stress, antioxidants are used in the poultry diet because of the reported benefits of these supplements including their anti-stress effects and also due to the fact that their utilization and thus normal concentrations are reduced during heat stress. In this review, we present the effects of antioxidants including phytochemicals, vitamins and minerals against high ambient temperature. In particular, the molecular mechanisms by which these substances react to temperature stress are described in detail. For instance, the cell-signaling pathways regulated by antioxidants alone include transcription factors [nuclear factor kappa-light-chain-enhancer of activated B cells (NF- $\kappa$ B) and nuclear factor (erythroid-derived 2)-like 2 (Nrf2) and activator protein-1 (AP-1) that regulate cyclooxygenase-2 (COX-2). We will also address some of the mechanisms proposed for the heat stress preventive activity of antioxidants focusing on the induction of antioxidant enzymes (phase II enzymes) through the activation of the antioxidant response element (ARE) transcription system. In addition, we present evidence that antioxidants interfere with several cell nutrient transporters including fatty acid-binding proteins (FABPs), fatty acid transport proteins (FATPs), glucose transporters (GLUTs), sodium-glucose cotransporters (SGLTs), the peptide transporters 1 (PepT-1) and 2 (PepT-2).

**SESSION-5**  
**GENETICS AND GENOMICS**  
**SHORT ORAL PRESENTATIONS**

## Determination of Polymorphism in the Dopamine D2 Receptor (DRD2) Gene in Five White Layer Lines Using PCR-RFLP Method

Eymen Demir<sup>a</sup>, Taki Karsli<sup>a</sup>, Murat Soner Balcioglu<sup>a</sup>, Hüseyin Göktuğ Fidan<sup>a</sup>, Mehmet Aslan<sup>a</sup>, Sedat Aktan<sup>b</sup>, Bahar Argun Karsli<sup>a</sup>, Kemal Karabağ<sup>c</sup>, Emine Şahin<sup>d</sup>

<sup>a</sup>Faculty of Agriculture, Department of Animal Science, Akdeniz University, Antalya, Turkey

<sup>b</sup>Faculty of Agriculture, Department of Animal Science, Suleyman Demirel University, Isparta, Turkey

<sup>c</sup>Faculty of Agriculture, Department of Agricultural Biotechnology, Akdeniz University, Antalya, Turkey

<sup>d</sup>Korkuteli Vocational School, Akdeniz University Korkuteli, Antalya

### Abstract

Vasoactive intestinal peptide (VIP) secreted from hypothalamus gland ensures releasing of prolactin by binding to receptors in the anterior pituitary. VIP is known prolactin (PRL) secreting factor in avian. There is a positive correlation between VIP amount and prolactin level in circulation. Furthermore dopamine, a neurotransmitter in brain, and its two receptors (DRD1 and DRD2) and VIP are involved in PRL secretion. Dopamine and its two receptors are effective in controlling PRL by affecting VIP releasing. The aim of this study was to determine polymorphism of DRD2 gene in five layer chicken lines raising in Ankara Poultry Research Institute. PCR-RFLP was used to determine polymorphism of DRD2 gene. 248 bp PCR fragments were digested with *Bse*GI restriction enzyme after PCR process. Including CC (248 bp), CT (248, 196 bp) and TT (196 bp), three genotypes were found at DRD2 gene. C allele frequency ranged from 0.175 (D-229 line) to 0.687 (Maroon line), while T allele frequency ranged from 0.313 (Maroon) to 0.825 (D-229). Although T allele frequency was higher than C allele frequency in Black, Brown, Blue and D-229 lines, T allele frequency was found lower than C allele frequency in Maroon line. No TT genotyped individual was found in Maroon line. The results obtained from this study have shown that DRD2 gene can be used in MAS (Marker Associated Selection) studies for egg production in five layer chicken lines raising in Ankara Poultry Research Institute.

### Introduction

Studies on breeding material in Turkey are carried out only by Ankara Poultry Research Institute. In institute whose establishment dates back to 1930s, studies on obtaining broiler and layer hybrids showed that obtained hybrids couldn't compete with foreign hybrids. After determining that present lines weren't enough, institute imported 4 white lines (Black Line,

Brown Line, Blue Line, Maroo Line) and 6 brown lines (Rhode Island Red I, Rhode Island Red II, Barred Rock I, Barred Rock II, Colombian Rock, Line-54) from Canada in 1995. Also D-229 which is white line was imported from Czech Republic in 2010. Today, institute which has 5 white and 6 brown layer lines has a target to increase egg yield and to decrease food consumption in present lines. These lines are imported for our country because they are only breeding material in Turkey. Considering the long-term interests of our country, breeding studies on these lines should continue increasingly (Durmuş et al. 2008; Anonymous 2014).

Thanks to development in molecular biology and genetics, in the recent 30 years, studies based on classical Mendel genetic have come to the molecular level. Since discovery of PCR, a number of PCR-based molecular methods have been developed. Today, PCR (Polymerase Chain Reaction) , RFLP (Restricted Fragment Length Polymorphism) , AFLP (Amplified Fragment Length Polymorphism) DNA Sequence Analysis, SSCP (Single Strand Conformation Polymorphism) and microsatellite DNA analysis could be shown as the most used DNA marker methods in the field of animal production (Karşlı et al. 2008, Karşlı et al. 2013). These and similar technologies could be used to increase the quantity and quality of features which are economically important, to genetic resource conversation programs by using genetic variations (Zanetti et al. 2010, Tadano et al. 2012, Ceccobelli et al. 2015), to determine genetic diseases (Karşlı et al. 2011, Şahin et al. 2013) , to identify parents (Özşensoy et al. 2014), to identify loci associated with quantitative traits and to obtain individuals who are resistant to various diseases (Minvielle et al. 2005, Teneva and Petkoviç 2010, Hako Touko et al. 2013).

Most of the economic traits of livestock show quantitative inheritance and a large number of genes with environmental conditions affect their phenotype expression. Egg yield and quality which have economic value in poultry show polygenic inheritance and also they have low heritability. In chickens egg production system begins to develop by reaching sexuality and it is shaped by many factors and their interactions. Egg yield and quality are influenced not only by genetic infrastructure but also by many environmental factors such as photoperiod length and feeding conditions. In addition to classical breeding studies in chickens, identification of candidate genes for egg production and quality with QTL and using them either together or individually in MAS, will be successful in selection and improve genetic progress (Li et al. 2009; Uemoto et al. 2009, Xu et al. 2011).

Candidate genes that may be used for egg production and quality in poultry include *Gonadotropin releasing hormone (GnRH)* (Xu et al. 2011), *Insulin-like growth factor (IGF-I)*, *Growth hormone (GH)* (Li et al. 2008), *Prolactin (PRL)* (Abdi vd 2014), *dopamine (DA)* (Xu et al. 2010), *Neuropeptide (Y NPY)* (Li et al. 2009), *Vasoactive intestinal peptide(VIP)* (Zhou et al. 2010), *Ovocalycin-32* (Uemoto et al. 2009), *Melatonin* (Li et al.

2013a) and their receptors. The subject of this study was to determine polymorphism of DRD2 gene in five white chicken layer lines raising in Ankara Poultry Research Institute.

## **Materials and Methods**

### ***Experimental populations***

Materials of present study consist of DNA isolated from five white layer line raising in Ankara Poultry Research Institute. Total 178 sample from Blue (n:40), Brown (n:40), D-229 (n:40), Black (n:26) and Maroon (n:32) were used. For DNA isolation, 2 ml blood was taken from vein under wings, *venous cutanea ulnaris*, of chickens and decanted to tubes with EDTA. Blood samples were stored at -20 °C until DNA isolation was performed.

### ***DNA Isolation and PCR-RFLP Process***

In this study, DNA isolation protocol reported by Miller (1988) was used for DNA extraction. Polymorphisms on the candidate gene of DRD2 arise from a point mutation. PCR-RFLP is the most useful method to determine mutations which is known. To determine polymorphism on DRD2 gene, primers (Forward: TGCACATAAAAGCCCACTCACTG and Reverse: GCCTGAGCTGGTGGGGGG) were used in PCR process.

The PCR programme was performed 30cycle of preliminary denaturation at 95 °C for 5 min, denaturation at 95°C for 45 s, annealing at 60 C for 45 s, extension at 72 °C for 45 s, and wit final extension step for 10 min at 72°C. The PCR products were separated by 2.0% agarose gel electrophoresis. The amplified fragment of DRD2 gene was digested with *BseGI* restriction enzyme as 8 µL of PCR production, 5U restriction enzyme, 5.3 µL H<sub>2</sub>O and 1.2 µL buffer Tango.

### ***Statistical analysis***

Gene and genotype frequencies in populations were obtained by using PopGen32 programme. In addition, populations were tested using Chi-Square statistic to determine whether there was deviation from Hardy-Weinberg equilibrium (Hartl and Clark 1989).

## **Result and Discussion**

248 bp length fragments were obtained by PCR process for DRD2 gene. After PCR process, 248 bp, 248 and 196 bp, 196 bp length fragments were obtained as CC, CT and TT genotypes respectively (Figure 1).

Three genotypes were found at DRD2 gene including CC, CT and TT. C allele frequency ranged from 0.175 (D-229) to 0.687 (Maroon), while T allele frequency ranged from 0.313 (Maroon) to 0.825 (D-229). Although T allele frequency was higher than C allele frequency in Black, Brown, Blue and D-229 lines, T allele frequency was found lower than C allele frequency in Maroon line. No TT genotyped individual was found in Maroon line (Table 1).

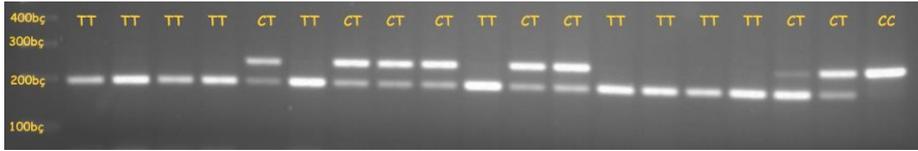


Figure 1 Digestion of DRD2 PCR products with *BseGI* restriction enzyme (Marker: Thermo, 100 bp, Cat. No: SM0241; 2.0% agarose gel, Digestion fragments TT: 81-167 bp, TC: 81-167-248 bp, CC: 248 bp)

Table 1. Allele and Genotypes frequencies for DRD2 gene

White Layer Lines	Gene	n	Allele Frequency		Genotype Frequency			$\chi^2$
			C	T	CC	CT	TT	
Black	DRD2	26	0.307	0.693	0.038	0.538	0.424	1.811 <sup>a</sup>
Brown	DRD2	40	0.262	0.738	0.075	0.375	0.550	0.040 <sup>a</sup>
Blue	DRD2	40	0.425	0.575	0.150	0.550	0.300	0.628 <sup>a</sup>
Maroon	DRD2	32	0.687	0.313	0.375	0.625	0.000	6.612 <sup>b</sup>
D-229	DRD2	40	0.175	0.825	0.025	0.300	0.675	0.061 <sup>a</sup>

$\chi^2_{0.05;1}$ : 3.84; a: not significant from deviation from Hardy-Weinberg equilibrium

Xu et al. (2011) reported that the 300-day egg yield of the TT genotype individuals for the Dopamine D2 receptor (DRD2) gene in chickens was higher than that of CC and TC genotypes. Xu et al. (2011) reported the TT genotype frequency as 0.04 in Ningdu chicken breed. In this study, TT genotype frequencies obtained in white layer chicken lines excluded Maroon line are significantly higher than the values reported in Ningdu chickens. The underlying reason for this may be selection process for egg production in these lines.

Polymorphisms on DRD2 gene in five white layer lines reared at the Ankara Poultry Research Institute were shown for the first time. The results obtained from this study have shown that DRD2 gene can be used in MAS studies for egg production in white egg lines reared at the Ankara Poultry Research Institute.

## References

- ABDİ, M., SEYEDABADI, H. and GORBANI, A. (2014). Prolactin and NPY gene polymorphism and its associations with production and reproductive traits in west-Azarbaijan native chicken. *Bull Env Pharmacol Life Sci.* 3: 39-45.
- ANONİM (2014). Ankara Tavukçuluk Araştırma İstasyonu Müdürlüğü, <http://arastirma.tarim.gov.tr/tavukculuk/Menu/48/Tarihce> (Erişim Tarihi: 01.12.2014).
- CECCOBELLİ, S., KARSLI, T., DI LORENZO, P., MAROZZI, G., LANDI, V., SARTI, F.M., SABBIONI, A. and LASAGNA, E. (2015). Genetic diversity of Cornigliese sheep breed using STR markers. *Small Ruminant Research.* 123: 62–69.

- DURMUŞ, İ., SARICA, M., AKTAN, S., YILDIZ, T., KAHRAMAN, Z. and ERTAŞ, S. (2008). Geliştirilmekte olan yerli ticari yumurtacı hibritlerin verim özelliklerinin belirlenmesi. *Tavukçuluk Araştırma Dergisi*. 8: 15-19.
- HAKO TOUKO, B.A., KEAMBOU, T.C., HAN, J.M., BEMBİDE, C., CHO, C.Y., SKİLTON, R.A., DJİKENG, A., OGUGO, M., MANJELİ, Y., TEBUG TUMASSANG, T., ZOLİ, P.A. AND OSAMA, S. 2013. The Major Histocompatibility Complex B (MHC-B) and QTL Microsatellite Alleles of Favorable Effect on Antibody Response against the Newcastle Disease. *International Journal of Genetic Research* 1(1): 1-8.
- HARTL, D.L. and CLARK, A.G. (1989). *Principles of Population Genetics*. Second Edition. Sinauer Associates, Inc., Sunderland, Massachusetts, pp.37
- KARSLI, T., BALCIOĞLU, M.S. and ALKAN, S. (2008). Sığırlarda Otozomal Resesif Kalıtım Gösteren Bazı Genetik Hastalıklar ve Moleküler Tanısı. *Hayvancılık Araştırma Dergisi*. 18 (1): 32-39.
- KARSLI, T., KARABAĞ, K. and BALCIOĞLU, M.S. (2013). Çiftlik Hayvanlarında DNA Teknolojileri ve Biyoteknoloji Kullanımı. İç Anadolu Bölgesi 1. Tarım ve Gıda Kongresi. Cilt III (Hayvansal Üretim), s:46-52. 2-4 Ekim 2013 NİĞDE.
- KARSLI, T., ŞAHİN, E., KARSLI, B.A., ALKAN, S. and BALCIOĞLU, M.S. (2011). Identification of alleles for factor XI (FXID) and uridine monophosphate synthase (DUMPS) deficiencies in Holstein cows reared in Antalya. *Kafkas Univ Vet Fak Derg*. 17 (3): 503-505.
- Lİ, H., ZHU, W., CHEN, K., WU, X., TANG, Q. and GAO, Y. (2008). Associations between GHR and IGF-1 Gene polymorphisms, and reproductive traits in Wenchang Chickens. *Turk J Vet Anim Sci.*, 32: 281-285.
- Lİ, H.F., ZHU, W.Q., CHEN, K.W., WU, X., TANG, Q.P., GAO, Y.S., SONG, W.T. and XU, H.L. (2009). Polymorphism in NPY and IGF-I genes associate with reproductive traits in Wenchang chicken. *Afr J Biotechnol.*, 8: 4744-4748.
- Lİ, D.Y, ZHANG, L., SMİTH, D.G., XU, H.L., LİU, Y.P., ZHAO, X.L., WANG, Y. AND ZHU, Q. (2013). Genetic effects of melatonin receptor genes on chicken reproductive traits. *Czech J. Anim. Sci.*, 58 (2): 58–64.
- MİNVIELLE, F., KAYANG, B.B., INOUE-MURAYAMA, M., MİVA, M, VİGNAL, A., GOURICHON, D., NEAU, A., MONVOISIN, J.L. AND ITO, S. (2005). Microsatellite mapping of QTL affecting growth, feed consumption, egg production, tonic immobility and body temperature of Japanese quail. *BMC Genomics*. 6 (87):1-9.
- MİLLER, S., DYKE, S D. and PLESKY, HA. (1988). Simple salting out procedure for extracting DNA from human cells. *Nucleic Acids Res*. 16: 1215.

- ÖZŞENSOY, Y., KURAR, E., DOĞAN, M., BULUT, Z., NİZAMLIOĞLU, M., IŞIK, A., ÇAMLIDAĞ, A. and ALTUNOK, V. (2014). Genetic characterization of Turkish cattle breeds by microsatellite markers: Usefulness for parentage testing. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*. 20 (4): 521-526.
- ŞAHİN, E., KARSLI, T., GALIÇ, A. and BALCIOĞLU, M.S. (2013). Identification of Bovine Leukocyte Adhesion Deficiency (BLAD) and BC (Bovine Citrullinemia) alleles in Holstein cows reared in Antalya region. *Journal of Applied Animal Research*. 41 (1): 56-60.
- TADANO, R., NAKAMURA, A. and KİNO, K. (2012). Analysis of genetic divergence between closely related lines of chickens. *Poultry Science*. 91: 327–333.
- TENEVA, A. and PETROVIĆ, M.P. (2010). Application of molecular markers in livestock improvement. *Biotech Anim Husb*. 26 (3): 135-154.
- UEMOTO, Y., SUZUKI, C., SATO, S., OHTAKE, T., SASAKI, O., TAKAHASHI, H. And KOBAYASHI, E. (2009). Polymorphism of the ovocalyxin-32 gene and its association with egg production traits in the chicken. *Poult Sci*. 88: 2512–2517.
- XU, H.P., ZENG, H., ZHANG, D.X., JIA, X.L., LUO, C.L, FANG, M.X., NIE, Q.H. and ZHANG, Q.X. (2011). Polymorphisms associated with egg number at 300 days of age in chickens. *Genet Mol Res*, 10: 2279-2289.
- ZANETTI, E., DE-MARCHI, M., DALVIT, C. and CASSANDRO, M. (2010). Genetic characterization of local Italian breeds of chickens undergoing in situ conservation. *Poultry Science*. 89: 420–427.

## **Productive and reproductive performances of different poultry breeds conserved in northeast of Italy**

**Martino Cassandro<sup>a</sup>, Filippo Cendron<sup>b</sup>**

Department of Agronomy, Food, Natural resources, Animals and Environment, University of Padova, Viale dell'Università 16, 35020 Legnaro, PD, Italy

### **Abstract**

Aim of this study was to evaluate the productive and reproductive performances in Veneto local chicken breeds (Padovana-PA, Ermellinata-EA, and Pepoi-PI, Polverara-PO, Robusta-RO and Millefiori-MI) under conservation scheme. The productive traits were live weights at 190 days of age and average daily gain, while the reproductive traits were fertility and live born chicks. Analysis of variance was applied for all traits considering the fixed effects of breed, sex and family's membership. In conclusion, strategies to increase add value for these local breeds should be provided in order to guarantee profit for farmers that are preserving these animal genetic resources.

**Key words:** *Chicken; Local breed, Conservation, Meat quality, Eggs production.*

### **Introduction**

In Veneto region of Italy, the poultry biodiversity was considered worthy of protection and enhancement due to historical, socio-cultural and productive potential. Among the causes of limited diffusion of these populations, the most noteworthy is the maddening offer standardized products that wide spread use of crossbreeding and genotypes are able to achieve with production performance. Impacts of this global genetic erosion due to similar reasons can also seen in several developed countries (Hoffmann, 2009).

Currently, the conservation of avian genetic resources is part of institutional activity in many Italian university and public funds are destined for facing this threat as well. Moreover, local chicken breeds may represent a source of gene for future breeding strategies and research (De Marchi et al., 2006), and their conservation has become an important issue for the international scientific community (Rischkowsky and Pilling, 2007). Fortunately, the expectation of modern consumers has evolved toward the demand of traditional products, usually, more respectful of the environment and of animal welfare; therefore, rural poultry production is gaining more and more interest (Castellini et al., 2002, 2006).

In order to facilitate the biodiversity, the conservation of breeds and counteract the process of globalization, the development of local and niche markets are an interesting approach in the poultry industry. This can also guarantee profits for farmers through local breeds that are superior to commercial hybrids due to certain phenotypic and genetic traits such as hardiness, disease resistance and meat quality (Reiter and Bessei, 1996). The conservation aims to maintain the genetic purity of breeds by implementing procedures that have proved successful reproduction and traceability of lineages at different stages of the reproductive cycle and the selection of the comeback of juveniles obtained.

Local chicken breeds of slow-growing rate, as Padovana (PA), Ermellinata (EA), Pepoi (PI), Polverara (PO), Robusta (RO) as well as, Millefiori (MI), are typically reared in extensive systems, and they could provide interesting alternatives to commercial broilers in niche markets. The recent development of organic animal production and consumer request for food safety and sustainable systems of production might encourage the use of local chicken breeds for several niche markets. Productive performance along with genetic diversity, reproductive and adaptive characteristics, and historical interest, are highly relevant to the inclusion of local breeds in conservation programmes (Ruanne, 1999).

Aim of this study was to evaluate the productive and reproductive performances in Veneto local chicken breeds (Padovana-PA, Ermellinata-EA, and Pepoi-PI, Polverara-PO, Robusta-RO and Millefiori-MI) under conservation scheme.

### **Materials and Methods**

Animal diets and experimental procedure: all chickens were provided with a high-protein grower diet; the ingredients were maize flour, toasted soybean meal, maize gluten meal, maize gluten, soybean oil, calcium phosphate, calcium carbonate, sodium chloride, and DL-methionine.

Genotype of poultry breeds: chickens were from nine genotypes, the Padovana Dorata (PAD) and Camosciata (PAC), Pepoi (PI), Polverara Bianca (POB) e Nera (PON), Ermellinata di Rovigo (EA), Robusta Maculata (ROM) e Lionata (ROL), Millefiori di Lonigo (MI).

**Statistical analysis:** data were subjected to analysis of variance (ANOVA) by the *generalized* linear model (GLM) procedure considering breed as fixed effect using SAS® software (1997, SAS Institute, Cary, NC), according with following fixed effect linear model :  $Y_{ijklm} = \text{mean} + \text{Genotype}_i + \text{Sex}_j + \text{Age}_k + \text{Family}_k + b \cdot \text{weight}_l + \text{error}_{ijklm}$  . For breed effect, a multiple comparison of least square means was performed using the Bonferroni's test.

## Results and Discussion

Live Weights (LW) of poultry breeds at 190 d of age were resulted significantly different among the poultry breeds. ROM, ROL, EA and MI have shown heavier live weight, while PI reported lighter breast weight than all breeds. The PO and PA chickens exhibited medium LW.

The chickens were treated with a specific diet, same for all breeds; the means of weights of ROM, ROL, MI and EA at 190 d, were  $2080 \pm 520$  gr,  $1972 \pm 326$  gr,  $2042 \pm 529,7$  gr and  $1890 \pm 477$  gr respectively, confirming these breeds as the heaviest among those analyzed. PI breed have been shown the lightest LW with  $1060 \text{ gr} \pm 216,3$  gr, while in the other breeds, the LW was positioned in the middle of the collected weights scale (PAC and PAD,  $1460 \pm 298,3$  gr and  $1530 \pm 343.1$  gr respectively, POB,  $1350 \pm 359,3$  gr, PON  $1250 \pm 306,4$  gr, MI  $2042$  gr).

The weight classification is sustained by the *adg*, that reaches its maximum with RO breed ( $13,3 \pm 1,74$  gr/day) and its minimum with PI chicken ( $6,45 \pm 1,39$  gr/day). The other breeds shown an intermediate *adg*; indeed, PAC and PAD shown  $8,60 \pm 1,70$  gr/day and  $9,01 \pm 1,86$  gr/day respectively, POB  $7,07 \pm 1,68$  gr/day, PON  $8,06 \pm 1,81$  gr/day, EA  $11,1 \pm 2,46$  gr/day and MI  $13,3 \pm 1,57$  gr/day. These results confirm and reinforce LW data, underlining the weak phenotype of PI.

Mainly, local breeds have shown a low LW and *adg*, compared with commercial line; however, it is possible to improve their productive performances without compromising the peculiar quality by means of crossbreeding strategies (Cassandro et al., 2015).

In order to evaluate the fertility, ~ 400 eggs from each poultry breeds were collected and incubated; the vitality of embryos was strictly monitored until 6<sup>th</sup> or 7<sup>th</sup> day of incubation, and before to be transferred to eggs hatch room. The collected data show that PAD and PAC, POB and PON, and EA have high fertility with percentage of live born chickens between 90% - 92%. ROM and ROL have good fertility with values around 85 % and 80 % respectively, while PI shown lower percentage of fertility (~70%). The chickens that have the greater number of births were PAD and PAC (~88 %), while PI is characterized by lower percentage (48%). All other breeds reported a percentage of births between 60 % - 80 %. PI also in this contest was result the weakest breed.

## Conclusion and References

From the comparison of the results, the RO and MI chickens were the breeds with the higher average body weight; in particular ROM that was the heaviest, while the PI breed showed the lower weight than all the others. Interestingly, also the *adg* factor is weak in the PI breed as well as reproductive performance. These data show that PI chicken is the weakest than all the other breeds both for productive and reproductive characteristics.

Moreover, in order to value the trade and the diffusion of these local chicken breeds in the rural environment of Veneto area, we are creating an official herd book of each chicken breed; through this way the conservation of native breeds with limited diffusion and the genetic traceability can be monitored, examined and conserved with constancy and precision.

In conclusion, a strictly conservation that need to be evaluated not only per unit of output but for others direct and indirect units of output related to social and human return, can guarantee profits for farmers.

### References

- CASTELLINI, C., DAL BOSCO, A., MUGNAI, C., & PEDRAZZOLI, M. (2006). Comparison of two chicken genotypes organically reared: oxidative stability and other qualitative traits of the meat. *Italian Journal of Animal Science*, 5(1), 29-42.
- CASTELLINI, C., MUGNAI, C. A. N. D., & DAL BOSCO, A. (2002). Effect of organic production system on broiler carcass and meat quality. *Meat science*, 60(3), 219-225.
- DE MARCHI, M., DALVIT, C., TARGHETTA, C., & CASSANDRO, M. (2006). Assessing genetic diversity in indigenous Veneto chicken breeds using AFLP markers. *Animal genetics*, 37(2), 101-105.
- HOFFMANN, I. (2009). The global plan of action for animal genetic resources and the conservation of poultry genetic resources. *World's poultry science journal*, 65(2), 286-297.
- REITER, K., & BESSEI, W. (1996). Effect of the distance between feeder and drinker on behaviour and leg disorders of broilers. In *Proceedings of the 30th International Congress of the International Society for Applied Ethology: 14-17 August, 1996, Guelph, Ontario, Canada. Guelph, Ont.: Colonel KL Campbell Centre for the Study of Animal Welfare, c1996.*
- RISCHKOWSKY, B., & PILLING, D. (2007). The state of the world's animal genetic resources for food and agriculture. *Food & Agriculture Org.*
- RUANE, J. (1999). Selecting breeds for conservation. *Gene banks and the conservation of farm animals' genetic resources* (Ondenbroek JK, ed). Lelystad, The Netherlands: DLO Institute for Animal Science and Health, 59-74.

**SESSION-6**  
**INCUBATION**

**INVITED PRESENTATIONS**

## **Incubation period and its effect on postnatal development in chickens**

**Henry van den Brand, Roos Molenaar**

Adaptation Physiology Group, Department of Animal Sciences, Wageningen University and Research, Wageningen, the Netherlands

### **Introduction**

Worldwide poultry meat consumption is expected to increase with 2.2% per year over the next decade (USDA, 2015). The popularity for poultry meat is related to the healthy character, the acceptability to all religions and the relatively low price compared to other meats. Parallel to the fast growing demand of poultry meat, the poultry sector is facing new challenges and already existing challenges become more important. These challenges are among others: 1) Animal health and welfare; 2) Product safety; 3) Product quality and 4) Efficiency of production. To overcome these challenges, it is important to have healthy and vital chickens at hatching and that these chickens can withstand (infectious) challenges in later life and produce a nutritious and healthy product at slaughter age.

Chicken quality at hatching is influenced by egg composition, pre-incubation conditions and incubation conditions. Egg composition, including eggshell conductance, is particularly determined by the breeder diet, breeder age and egg size (Nanguay, 2016). Pre-incubation conditions that influence viability and chicken quality are storage duration and storage conditions, such as the temperature (Reijrink et al., 2008). Incubation conditions affecting chicken quality includes a wide variety of factors, such as incubation temperature, relative humidity, gas concentrations (CO<sub>2</sub>, O<sub>2</sub>), air velocity, light, noise level and dust (Molenaar et al., 2010a; De Gouw et al., 2017).

Within the limited space of this overview, we will focus on incubation temperature. Incubation temperature has been considered as the most important incubation factor (Decuypere and Michels, 1992; Meijerhof, 2009), not only affecting embryonic development and hatchling quality, but also later life performance, health and robustness.

### **Temperature during natural and artificial incubation**

In nature, a hen is brooding a clutch of approximately 15 eggs. The hen is incubating the eggs by using her so called 'brood patch', which has a temperature of approximately 41°C. The temperature at the bottom of the nest is considerably lower, resulting in the presence of a temperature gradient across the egg. Additionally, the hen is turning her eggs and leaving the nest regularly (Archer and Mench, 2014), which means that the egg, including the embryo, is exposed to temperature fluctuations. Both aspects

suggest that the embryo is able to adapt to temperature differences and an indication is found in the capability of the embryo to redistribute its blood flow within the egg (for review see Tzschentke, 2007).

However, in artificial incubation there is no temperature gradient across the eggs, which means that it is essential to provide the embryo with the correct temperature to optimise its survival and development, as the embryo has very limited capacity to change its temperature. This is even more difficult, because during the incubation process the egg is continuously losing heat via evaporation and additionally, the growing embryo is producing more and more heat as a result of a higher metabolic rate. The ratio between the heat loss and heat production is expressed by the temperature that the embryo is experiencing and is often referred to as embryo temperature (Meijerhof and Van Beek, 1993). Because the embryo temperature is difficult to measure without disturbing the embryo, in practise eggshell temperature (EST), measured at the halfway end between the blunt and pointed end of the egg, is often used as an indicator of the embryo temperature.

To obtain an optimal embryo temperature inside an incubator, both the heat loss via evaporation and variation in heat production during the process of incubation should be taken into account. To optimize conditions, the temperature profile used in the incubator needs to be adjusted to meet the required embryo temperature, based on the stage of incubation and origin of the eggs

### **Consequences of incubation temperature on embryonic development and hatchling quality**

Due to the low embryonic heat production and relatively high evaporative heat loss in early incubation, embryonic temperature can be lower than optimal (37.5-38.0°C). An EST of 36.7°C in the first week resulted in slightly higher embryonic mortality than an EST of 37.8°C (10.2 vs 8.9%), more second grade chickens at hatching (3.8 vs 0.0%), shorter chickens at hatching (17.9 vs 18.8 cm) and a lower yolk free body mass at hatching (YFBM; 31.2 vs 34.6 g; Lourens et al., 2005). Alternatively, a high temperature in the first week of incubation often result in higher mortality or a higher incidence of malformations, such as exposed brains, cross beaks, four legs and eye abnormalities (Wilson, 1991).

During the second half of incubation, when embryos grow fast and produce a considerable amount of heat, negative effects are found of high EST on survival and embryonic development. Hatchability can be reduced due to a higher embryonic mortality in the last week of incubation (which might be related to the higher percentage of malpositioned embryos) and a higher percentage of second grade chickens (often related to a poor navel condition or weak and pale chicken). Furthermore, YFBM at hatching and organ development (especially heart and liver weights) were lower at high EST

(e.g. Lourens et al., 2005; 2007; Leksrisonpong et al., 2009; Molenaar et al., 2010b, 2011a,b; Ipek et al., 2014; Nangsuay et al., 2016).

Recent results suggest that in the second of incubation in the last week of incubation a lower EST might lead to better embryonic development and hatchling quality. Maatjens et al. (2014a,b, 2016a, b; 2017) performed a series of studies in which effects of different EST on embryonic development, hatchling quality and first week performance were investigated. They demonstrated that an EST of 36.7°C only during the hatching phase (day 18 of incubation onward) resulted in higher YFBM, higher heart weights and higher hepatic glycogen levels at hatching compared to an EST of 38.9°C with an EST of 37.8°C in between. In follow up studies, the EST was lowered further till 35.6°C from day 15, 17 or 19 of incubation onward. Again an EST of 35.6°C or 36.7°C resulted in the highest YFBM and lowest residual yolk at hatching compared to an EST of 38.9°C. Even more outspoken was the effect of these low EST treatments on relatively heart weight. Exposure to an EST of 38.9°C from day 15 of incubation onward, resulted in a decrease in heart weight, which was never restored till hatching. An EST of 35.6°C from day 15 of incubation onward resulted in an increased relative heart weight from day 15 of incubation onward (Maatjens et al., 2016a; Figure 1).

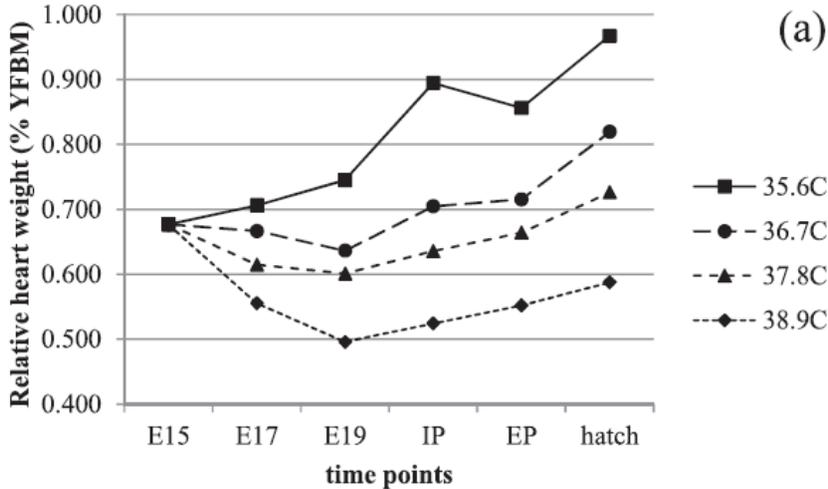


Figure 1. Effect of eggshell temperature (EST; 35.6, 36.7, 37.8 or 38.9°C) from day 15 of incubation onward on relative heart weight (% YFBM) at incubation day 15 (E15), 17 (E17), 19 (E19), internal pipping (IP), external pipping (EP) and hatching (Maatjens et al., 2016a).

It can be concluded that both a low EST (<36.7C) in the first week of incubation or a high EST (>38.5C) in the second half of incubation retard embryonic development and hatchling quality. The mechanisms explaining these effects are not fully understood yet, but based on several studies some potential mechanisms involved in the relationship between incubation temperature and embryonic development or hatchling quality will be described in the next paragraph.

### **Potential mechanisms**

The negative consequences on hatchability and hatchling quality of high incubation temperatures during the second half of incubation might probably originate from the increase in metabolic rate of the embryo at high incubation temperature (Molenaar et al., 2013). Because chicken embryos act as poikilothermic animals, the metabolic rate is highly dependent on the incubation temperature. A higher metabolic rate requires a higher nutrient utilisation and oxidation. Nutrients that are used as an energy source are mainly yolk lipids (Noble and Cocchi, 1990). Lipid oxidation requires a substantial amount of oxygen and because of the high metabolic rate and limited eggshell conductance, oxygen may become the limiting factor for maximal lipid oxidation (Nangsuay, 2016). Consequently, lipid oxidation from the yolk may be depressed, resulting in larger residual yolk size at hatching at higher EST (Lourens et al., 2005; Molenaar et al., 2010b). To fulfil the energy requirements, the embryo will partly switch to alternative energy sources. The first alternative energy source is glycogen. Because glycogen reserves are limited in the fresh egg (<1%; Romanoff and Romanoff, 1949), the embryo builds up glycogen stores during incubation in the heart, liver, muscle and yolk sac membrane (Foye et al., 2007). This glycogen can be converted to glucose and oxidised anaerobically during the hatching process to obtain energy. Several studies found that with a high EST, the embryo had a lower amount of glycogen available at the start of the hatching process. A limited glycogen store indicates a lower amount of readily available energy and might explain the higher percentage of dead-in-shell chickens and lower hatchability at high EST (Christensen et al., 1993; Lourens et al., 2005).

As a second alternative energy source, glucogenic amino acids can be used and there are indications that this happens at a higher rate during high compared to normal EST. During late incubation, the albumen of the egg is already utilized, meaning that protein is only available in the yolk and in the developing embryo. Glucogenic amino acids can be deaminated and the carbon skeleton can be immediately oxidized for ATP production or first converted to glucose by gluconeogenesis, which might result in less utilization of protein for building up the embryo or even by breaking down muscles from the embryonic body. Both will result in lower YFBM, as

found in several studies (Lourens et al., 2005, 2007; Molenaar et al., 2010b, 2011b, 2013). The source of the glucogenic amino acids is not investigated yet, but an important muscle is the heart and it has clearly been shown that high EST in the last week of incubation results in lower heart weights (up to 30%), due to lower build up or higher catabolism of the heart muscle (Wineland et al., 2000; Lourens et al., 2007; Molenaar et al., 2011b, 2013; Maatjens et al., 2014a, 2016a). The consequences of a lower heart weight at the moment of hatching for later life will be discussed in the next paragraph.

### **Consequences of high EST on later life**

A poorer developed hatchling might have several negative consequences for health and performance in later life, but also have an effect on the chickens thermoregulatory system. Recent studies demonstrated that especially a high EST during the second part of incubation affected body temperature of the chicken at hatch and in the first week of age and as a consequence also the preferred ambient temperature during this period (Morita et al., 2016a,b). These differences in body and preferred ambient temperature are probably due to differences in skin vascularisation (Morita et al., 2016a,b), and consequently differences in heat loss, but also might be related to the quality of the feathering. Scott et al. (2015) demonstrated that a high EST affected the number of feather follicles, particularly at the thigh and breast. An higher number of feather follicles in the thigh and a decreased amount of feather follicles in the breast was found for the high EST group (39.7°C) compared to the control EST group (37.7°C) at 22 days of age ( $P < 0.05$ ). Even at 42 days of age, chickens incubated at a high EST (38.9 to 40.0°C) had a lower feathering quality than chickens incubated at a low (33.3 to 36.7°C) or normal EST (37.8 to 38.2°C) (Ipek and Sözcü, 2016). It can be hypothesized that chickens incubated at different temperatures are thermoregulatory different and consequently the broiler house temperatures need to be adjusted accordingly.

In several studies, it has been demonstrated that a high EST (38.5-39.5°C) in the second half of incubation resulted in a lower performance expressed by lower body weights in later life (Hulet et al., 2007; Leksrisompong et al., 2009; Molenaar et al., 2011a; Ipek et al., 2015 Sözcü and Ipek, 2015). The extend of the effect of a high EST is variable among studies and can probably be explained by the duration and temperature range that is used and may even be affected by the ambient temperature that the chickens experience in the post-hatch period (Molenaar et al., 2011a). Furthermore, it has been demonstrated that an excessive high EST for a long period in the last part of incubation ( $>40.0^\circ\text{C}$ ) resulted in impaired carcass quality, as expressed by a lower percentage of breast filet (Clark et al., 2017, Li et al., 2017).

Not only body weight and carcass quality appear to be negatively affected by high EST during the second half of incubation, also mortality has been demonstrated to be higher in chickens incubated at a high EST in the second half of incubation (Molenaar et al., 2010b, Ipek et al., 2015; Sözcü and Ipek, 2015). Particularly, the prevalence of ascites related mortality was increased, which might be related to the impaired heart development found at hatching. At the moment the heart development is retarded at hatching and the oxygen demand is high during the grow-out phase, due to the high growth rate of the chickens, it has been speculated that less developed hearts are not able to provide sufficient oxygen for its respiratory demand, which is the first step in the development of ascites (Molenaar et al., 2011a).

Another animal health and welfare aspect that appears to be affected by incubation temperature is leg health. Both low and high incubation temperatures are related to impaired bone development and leg disorders. Yalcin et al. (2007) were one of the first demonstrating a relationship between incubation temperature and leg disorders. A low (36.8°C) and high (39.6°C) incubation temperature between day 0 to 8 or between 10 to 18 of incubation resulted in a higher incidence of tibial dyschondroplasia. Oviedo-Rondón et al. (2008), Van der Pol et al. (2014) and Oznurlu et al. (2016) found that incubation temperature affected the dimensions of the tibia and femur in both turkeys and broilers. Additionally, Oviedo-Rondón et al. (2009) found a (tendency to a) higher incidence of crooked toes, hock burns and twisted legs in chickens incubated at a temperature of 39.0°C between day 18 of incubation and hatching compared to chickens incubated at 37.0°C. These leg abnormalities might be related to impaired gait scores as found by Ipek and Sözcü (2016). Not only developmental leg disorders appears to be affected by incubation temperature, but also degenerative leg disorders, such as footpad dermatitis. De Jong et al. (2012) demonstrated that the hatchery where the broiler chickens originated from had large influence on the prevalence of footpad dermatitis, which at least suggest that hatchery conditions appears to play a role in degenerative leg disorders. Evidence is provided that particularly incubation temperature might be the cause of the differences found among hatcheries in the prevalence of footpad dermatitis, because Da Costa et al. (2016) demonstrated that incubation temperature profile affected the quality of the footpad dermis and epidermis.

### **An egg is an egg?**

Based on the information described in this review, it can be concluded that incubating eggs at the most optimal temperature benefits chicken health and welfare and the poultry producers return on investment. However, incubating all eggs at an correct and uniform eggshell temperature is challenging. In practice, the hatchery has to deal with eggs of different origin, varying in size and composition. Incubators have become larger over the years to make

the production more efficient, but the downside is that different batches of eggs with probably different requirements need to be set in the same incubator. For example, the embryo temperature differs between a large or small egg incubated in the same machine. Larger eggs contain larger embryos and they produce more metabolic heat than smaller eggs (Lourens et al., 2006) and thereby they will have a higher EST when incubated in the same incubator.

This is also nicely illustrated by Elibol and Brake (2008), who selected eggs on egg weight and placed them in a commercial incubator near the fan or far away from the fan. Large eggs (68.8 gram) experienced an 0.7°C higher EST far away from the fan than near the fan, whereas this difference was absent for average (65.3 gram) and small (62.4 gram) sized eggs. In the large eggs, the percentage of late dead and second grade chickens was higher in eggs incubated far away from the fan than in eggs incubated near the fan, whereas this difference was absent in average and small sized eggs. This study clearly demonstrates that setting different egg sizes in one incubator may not benefit them all. Setting eggs by breeder age and/or egg size will help to obtain uniform conditions inside the incubator.

Even when eggs are selected on egg weight, they can still differ in egg composition, affecting hatchling quality and performance in the post-hatch period. Nangsuay et al. (2011, 2013) demonstrated that both small (58-59 gram) and large eggs (65-66 gram) of older broiler breeders (53 weeks) had higher yolk weights than eggs of both weight classed in young broiler breeders (29 weeks). At hatching, chicken weight, residual yolk and YFBM was fully determined by egg weight and not by breeder age. However, chickens of older breeders had deposited more protein and fat in their body than chickens of younger breeders. This could indicate that chickens of the same weight, but originating from older breeders have better thermoregulatory capacities than chickens originating from younger breeders (Weytjens et al., 1999).

## **Conclusion**

Incubation conditions and particularly incubation temperature is an important factor determining chicken quality at hatching and health, welfare and performance in later life. Considering the potential consequences of incubation temperature are important to obtain optimal animal health and welfare and return on investment for poultry producers, but are also essential in research to obtain reliable results. Even small deviations in incubation temperatures or EST can already have large effects and consequently influence obtained results, particularly when there is an opportunity that incubation temperature interacts with egg size or egg composition.

## References

- ARCHER, G.S. AND J.A. MENCH. (2014) Natural incubation patterns and the effects of exposing eggs to light at various times during incubation on post-hatch fear and stress responses in broiler (meat) chickens. *Applied Animal Behaviour Science*. 152:44-51.
- CHRISTENSEN, V.L., W.E. DONALDSON AND K. E. NESTOR. (1993) Embryonic viability and metabolism in turkey lines selected for egg production or growth. *Poultry Science* 72:829-838.
- CLARK, D.L., K.G. WALTER AND S.G. VELLEMAN. (2017) Incubation temperature and time of hatch impact broiler muscle growth and morphology. *Poultry Science* 96:4085-4095.
- FOYE, O.T., P.R. FERKET AND Z. UNI. (2007) Ontogeny of energy and carbohydrate utilisation of the precocial avian embryo and hatchling. *Avian and Poultry Biology Review* 18:93-101.
- DA COSTA, M.J., E.O. OVIEDO-RONDÓN, M.J. WINELAND, K. CLAASSEN AND J. OSBORNE. (2016) Effects of incubation temperatures and trace mineral sources on chicken live performance and footpad skin development. *Poultry Science* 95:749-759.
- DECUYPERE, E. AND H. MICHELS. (1992) Incubation temperature as management tool: A review. *World Poultry Science Journal* 48:28-38.
- DE GOUW, P., L.J.F. VAN DE VEN, A. LOURENS, B. KEMP AND H. VAN DEN BRAND. (2017) Effects of dust, formaldehyde and delayed feeding on early postnatal development of chickens. *Research in Veterinary Science* 112:201-207.
- DE JONG, I.C., J. VAN HARN, H. GUNNINK, V.A. HINDLE AND A. LOURENS. (2012) Footpad dermatitis in Dutch broiler flocks: Prevalence and factors of influence. *Poultry Science* 91:1569-1574.
- IPEK, A. AND A. SÖZCÜ. (2016) The effects of eggshell temperature fluctuations during incubation on welfare status and gait score of broilers. *Poultry Science* 95:1296-1303.
- IPEK, A., U. SAHAN, S.C. BAYCAN AND A. SÖZCÜ. (2014) The effects of different eggshell temperatures on embryonic development, hatchability, chick quality, and first-week broiler performance. *Poultry Science* 93:464-472.
- IPEK, A., U. SAHAN AND A. SÖZCÜ. (2015) The effects of different eggshell temperatures between embryonic day 10 and 18 on broiler performance and susceptibility to ascites. *Brazilian Journal of Poultry Science* 17:387-394.
- HULET, R., G. GLADYS, D. HILL, R. MEIJERHOF AND T. EL-SHIEKH. (2007) Influence of egg shell embryonic incubation temperature and broiler breeder flock age on posthatch growth performance and carcass characteristics. *Poultry Science* 86:408-412.

- LEKSRISOMPONG, N., H. ROMERO-SANCHEZ, P.W. PLUMSTEAD, K.E. BRANNAN AND J. BRAKE. (2007) Broiler incubation. 1. Effect of elevated temperature during late incubation on body weight and organs of chicks. *Poultry Science* 86:2685-2691.
- LI, X., J. QIU, H. LIU, Y. WANG, J. HU, X. GAN AND J. WANG. (2017) Long-term thermal manipulation in the late incubation period can inhibit breast muscle development by activating endoplasmic reticulum stress in duck (*Anas platyrhynchos domestica*), *Journal of Thermal Biology* 70:37-45.
- LOURENS, A., H. VAN DEN BRAND, R. MEIJERHOF AND B. KEMP. (2005) Effect of eggshell temperature during incubation on embryo development, hatchability, and posthatch development. *Poultry Science* 84:914-920.
- LOURENS, A., R. MOLENAAR, H. VAN DEN BRAND, M.J.W. HEETKAMP, R. MEIJERHOF AND B. KEMP. (2006a) Effect of egg size on heat production and the transition of energy from egg to hatchling *Poultry Science* 85:770-776.
- LOURENS A., H. VAN DEN BRAND, M.J.W. HEETKAMP, R. MEIJERHOF AND B. KEMP. (2007) Effects of eggshell temperature and oxygen concentration on embryo growth and metabolism during incubation. *Poultry Science* 86:2194-2199.
- MAATJENS, C.M., I.A.M. REIJRINK, R. MOLENAAR, C.W. VAN DER POL, B. KEMP AND H. VAN DEN BRAND. (2014a) Temperature and CO<sub>2</sub> during the hatching phase. I. Effects on chick quality and organ development. *Poultry Science* 93:645-654.
- MAATJENS, C.M., I. A.M. REIJRINK, R. MOLENAAR, C.W. VAN DER POL, B. KEMP AND H. VAN DEN BRAND. (2014b) Temperature and CO<sub>2</sub> during the hatching phase. II. Effects on chicken embryo physiology. *Poultry Science* 93:655-663.
- MAATJENS, C.M., I.A.M. VAN ROOVERT-REIJRINK, B. ENGEL, C.W. VAN DER POL, B. KEMP AND H. VAN DEN BRAND. (2016a) Temperature during the last week of incubation. I. Effects on hatching pattern and broiler chicken embryonic organ development. *Poultry Science* 95:956-965.
- MAATJENS, C.M., I.A.M. VAN ROOVERT-REIJRINK, I. VAN DEN ANKER, B. ENGEL, C.W. VAN DER POL, B. KEMP AND H. VAN DEN BRAND. (2016b) Temperature during the last week of incubation. II. Effects on first week broiler development and performance. *Poultry Science* 95:2136-23144.
- MAATJENS, C.M., I.A.M. VAN ROOVERT-REIJRINK, B. ENGEL, C.W. VAN DER POL., B. KEMP AND H. VAN DEN BRAND. (2017) Temperature during the last week of incubation. III. Effects on chicken embryo physiology. *Poultry Science* 96:1451-1458.

- MEIJERHOF, R.(2009) Incubation principles: What does the embryo expect from us? Proc. 20th Australian Poultry Science Symposium, Sydney, Australia, pp. 106-110.
- MOLENAAR, R., I.A.M. REIJRINK, R. MEIJERHOF, AND H. VAN DEN BRAND.( 2010a) Meeting embryonic requirements of broilers throughout incubation: A review. Brazilian Journal of Poultry Science 12:137-148.
- MOLENAAR, R., R. MEIJERHOF, I. VAN DEN ANKER, M.J.W. HEETKAMP, J.J.G.C. VAN DEN BORNE, B. KEMP AND H. VAN DEN BRAND. (2010b) Effect of eggshell temperature and oxygen concentration on survival rate and nutrient utilization in chicken embryos. Poultry Science 89:2010-2021.
- MOLENAAR, R., R. HULET, R. MEIJERHOF, C.M. MAATJENS, B. KEMP AND H. VAN DEN BRAND. (2011a) High eggshell temperatures during incubation decrease growth performance and increase the incidence of ascites in broiler chickens. Poultry Science 90:624-632.
- MOLENAAR, R., I. VAN DEN ANKER, R. MEIJERHOF, B. KEMP AND H. VAN DEN BRAND. (2011b) Effect of eggshell temperature and oxygen concentration during incubation on the developmental and physiological status of broiler hatchlings in the perinatal period. Poultry Science 90:1257-1266.
- MOLENAAR, A., J.J.G.C. VAN DEN BORNE, E. HAZEJAGER, N.B. KRISTENSEN, R. MEIJERHOF, B. KEMP AND H. VAN DEN BRAND. (2013) Effect of temperature on glucose metabolism in the developing chicken embryo. PlosOne doi: 10.1371/journal.pone.0059637.
- MORITA, V.D., V.R. DE ALMEIDA, J.B. MATOS, T.I. VICENTINI, H. VAN DEN BRAND AND I.C. BOLELI. (2016a) Incubation temperature during fetal development influences morphophysiological characteristics and preferred ambient temperature of chicken hatchlings. PlosOne doi: 10.1371/journal.pone.0154928.
- MORITA, V.D., V.R. ALMEIDA, J.D. MATOS, T.I. VINCENTINI, H. VAN DEN BRAND AND I.C. BOLELI. (2016b) Incubation temperature alters thermal preference and response to heat stress of broiler chickens along the rearing phase. Poultry Science 95:1795-1804.
- NANGSUAY, A. (2016) Are all egg equal? Embryonic development and nutrient metabolism in chicken eggs of different origins. PhD thesis, Wageningen University, Wageningen, the Netherlands.
- NANGSUAY, A., Y. RUANGPANIT, R. MEIJERHOF AND S. ATTAMANGKUNE. (2011) Yolk absorption and embryo development of small and large eggs originating from young and old breeder hens. Poultry Science 90:2648-2655.

- NANGSUAY, A., R. MEIJERHOF, Y. RUANGPANIT, B. KEMP AND H. VAN DEN BRAND. (2013) Energy utilization and heat production of embryos of eggs originating from young and old broiler breeder flocks. *Poultry Science* 92:474-482.
- NANGSUAY, A., R. MEIJERHOF, I. VAN DEN ANKER, M.J.W. HEETKAMP, V.D. MORITA, B. KEMP AND H. VAN DEN BRAND. (2016) Effects of breeder age, broiler strain, and eggshell temperature on development and physiological status of embryos and hatchlings. *Poultry Science* 95: 1666-1679.
- NOBLE, R.C. AND M. COCCHI. (1990) Lipid-metabolism and the neonatal chicken. *Progress in lipid research* 29:107-140.
- OVIEDO-RONDÓN, E.O., J. SMALL, M.J. WINELAND, V.L. CHRISTENSEN, J.L. GRIMES, S.V.L. FUNDERBURK, D.T. ORT AND K.M. MANN. (2008) Effects of incubator temperature and oxygen concentration during the plateau stage of oxygen consumption on turkey embryo long bone development. *Poultry Science* 87:1484-1492.
- OVIEDO-RONDÓN, E.O. M. J. WINELAND, J. SMALL, H. CUTCHIN, A. MCELROY, A. BARRI AND S. MARTIN. (2009) Effect of incubation temperatures and chick transportation conditions on bone development and leg health. *Journal of Applied Poultry Research* 18:671-687.
- OZNUURLU, Y., E. SUR, T. OZAYDIN, I. CELIK AND D. ULUISIK. (2016) Histological and histochemical evaluations on the effects of high incubation temperature on the embryonic development of tibial growth plate in broiler chickens. *Microscopy Research and Technique* 79:106-110.
- REIJRINK, I.A.M., R. MEIJERHOF, B. KEMP AND H. VAN DEN BRAND. (2008) The chicken embryo and its micro-environment during egg storage and early incubation. *Poultry Science* 64:481-589.
- ROMANOFF, A.L. AND A.J. ROMANOFF. (1949) *The avian egg*. John Wiley and Sons, New York, USA.
- SCOTT, J., M.J. DA COSTA AND E.O. OVIEDO-RONDÓN. (2015) Incubation temperature profiles affect broiler feathering. *Journal of Applied Poultry Research*. 24:49-57.
- SÖZCÜ, A. AND A. IPEK. (2015) Acute and chronic eggshell temperature manipulations during hatching term influence hatchability, broiler performance, and ascites incidence. *Poultry Science* 94:319-327.
- TZSCHENTKE, B. (2007) Attainment of thermoregulation as affected by environmental factors. *Poultry Science* 86:1025-1036.
- USDA, (2015) *Agricultural projections to (2024)* United States department of Animal Sciences. [https://www.usda.gov/oce/commodity/projections/USDA\\_Agricultural\\_Projections\\_to\\_\(2024\).pdf](https://www.usda.gov/oce/commodity/projections/USDA_Agricultural_Projections_to_(2024).pdf).

- Van der Pol, C.W., I.A.M. van Rovert-Reijrink, C.M. Maatjens, I. van den Anker, B. Kemp and H. van den Brand. (2014) Effects of eggshell temperature throughout incubation on broiler hatchling leg bone development. *Poultry Science* 93:2878-2883.
- WEYTIJENS, S., R. MEIJERHOF, J. BUYSE AND E. DECUYPERE. (1999) Thermoregulation in chicks originating from breeder flocks of two different ages. *Journal of Applied Poultry Research* 8:139-145.
- WILSON, H.R. (1991) Physiological requirements of the developing embryo: temperature and turning. In: *Avian Incubation*. S.G. Tullet (Ed). Butterworth-Heinemann, London, UK.
- WINELAND, M.J., K.M. MANN, B.D. FAIRCHILD, AND V.L. CHRISTENSEN. (2000) Effect of different setter and hatcher temperatures upon the broiler embryo. *Poultry Science* 79 (Suppl. 1): 123 (Abstract).
- YALÇIN, S., H.B. MOLAYOĞLU, M. BAKA, O. GENİN AND M. PINES. (2007) Effect of temperature during the incubation period on tibial growth plate chondrocyte differentiation and the incidence of tibial dyschondroplasia. *Poultry Science* 86:1772-1783.

**SESSION-6**  
**INCUBATION**

**SHORT ORAL PRESENTATIONS**

## Comparison of Embryo Development and Quality Characteristics of Uncontrolled Village Eggs and Commercial Eggs Produced in Different Seasons

Musa Sarıca, Kadir Erensoy, Ayşe Özsoy

Ondokuz Mayıs University, Agricultural Faculty, Department of Animal Science, Samsun, Turkey

### Abstract

The village hen can be marketed at a higher price with the image that the eggs are healthy. There are serious risks to the health conditions of chickens that can roam everywhere in uncontrolled conditions in small herds with roosters. Chickens can get any kind of waste and negative effect to search for food. In this study, eggs produced from village hens were compared with free-range production system and traditional cage systems in terms of egg quality traits. In most of the external and internal quality traits, differences were found significant according to production systems in the study ( $P<0.05$ ). However, The yolk color was found similar. Fertility was observed in the eggs obtained from village flocks, which could be a risk of embryo development in hot seasons.

**Key words:** Village hen eggs, free-range eggs, traditional cage system, egg quality

### Kontrolsüz Köy Tavuğu Sürülerinde Farklı Mevsimlerde Üretilen Yumurtalarda Embriyo Gelişimi ile Kalite Özelliklerinin Ticari Yumurtalarla Karşılaştırılması

#### Özet

Köy tavuğu yumurtaları sağlıklı olduğu imajı ile daha yüksek fiyatla pazarlanabilmektedir. Kontrolsüz koşullarda horoz katılmış küçük sürüler halinde her yerde dolaşabilen tavukların sağlık koşullarında ciddi riskler bulunmaktadır. Tavuklar besin aramak için her türlü atığa ve olumsuz etkene ulaşabilmektedir. Bu çalışmada köy tavuklarından üretilen yumurtalar, serbest gezinmeli üretim sistemi (kahverengi) ile geleneksel kafes sisteminde üretilen yumurtalarla (beyaz ve kahverengi) yumurta kalite özellikleri bakımından karşılaştırılmıştır. Çalışmada ele alınan dış ve iç kalite özelliklerinin çoğunluğunda üretim sistemlerine göre farklılıklar önemli ( $P<0.05$ ), sarı rengi ise benzer bulunmuştur. Köy tavuklarından elde edilen yumurtaların büyük oranda dömlü olmasının sıcak dönemlerdeki depolamalar için sorun olduğu belirlenmiştir.

**Anahtar kelimeler:** *Köy yumurtası, serbest gezinmeli, geleneksel kafes sistemi, yumurta kalitesi*

## **Introduction**

Although the yield of eggs and meat is low and the mortality rate is high, the production of the village hen continues to be widespread throughout the world. In rural areas, poultry production is particularly important for producers to provide their animal protein needs in a certain way (FAO, 2017), and to ensure that excess crops are sold to the family budget, although poultry production has second-tier prospects in other agricultural activities. In some undeveloped and developing countries, each family usually has 5-20 chickens. These animals move freely around the poultry houses during the day for searching feed and are taken to a closed area against the predators or the danger of stealing in the evenings. In this production system, additional feed can be given to animals if necessary (Alders and Spradbrow, 2001, Alders and Pym, 2009). Although the amount of eggs and meat obtained from the village hen in total meat and egg production in our country is still important despite the fact that it has fallen due to avian influenza in recent years. The data for the share of the system in total production is based on estimates. Consumers tend to consume village hen eggs due to the influence of publications in the media against commercial egg production in recent years. Since it is not possible to increase the production of this field in the short term, consumers could buy commercial cage eggs rather than village eggs in practice. In uncontrolled conditions, natural hatching is also widely used in the production of village chickens, which have freedom of entry wherever they wish. 10-15 chickens and 1 cock are counted to produce fertile eggs in village flocks. Chickens can hatch 2-4 times per year (Awuni, 2002). Non-incubated eggs are used for consumption. So, embryo development can occur especially in the eggs stored in hot summer months. In our country, village chickens have been in the recent years for the reasons of commercial poultry farms, the risk of disease, the spread of avian influenza and the tendency of consumers to accept natural products without knowing these products. Nor can it be said that working in this area is sufficient. The fact that the most important factor in this matter is the lack of the possibility of being defined as a production system is that the locality has changed a lot. On the other hand, a significant part of the laying hens that have completed commercial production periods are taken to the villages and marketed as village chickens here (Sarica, 2017). For these reasons, it is also not possible to see the swarms in the villages as a source of genes. In this paper, uncontrolled village eggs were compared with controlled free-range, conventional cage system brown and white shell eggs for some external and internal quality traits. In addition, randomly selected eggs from village eggs were placed in an incubator and embryo development was

checked at 18<sup>th</sup> day. Thus, the rate of fertilization in village eggs was determined and data executed for the embryo development of these eggs.

### **Materials and Methods**

120 eggs were obtained from the villages and 60 from the laying hens in commercial cage (white and brown) and free-range production system in the autumn season (September 2017). Although there is no clear net result regarding the age of animals in village hen flocks, most of them are made up of young animals that have begun to lay new eggs. In the free-range production system, brown layer hybrids were at 44 weeks of age, brown hybrids were at 38 weeks of age in cage system, and white layer hybrids were 40 weeks of age. Since the cockerel was found in the villages, 60 eggs were placed in the incubator and the embryo development was determined. In the study, 60 eggs from each production system were numbered individually after weighing. In all of the eggs, the shape index, the shell color, the shell cleanliness, the shell thickness, the albumen and yolk height, the albumen width and the length, the number of blood and meat spots in albumen and yolk, the albumen, yolk and shell weights, respectively. The values of albumen index, Haugh unit and yolk index were calculated from these data (Sarica and Erensayin, 2014). Kruskal Wallis analyzes were performed for non-parametric values from the obtained data. Data were subjected to analysis of variance, and means were compared by Tukey test (5%) and variance analysis and production systems were compared. SPSS statistical package program was used in the analyzes.

### **Results**

Differences in egg weights among production systems can vary depending on genotype and age. The shape index of village eggs was found to be rounder compared with other production system eggs. In other production systems, similar egg weight was determined. Shell defects and shell dirtiness were highest in the village eggs and free-range eggs ( $P < 0.05$ ). Although there were significant differences in their albumen and yolk traits, yolk color was found to be similar in all production systems. The most important difference was the rate of fertile eggs which is found very high in the village eggs. In controlled production systems, no fertility was observed in the eggs due to cockerel absence in the flocks (Table 1).

Table 1. Some quality traits of different production system eggs (Average, minimum and maximum values)

Traits	Production system			
	Village eggs	Free-range eggs	Conventional cage brown eggs	Conventional cage white eggs
<b>Shell traits</b>				
Egg weight (g)	59.7 (84.0-47.2)a	60.2 (52.4-67.9)a	54.4 (53.9-54.9)b	56.7 (49.7-59.0)b
Shape index (%)	73.8 (63.5-85.1)b	77.7 (65.2-82.5)a	77.9 (72.9-82.2)a	76.4 (73.2-84.3)a
Shell thickness (mm)	0.316 (0,210-0,380)a	0.330 (0,305-0,360)b	0.349 (0.320-0.385)c	0.340 (0.320-0.370)c
Shell cleanliness* <sup>1</sup>	0.97 (0-4)a	0.73 (0-3)a	0.20 (0-2)b	0.23 (0-1)b
Shell defects * <sup>2</sup>	1.00 (0-3)a	0.80 (0-3)a	0.17 (0-1)b	0.00 (0-0)b
Shell colour* <sup>3</sup>	0.77 (0-2)b	1.83 (1-2)a	1.90 (1-2)a	0.00 (0-0)c
Shell ratio (%)	10.2 (6.3-13.4)b	10.6 (9.3-13.0)b	12.0 (9.1-13.8)a	11.6(9.7-13.3)a
<b>Albumen Traits</b>				
Albumen height (mm)	5.58 (3.3-9.8)b	5.51(3.3-7.3)b	6.98 (4.9-7.8)a	6.21 (4.2-6.3)a
Albumen index	6.55 (2.75-13.20)b	5.44 (2.74-8.42)c	8.71 (5.20-13.21)a	5.27 (3.69-7.03)c
Haugh Unit	72.3 (47.80-98.31)c	71.8 (51.79-84.81)c	84.5 (70.48-98.8)a	79.5 (70.11-83.0)b
Albumen pH	9.12 (8.3-9.4)b	9.27 (9.1-9.4)a	9.09 (8.9-9.2)b	9.21 (9.2-9.3)a
Albumen ratio (%)	61.3 (55.8-69.9)b	62.2 (57.5-66.9)b	63.8 (59.8-67.5)a	60.4(57.3-63.7)c
<b>Yolk traits</b>				
Yolk height (mm)	17.6 (15.2-19.8)a	16.8 (15.6-18.6)b	17.3 (15.8-18.9)a	16.2 (14.6-17.7)c
Yolk colour (1-15)	10.4 (5-14)a	10.7 (7-13)a	10.7 (6-14)a	9.8 (7-14)a
Yolk index	40.8 (36.2-49.0)b	40.2 (37.0-45.9)b	44.4 (39.0-48.3)a	37.2 (32.9-41.3)c
Yolk pH	6.24 (6.0-6.8)a	6.12 (5.9-6.3)b	6.14 (5.8-7.0)b	6.18 (6.0-6.9)ab
Yolk ratio (%)	28.6 (19.8-35.3)a	27.2 (21.8-32.1)b	24.3 (20.1-27.4)c	28.0 (24.4-30.6)ab
<b>Appearance</b>				
Meat spots* <sup>4</sup>	0.17 (0-2)b	0.73 (0-3)a	0.23 (0-1)b	0.00 (0-0)b
Blood spots* <sup>5</sup>	0.20 (0-2)b	0.63 (0-4)a	0.27 (0-3)b	0.00 (0-0)b
<b>Fertility rate (%)</b>	98.3	0.00	0.00	0.00

\*1:0 clean, 4 very dirty; \*2:0 normal, 4 very defective; \*3: 0 white, 1 light Brown, 2 brown; \*4:0 not-seen, 1 meat spot small part, 2 meat spot two and more; \*5:0 not-seen, 1 blood drop small part, 2 blood drops two and more; According to the Duncan test results, the differences between the averages shown in different letters on the same line are significant.

## Conclusions

Consumers mostly prefer darker yolks in the eggs. Also, it is believed that village eggs were higher in dark yolk color, but in our study, this was not observed in the eggs. Mixed-colored shell color has been a consumer preference in recent years, and this trait could be observed in village eggs. However, fertility is found as a serious problem, especially in hot seasons, depending on storage condition of eggs. Because there is a wide period in May-October when the average temperature in the region where the eggs are taken exceeds 24°C. For this reason, there is a need to take measures to prevent the development of embryos in the preservation of eggs in these periods.

## References

- ALDERS, R.G. and PYM, R.A.E., 2009. Village Poultry: Still Important to Millions, Eight Thousand Years after Domestication. *World's Poultry Sci., J.*, 65:181-190.
- ALDERS, R. and SPRADBROW, P., 2001. Controlling Newcastle Disease in Village Chickens. A Field Manual. *ACIAR Monograph No:82*, 112 pp.
- AWUNI, J.A., 2002. Strategies for the Improvement of Rural Chicken Production in Ghana, In: Characteristics and Parameters of Family Poultry Production in Africa. *IAEA, VIENNA*. 33-37.
- FAO, 2017. FAOSTAT Statistical Database of Food and Agriculture Organization of the United Nations, [www.fao.org](http://www.fao.org), Rome Italy.
- SARICA, M., 2017. Alternatif yumurta üretim sistemlerinin karşılaştırılması. *Yumurta Zirvesi*, 2-5 Kasım, Antalya.
- SARICA, M. and ERENSAYIN, C., 2014. Tavukçuluk Ürünleri. Tavukçuluk Bilimi, 110-164, *Bey Ofset Matbaacılık*, Ankara.

## The Effect of Egg Storage Period, Hatching Time, and Initial Brooding Litter Temperature on Performance of Chicks from Young Breeder

Reza Shiranjang, Serdar Özlü, Okan Elibol

Department of Animal Science, Faculty of Agriculture, University of Ankara, Ankara, Turkey

### Abstract

This experiment was conducted to determine the effect of egg storage period (short: 5 d; long: 12 d), hatching time (early, middle, and late), and initial brooding litter temperature in the first two days (hot: 34°C; cool: 28°C) on performance of chicks from 27-wk old broiler breeder flock. Hatching time was determined by identifying all chicks that hatched from 468-486 h (Early), 487-492 h (Middle), and 493-514 h (Late) after start of incubation of eggs. Incubation duration was extended with increasing storage period ( $P<0.05$ ). Although body weight (BW) and feed conversion ratio (FCR) were affected by storage period at 35 d ( $P<0.05$ ), there was no significant difference in feed consumption (FC). BW at 2 d was decreased in cool brooding temperature and late hatched chicks compare with hot brooding temperature and early hatched chicks ( $P<0.05$ ), whereas at 35d, there was no significant difference in BW, FC, and FCR owing to hatching time and litter brooding temperature. However, litter temperature by hatching time interaction was significant, implicating that the highest mortality for Late hatched chicks was obtained under cool brooding temperature in the first two days ( $P<0.05$ ). As a result of this study, broiler performance of chicks obtained from young breeder was negatively affected by long storage period under cool brooding temperature with delayed hatching time.

**Key words:** *Young Flock, Brooding Litter Temperature, Egg Storage Period, Hatching Time, Broiler Performance.*

## Genç Sürülerde Depo Süresi, Çıkış Zamanı ve İlk İki Gün Altlık Sıcaklığının Broiler Performansı Üzerine Etkileri

### Özet

Bu çalışmada, depo süresi (kısa depo:5 gün veya uzun depo:12 gün), çıkış zamanı (erken, orta ve geç) ve ilk iki gün altlık sıcaklığının (sıcak: 34°C veya serin: 28°C) etlik piliç performansı üzerine etkileri araştırılmıştır. 27 haftalık ebeveyn sürüsünden yumurtalar kullanılmıştır. Kuluçkanın 468-486. saati, 487-492. saati ve 493-514. saatlerinde çıkan civcivler sırasıyla erken,

orta ve geç olarak ayrılmıştır. Uzun süre depolama, civcivlerin çıkış zamanının uzamasına neden olmuştur ( $P<0.05$ ). Depolama süresi 35. gün canlı ağırlık (CA) ve yem değerlendirme sayısını (YDS) olumsuz etkilemesine ( $P<0.05$ ) karşın yem tüketim (YT) değerleri bakımından gruplar arasında istatistik olarak farklılık tespit edilmemiştir. Geç dönemde çıkan civcivler ile altlık sıcaklığı serin olan civcivlerde 2. gün canlı ağırlık değerleri diğer gruplara göre daha düşük elde edilmiştir ( $P<0.05$ ). Çalışmanın 35. gününde CA, YT ve YDS bakımından altlık sıcaklığı ve çıkış zamanı grup ortalamaları arasında istatistik olarak önemli farklılıklar tespit edilmemesine karşın ölüm oranı bakımından altlık sıcaklığı x çıkış zamanı interaksiyon etkisi tespit edilmiştir. Diğer bir deyişle, en yüksek ölüm oranı ilk iki gün serin altlıkta tutulan geç dönemde çıkan civcivlerde gözlenmiştir ( $P<0.05$ ). Sonuç olarak uzun süre depolama, çıkış zamanının gecikmesiyle birlikte düşük altlık sıcaklık koşullarında tutulan genç sürülerden elde edilen civcivlerin broiler performansını olumsuz etkilemiştir.

**Anahtar kelimeler:** *Genç Sürü, Altlık Sıcaklığı, Depo Süresi, Çıkış Zamanı, Broiler Performansı.*

## Introduction

The environmental conditions during storage and storage duration can have a dramatic impact on hatchability, as reviewed in Brake et al. (1997). To achieve maximum hatchability, it is recommended that eggs be stored for no longer than three days and it is important to maintain temperature and relative humidity (RH) during egg storage at 18°C and 70-78%, respectively. Generally, as egg storage time increases, temperature in the storage room should be decreased and RH increased to prevent dehydration (Christensen et al., 2002, Elibol et al., 2002a, Elibol et al., 2002b). Egg storage beyond 7 d is associated with a decline in hatchability (Whitehead et al., 1985, Lapao et al., 1999, Fassenko et al., 2001, Tona et al., 2003, Ates et al., 2004), an increase in incubation period (Mather and Laughlin, 1976, Tona et al., 2003, Ates et al., 2004), a decline in chick quality (Tona et al., 2003, Reijrink et al., 2009), a decline in chick length (Goliomytis et al., 2015) and a deterioration in post-hatch performance (Merritt, 1964, Tona et al., 2003, Ates, 2004). Shiranjang et al. (2014) reported that the eggs stored for 4 d hatched earlier than those stored for 11 d and Brake et al. (2014) found that mortality and BW gain was poorer in late chicks relative to early and middle hatched chicks. Chicks are not able to control their body temperature at the day of hatch. After hatching, the transition into a warm-blooded organism takes place about 3 and 4 days, depending on the chick size (Molenaar, 2012). Scott and Washburn (1985) suggested that during the first 5 d of the brooding period, the temperature should be around 32.0°C, even though the thermoregulatory mechanism of the chickens was expected to develop very

rapidly, to have competitive broiler production results. The most important management factor was to have the chicks move and eat during the first 2 d of the brooding period (Leksrisompong et al., 2009). The objective of this study was to determine the effects of egg storage period, hatching time, and initial brooding litter temperature on feed consumption, BW, and mortality of chicks from 27-wk-old broiler breeder flock.

### **Materials and Methods**

Eggs were obtained from a commercial Ross 308 broiler breeder at 27 wk old and stored for 5 d or 12 d, under 18°C temperature and 75% relative humidity. A total of 1500 eggs were placed in 50-egg trays and set in 2 laboratory incubators (Çimuka, Ankara) under standard single-stage conditions. Hatching time was determined by identifying all chicks that hatched from 468 to 486 h (early), 487 to 492 h (middle), and 493 to 514 h (late) after start of incubation of eggs. At 514 h of incubation, all chicks were removed from the hatcher, feather sexed, permanently identified with neck tags, weighed, and placed in 2 brooding rooms (cool litter temperature of 28°C and hot litter temperature of 34°C) with 18-24 pens each for a total of 588 chicks. After 48 h, litter temperature was equaled to 30°C in both rooms. Birds and feed were weighed at placement and 2, 7, and 35 d of age. Mortality was recorded twice daily. The data collected during the rearing period were subjected to GLM procedure to estimate main effects of the egg storage period, hatching time and initial brooding litter temperature, and interaction between them (Minitab, 2004).

### **Results and Discussion**

The current study showed that incubation period extended as storage period increased. The total of early and middle hatched chick percentage was 85.4% for 5 d stored eggs, but 45.2% was hatched for 12 d stored eggs. These findings are in general agreement with the results of Yildirim (2005) who found that after long storage, the percentage of hatched chicks was influenced by the storage period (Elibol et al., 2002a). There were no significant differences in BW from placement to 7 d due to egg storage period (5 d vs. 12 d), but the BW of the chicks hatched from 5 d stored eggs was significantly greater (60 g) compared with chicks hatched from 12 d stored eggs at 35 d. However, there was no significant difference in FC and mortality at 35 d among storage groups. Hot-brooded chicks exhibited greater feed consumption and had greater BW at 2 d compared with cool-brooded chicks ( $P<0.05$ ) but this advantage disappeared by 35 d. Broiler chick BW was greater at placement in Late chicks compared to Early and Middle chicks ( $P<0.05$ ), but this advantage disappeared by 7 d and 35 d. Late hatching chicks exhibited greater cumulative mortality compared with early and middle hatching chicks ( $P<0.05$ ). The greatest mortality occurred

in late hatching chicks when subjected to cool litter temperature during the first 2 d of brooding. These findings are in general agreement with the results of Butcher and Nilipour (2002), Tona et al. (2004), Ates et al. (2004), and Yalcin et al. (2017).

### Conclusion

It is well known that the egg storage period prior to incubation can influence hatchability, hatching time, chick quality, and broiler performance. Therefore, these factors are of considerable concern in commercial hatchery practice. Hatching eggs from younger flocks have also been most often subjected to extended storage on a routine basis due to the combined effects of low egg production and less than minimum hatching egg weight, such that extra time was required to accumulate sufficient numbers for setting. The incubation period was increased with the extended stored period. Even though the thermoregulatory mechanism of the chickens was expected to develop very rapidly, the chicks can't move and eat during the first 2 d of the brooding period. One general recommendation that can be drawn from our data was that litter temperature should reach 34°C at the time of placement and be decreased to 30°C or slightly below by the second day of the brooding period to achieve lower mortality when the younger flock eggs stored extended period.

### References

- ATES, C. (2004) The effect of storage period of eggs on hatching time and broiler performance. Ankara University.
- ATES, C., ELIBOL, O. and BRAKE, J. (2004) The effect of storage period of eggs on hatching time and broiler performance. *Proc. of XXII World's Poult. Congr., Istanbul, Turkey.*
- BRAKE, J., ÖZLÜ, S. and ELIBOL, O. (2014) Relationship of hatch time to broiler chick percentage yolk sac and subsequent live performance. *Poultry Science* 93: 213.
- BRAKE, J., WALSH, T. J., BENTON JR, C. E., PETITTE, J. N., MEIJERHOF, R. and PEÑALVA, G. (1997) Egg handling and storage. *Poultry Science* 76: 144-151.
- BUTCHER, G. D. and NILIPOUR, A. H. (2002) Management of hatching eggs and broiler performance (University of Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, EDIS).
- CHRISTENSEN, V. L., WINELAND, M. J., FASENKO, G. M. and DONALDSON, W. E. (2002) Egg storage alters weight of supply and demand organs of broiler chicken embryos. *Poultry Science* 81: 1738-1743.
- ELIBOL, O., HODGETTS, B. and BRAKE, J. (2002a) The effect of storage and pre-warming periods on hatch time and hatchability. *Avian and Poultry Biology Reviews* 13: 243-244.

- ELIBOL, O., PEAK, S. D. and BRAKE, J. (2002b) Effect of flock age, length of egg storage, and frequency of turning during storage on hatchability of broiler hatching eggs. *Poultry Science* 81: 945-950.
- FASENKO, G. M., ROBINSON, F. E., WHELAN, A. I., KREMENIUK, K. M. and WALKER, J. A. (2001) Prestorage incubation of long-term stored broiler breeder eggs: 1. Effects on hatchability. *Poultry Science* 80: 1406-1411.
- GOLIOMYTIS, M., TSIPOUZIAN, T. and HAGER-THEODORIDES, A. L. (2015) Effects of egg storage on hatchability, chick quality, performance and immunocompetence parameters of broiler chickens. *Poultry Science*: pev200.
- LAPAO, C., GAMA, L. and SOARES, M. C. (1999) Effects of broiler breeder age and length of egg storage on albumen characteristics and hatchability. *Poultry Science* 78: 640-645.
- LEKSRISSOMPONG, N., ROMERO-SANCHEZ, H., PLUMSTEAD, P., BRANNAN, K., YAHAV, S. and BRAKE, J. (2009) Broiler incubation. 2. Interaction of incubation and brooding temperatures on broiler chick feed consumption and growth. *Poultry Science* 88: 1321-1329.
- MATHER, C. M. and LAUGHLIN, K. (1976) Storage of hatching eggs: The effect on total incubation period. *British Poultry Science* 17: 471-479.
- MERRITT, E. (1964) Pre-incubation storage effects on subsequent performance of chickens 1. *British Poultry Science* 5: 67-73.
- MINITAB (2004) Minitab release 14 statistical software, Journal, (Minitab Inc., United Kingdom).
- MOLENAAR, R. (2012) The importance of the brooding period, Journal, pp. 1-6 (Salvador, Bahia, Brail).
- REIJRINK, I., MEIJERHOF, R., KEMP, B., GRAAT, E. and VAN DEN BRAND, H. (2009) Influence of prestorage incubation on embryonic development, hatchability, and chick quality. *Poultry Science* 88: 2649-2660.
- SCOTT, T. and WASHBURN, K. (1985) Evaluation of growth, hormonal, and hematological responses of neonatal chickens to reduced temperature brooding. *Poultry Science* 64: 777-784.
- SHIRANJANG, R., ÖZLÜ, S., GUCBILMEZ, M., ELIBOL, O. and BRAKE, J. (2014) Effects of broiler hatching egg storage period and storage heating on hatchability, hatching time, and subsequent broiler live performance. *Poultry Science* 93: 180.
- TONA, K., BAMELIS, F., DE KETELAERE, B., BRUGGEMAN, V., MORAES, V. M. B., BUYSE, J., ONAGBESAN, O. and DECUYPERE, E. (2003) Effects of egg storage time on spread of hatch, chick quality, and chick juvenile growth. *Poult. Sci.* 82: 736-741.
- TONA, K., ONAGBESAN, O., DE KETELAERE, B., DECUYPERE, E. and BRUGGEMAN, V. (2004) Effects of age of broiler breeders and egg

storage on egg quality, hatchability, chick quality, chick weight, and chick posthatch growth to forty-two days. *The Journal of Applied Poultry Research* 13: 10-18.

WHITEHEAD, C., MAXWELL, M., PEARSON, R. A. and HERRON, K. M. (1985) Influence of egg storage on hatchability, embryonic development and vitamin status in hatching broiler chicks. *British Poultry Science* 26: 221-228.

YALCIN, S., GURSEL, I., BILGEN, G., HORULUOGLU, B. H., GUCLUER, G. and IZZETOGLU, G. T. (2017) Effect of egg storage duration and brooding temperatures on chick growth, intestine morphology and nutrient transporters. *Animal* 11: 1791-1797.

YILDIRIM, I. (2005) Effects of breeder age and pre-incubation storage of eggs on hatchability, time of hatch and relative organ weight of quail chicks at hatch. *South African Journal of Animal Science* 35: 135-142.

# **SESSION-6**

# **INCUBATION**

**5 MINUTES ORAL PRESENTATIONS**

## Effects of Propolis and Thyme Essential Oil as a Biofumigants on Growth Performance Parameters of Hatching Eggs

Ayşen Bulancak, Mikail Baylan

The University of Cukurova, Agricultural Faculty, Department of Animal Science, Adana, Turkey.

### Abstract

This research was conducted to determine the effects of propolis and thyme essential oil on growth performance parameters which could be an alternative to chemicals used at disinfection. Two thousand and one hundred sixty unwashed, non broken-cracked, normal sized, (uninfected with feces and pad) clean hatching eggs from 39 wk aged of Ross 308 were divided into seven treatment groups, disinfected by dipping method with 2 doses (10% and 20%) of Propolis (P1-P2), 2 doses (8 and 16 ml/L) of Thyme essential oil (*Origanum onites* L., T1-T2), ethyl and isopropyl alcohol (Negative Control), Formaldehyde (Positive Control) and untreated group (Control). Best chick weights obtained from isopropyl alcohol group as 45.816gr and T2 group as 45,697gr.

At the end of incubation period, 630 chicks were taken into fattening program about 5 weeks. The overall mortality rate has been detected as 4.13% and highest loss was 0.42% at P group at second week. 5th live weight values were obtained as T2 (2468.51gr), P1 (2453.24gr), P2 (2445.12gr), T1 (2367.44gr), P (2359.45gr), E (2340.06gr) and formaldehyde (2298.10gr) respectively ( $P<0.05$ ). The best results at feed conversion ratios were 1.420 at T1 and 1.429 at T2 group. Significant differences between application groups were found in inedible viscera, heart (female), gizzard, right leg, back and carcass weight values ( $P<0.05$ ).

In the light of findings obtained from study; it is concluded that T1 (8ml/L) and P1 (10% concentration) doses can be used at disinfection of hatching eggs by dipping method as an alternative to formaldehyde without affecting incubation and growth performance negatively by decreasing microbial load.

**Key Words:** Hatching egg, Disinfection, Propolis, Thyme oil, Carcass parameters

## Effect of Oregano and Rosemary Essential Oil Supplementation on Broiler Performance and Caecal Microflora

Ece Cetin<sup>a</sup>, Bahadır Anar<sup>b</sup>, Seran Temelli<sup>c</sup>,  
Serife Sule Cengiz<sup>d</sup>, Mustafa Eren<sup>d</sup>

<sup>a</sup>Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, University of Namik Kemal, Degirmenalti Campus, 59030, Tekirdag, Turkey

<sup>b</sup>Department of Animal Nutrition and Nutritional Diseases, Institute of Health Science, Uludag University, Gorukle Campus, 16059, Bursa, Turkey

<sup>c</sup>Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Uludag University, Gorukle Campus, 16059, Bursa, Turkey

<sup>d</sup>Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Uludag University, Gorukle Campus, 16059, Bursa, Turkey

### Abstract

In this study, effect of dietary supplementation of oregano and rosemary essential oils (EO) on performance and caecal microflora of broilers was investigated. A total of 450 Ross 308 male day old chicks were divided into 5 groups: a Control (C), fed a basal diet; four treatment groups, which received a basal diet supplemented with oregano and rosemary EOs individually (O, 300 mg/kg oregano EO; R, 300 mg/kg rosemary EO) and combined (OR1, 150 mg/kg oregano EO + 150 mg/kg rosemary EO; OR2, 200 mg/kg oregano EO + 200 mg/kg rosemary EO). Body weight (BW), feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR), and caecal microflora were determined weekly, and at the end of 42 d, respectively. BW in R ( $P<0.05$ ) and OR2 groups ( $P<0.001$ ), and BWG and FCR in OR2 group ( $P<0.05$ ) were significantly higher than C group in 42 d, despite no difference in FI in any group during rearing. Cecal coliform bacteria ( $P<0.001$ ) and *Clostridium* spp. ( $P<0.01$ ) decreased, and *Lactobacillus* spp. ( $P<0.001$ ) increased substantially between C and treatment groups. All samples were positive for *Escherichia coli* and negative for *Clostridium perfringens*. Results suggested that combined oregano and rosemary (200 mg/kg ea) EO supplementation significantly increased BW and BWG, improved FCR in 0-42 d, beneficially influenced caecal microflora by lowering coliforms and *Clostridium* spp., and increasing *Lactobacillus* spp.

**Keywords:** Oregano, Rosemary, Broiler, Performance, Caecal Microflora

### Introduction

European Union initiated the ban for antibiotic use as growth promoters in feed additives in poultry in January 2006, which was followed by many other countries in the world including Turkey, due to the development of

resistance and its genetic transfer between animal and human microbiota (Sugiharto, 2016; Mohiti-Asli and Ghanaatparast-Rashti, 2017). This action led to pursuit for new alternatives with similar beneficial effects as antibiotics in the poultry industry. In recent years, nutraceuticals such as probiotics, prebiotics, symbiotics, organic acids, exogenous enzymes, polyunsaturated fatty acids and phytobiotics, most of which are generally recognized as safe (GRAS), are used in the food industry and in animal diets, particularly in broilers, for promoting growth performance and modulating intestinal microbial flora (Sugiharto, 2016; Franciosini et al., 2016). Among these, phytobiotics can both be in the form of flowers, roots, bark, leaves, seeds, peel, fruits and wood, and also as extracts of aromatic and volatile liquids of these parts, which are known as essential oils (EOs) (O'Bryan et al., 2015). In addition to their many distinct and favourable effects such as increasing feed consumption, stimulating secretion of digestive enzymes, gastric and intestinal mobility, EOs of aromatic plants have also antimicrobial, antiviral, antiparasitic, antifungal, immunomodulating, antioxidant and anti-inflammatory activities (Wati et al., 2015; Zeng et al., 2015; Giannenas et al., 2016).

Oregano (*Origanum vulgare* L.) and rosemary (*Rosmarinus officinalis* L.) genera belong to the *Lamiaceae* family and are used as feed additives in diets (Sienkiewicz, 2013). Oregano is an aromatic plant widely distributed in the Mediterranean region and in Asia. Oregano EO is a volatile oil concentrated from natural plant products, and harbours high percentages of volatile aroma compounds such as thymol and carvacrol (Silva et al., 2012). These major compounds, which can have anti-inflammatory and antioxidative activities, exert their antimicrobial effects by disrupting inorganic ion balance and disturbing pH homeostasis in bacterial membranes (Corduk et al., 2013; Hashemipour et al., 2013; Zou et al., 2016). Another aromatic herb, rosemary has several naturally active compounds with antioxidant activity, mainly the phenolic diterpenes, such as carnosol, rosmanol, and their acid forms or flavonoids. On the other hand, the major components of rosemary EOs are monoterpenes such as  $\alpha$ -pinene, 1,8-cineole, myrcene and borneol, which possess strong antimicrobial activities (Yasar et al., 2011; Yesilbag et al., 2011; Khazaei et al., 2017). Previous literature has many studies highlighting the beneficial effects of oregano and rosemary, as herbs (Yasar et al., 2011; Yesilbag et al., 2011; Khazaei et al., 2017; Demir et al., 2005; Cross et al., 2007; Tollba, 2010; Abdel-Wareth et al., 2012), in EO forms (Giannenas et al., 2016; Yesilbag et al., 2011; Cross et al., 2007; Botsoglou et al., 2002; Kirkpinar et al., 2011), in aqueous extract (Franciosini et al., 2016), in extracted active component such as carvacrol and/or thymol (Jang et al., 2007; Tiihonen et al., 2010; Abudabos and Alyemni, 2013; Sun et al., 2015), EO blends (Giannenas et al., 2016; Kirkpinar et al., 2011; Cetin et al., 2016), and in combination with other feed additives such as probiotics,

organic acids, attapulgit (Aksu and Bozkurt, 2009; Buğdayci and Ergün, 2011; Cho et al., 2014; Skoufos et al., 2016) in broiler diets for performance and gut health (Giannenas et al., 2016; Yasar et al., 2011; Khazaei et al., 2017; Cetin et al., 2016; Skoufos et al., 2016; Al-Kassie et al., 2008; Mountzouris et al., 2011; Norouzi et al., 2015). There are reports on the use of various levels of oregano (25-1200 mg/kg) and rosemary (100-500 mg/kg) EOs for performance and for determining their effect on intestinal flora. Also within these, although some studies used the same EO levels, there are differences in their performance and microbial flora results. However, in current literature, we have not come across a study using 'oregano and rosemary EO combination' specifically in the level of 200 mg/kg oregano + 200 mg/kg rosemary.

Therefore, this study aimed to determine the synergistic effect of oregano and rosemary EOs in different levels on broiler performance and caecal microflora by examining their individual (300 mg/kg) and combined (150 mg/kg oregano + 150 mg/kg rosemary and 200 mg/kg oregano + 200 mg/kg rosemary) supplementation in basal diets.

## Results

This study was conducted to determine the effect of oregano and rosemary EOs on broiler performance and caecal microflora supplemented individually and combined to the basal diets.

Effects of oregano and rosemary EO supplementation on broiler performance during rearing period are presented in Table 3. When C group was compared to treatment groups, BW in C was significantly lower than R ( $P<0.05$ ) and OR2 ( $P<0.001$ ) by 42 d. Within treatment groups, birds in R group had significantly higher BW than those in OR1 and OR2 treatment groups on 21 d of the experiment ( $P<0.05$ ). BWG and FCR of the birds in OR2 group were better than C group ( $P<0.05$ ). There was no significant difference in FI in C versus treatments and within treatment groups during the rearing period ( $P>0.05$ ).

Effect of dietary supplementation with EO on caecal microflora from the aspect of coliform bacteria, *Clostridium* spp. and *Lactobacillus* spp. counts of broilers at 42 d of age are given in Table 4. There was approximately 1 log reduction in coliform bacteria and *Clostridium* spp. counts, and 1 log increase in *Lactobacillus* spp. counts in C and treatment groups. Statistical analyses revealed a significant difference in coliform bacteria and *Lactobacillus* spp. counts ( $P<0.001$ ), and *Clostridium* spp. counts ( $P<0.01$ ) between C and all treatment groups, while there was no difference within treatment groups ( $P>0.05$ ). None of the samples were positive for *Clostridium perfringens*, while all were positive for *E. coli*.

## Conclusion

Current study results suggested that combined (OR2, 200 mg/kg oregano + 200 mg/kg rosemary) EO supplementation significantly increased BW, BWG and improved FCR in 0-42 d, as well as beneficially influenced caecal microflora of broilers by lowering counts of coliform bacteria and *Clostridium* spp. and increasing *Lactobacillus* spp.

## References

- ABDEL-WARETH AAA, KEHRAUS S, HIPPENSTIEL F, SUDEKUM KH (2012). Effects of thyme and oregano on growth performance of broilers from 4 to 42 days of age and on microbial counts in crop, small intestine and caecum of 42-day-old broilers. *Anim Feed Sci Technol*, 178, 198-202, 2012. DOI:10.1016/j.anifeedsci.2012.10.006
- ABUDABOS SM, ALYEMNI AH. (2013). The effect of feeding a commercial essential oil product to broilers challenged with *Clostridium perfringens*. *Afr J Microbiol Res*, 7, 4539-4545, 2013. DOI: 10.5897/AJMR2013.6074
- AKSU T, BOZKURT AS. (2009). Effect of dietary essential oils and/or humic acids on broiler performance, microbial population of intestinal content and antibody titres in the summer season. *Kafkas Univ Vet Fak Derg*, 15, 185-190, 2009. DOI:
- AL-KASSIE GAM, MOHAMMED MF, HAMOOD MF, JAMEEL YJ. (2008). The effect of anise and rosemary on the microbial balance in gastro intestinal tract for broiler chicks. *Int J Poult Sci*, 7, 610-612, 2008. DOI: 10.3923/ijps.2008.610.612
- BOTSOGLOU NA, FLOROU-PANERI P, CHRISTAKI E, FLETOURIS DJ, SPAIS AB. (2002). Effect of dietary oregano essential oil on performance of chickens and on iron-induced lipid oxidation of breast, thigh and abdominal fat tissues. *Br Poult Sci*, 43, 223-230, 2002. DOI: 10.1080/00071660120121436
- BUĞDAYCI KE, ERGÜN A. (2011). The effects of supplemental essential oil and/or probiotic on performance, immune system and some blood parameters in broilers. *Vet J Ankara Univ*, 58, 279-284, 2011. DOI:
- CETIN E, YIBAR A, YESILBAG D, CETIN I, CENGİZ SS. (2016). The effect of volatile mixtures on the performance and ilio-caecal microflora of broiler chickens. *Br Poult Sci*, 57, 780-787, 2016. DOI: 10.1080/00071668.2016.1214682
- CHO JH, KIM HJ, KIM IH. (2014). Effects of phytogetic feed additive on growth performance digestibility, blood metabolites, intestinal microbiota, meat color and relative organ weight after oral challenge with *Clostridium perfringens* in broilers. *Livest Sci*, 160, 82-88, 2014. DOI: 10.1016/j.livsci.2013.11.006

- CORDUK M, SARICA S, YARIM GF. (2013). Effects of oregano or red pepper essential oil supplementation to diets for broiler chicks with delayed feeding after hatching. 1. Performance and microbial population. *J Appl Poult Res*, 22, 738-749, 2013. DOI:10.3382/japr.2012-00672
- CROSS DE, MCDEVITT RM, HILLMAN K, ACAMOVIC T. (2007). The effect of herbs and their associated essential oils on performance, dietary digestibility and gut microflora in chickens from 7 to 28 days of age. *Br Poult Sci*, 48, 496-506, 2007. DOI: 10.1080/00071660701463221
- DEMIR E, SARICA S, OZCAN MA, SUICMEZ M. (2005). The use of natural feed additives as alternative to an antibiotic growth promoter in broiler diets. *Arch Geflügelk*, 63, 110-116, 2005. DOI:
- FRANCIOSINI MP, CASAGRANDE-PROIETTI P, FORTE C, BEGHELLI D, ACUTI G, ZANICHELLI D, ALESSANDRO DAL BOSCO, CASTELLINI C, TRABALZA-MARINUCCI M. (2016). Effects of oregano (*Origanum vulgare* L.) and rosemary (*Rosmarinus officinalis* L.) aqueous extracts on broiler performance, immune function and intestinal microbial population. *J Appl Anim Res*, 44, 474-479, DOI: 10.1080/09712119.2015.1091322
- GIANNENAS I, TZORA A, SARAKATSIANOS I, KARAMOUTSIOS A, SKOUFOS S, PAPAIOANNOU N, ANASTASIOU A, SKOUFOS I. (2016). The effectiveness of the use of oregano and laurel essential oils in chicken feeding. *Ann Anim Sci*, 16, 779-796. DOI: 10.18782/2320-7051.2397
- HASHEMIPOUR H, KERMANSHAHI H, GOLIAN A, RAJI A, VAN KRIMPEN MM. (2013). Effect of thymol + carvacrol by next enhance 150 ® on intestinal development of broiler chickens fed CMC containing diet. *Iran J Appl Anim Sci*, 3, 567-576, 2013. DOI:
- JANG IS, KO YH, KANG SY, LEE CY. (2007). Effect of a commercial essential oil on growth performance, digestive enzyme activity and intestinal microflora population in broiler chickens. *Anim Feed Sci Technol*, 134, 304-315, 2007. DOI: 10.1016/j.anifeeds.2006.06.009
- KHAZAEI R, ESMAILZADEH L, SEIDAVI A, SIMÕES J (2017). Comparison between rosemary and commercial antioxidant blend on performance, caecal coliform flora and immunity in broiler chickens fed with diets containing different levels of poultry fat. *J Appl Anim Res*, 45, 263-267, 2017. DOI:10.1080/09712119.2016.1174125
- KIRKPINAR F, UNLU HB, OZDEMIR G. (2011). Effects of oregano and garlic essential oils on performance, carcass, organ and blood characteristics and intestinal microflora of broilers. *Livest Sci*, 137, 219-225, 2011. DOI: 10.1016/j.livsci.2010.11.010
- MOHITI-ASLI M, GHANAATPARAST-RASHTI M. (2017). Comparing the effects of a combined phyto-genic feed additive with an individual essential oil of oregano on intestinal morphology and microflora in broilers. *J Appl Anim Res*, . DOI: 10.1080/09712119.2017.1284074.

- MOUNTZOURIS KC, PARASKEVAS V, TSIRTSIKOS P, PALAMIDI I, STEINER T, SCHATZMAYR G, FEGEROS K. (2011). Assessment of a phytogetic feed additive effect on broiler growth performance, nutrient digestibility and caecal microflora composition. *Anim Feed Sci Technol*, 168, 223-231, 2011. DOI:10.1016/j.anifeedsci.2011.03.020
- NOROUZI B, QOTBI AAA, SEIDAVI A, SCHIAVONE A, MARIN ALM. (2015). Effect of different dietary levels of rosemary (*Rosmarinus officinalis*) and yarrow (*Achillea millefolium*) on the growth performance, carcass traits and ileal microbiota of broilers. *Ital J Anim Sci*, 14, 448-453, 2015. DOI:10.4081/ijas.2015.3930
- O'BRYAN CA, PENDLETON SJ, CRANDALL PG, RICKE SC. (2015). Potential of plant essential oils and their components in animal agriculture-in vitro studies on antibacterial mode of action. *Front Vet Sci*. DOI: 10.3389/fvets.2015.00035.
- SIENKIEWICZ M, LYSAKOWSKA M, PASTUSZKA M, BIENIAS W, KOWALCZYK E (2013). The potential of use basil and rosemary essential oils as effective antibacterial agents. *Molecules*, 18, 9334-9351. DOI:10.3390/ molecules18089334
- SILVA N, ALVES S, GONCALVES A, AMARAL JS, POETA P. (2012). Antimicrobial activity of essential oils from Mediterranean aromatic plants against several foodborne and spoilage bacteria. *Food Sci Technol Int*, 19, 503-510, 2012. DOI: 10.1177/1082013212442198.
- SKOUFOS I, GIANNEAS I, TONTIS D, BARTZANAS T, KITTAS C, PANAGAKIS P, TZORA A. (2016). Effects of oregano essential oil and attapulgit on growth performance, intestinal microbiota and morphometry in broilers. *S Afr J Anim Sci*, 46, 77-88, 2016. DOI: 10.4314/sajas.v46i1.10
- SUGIHARTO, S. (2016). Role of nutraceuticals in gut health and growth performance of poultry. *Journal of the Saudi Society of Agricultural Sciences*, 15, 99-111, DOI: 10.1016/j.jssas.2014.06.001 1
- SUN Q, LIU D, GUO S, CHEN Y, GUO Y. (2015). Effects of dietary essential oil and enzyme supplementation on growth performance and gut health of broilers challenged by *Clostridium perfringens*. *Anim Feed Sci Technol*, 207, 234-244, 2015. DOI: 10.1016/j.anifeedsci.2015.06.021
- TIIHONEN K, KETTUNEN H, BENTO MHL, SAARINEN M, LAHTINEN S, OUWEHAND AC, SCHULZE H, RAUTONEN N. (2010). The effect of feeding essential oils on broiler performance and gut microbiota. *Br Poult Sci*, 51, 381-390, 2010. DOI: 10.1080/00071668.2010.496446.
- TOLLBA AAH. (2010). Reduction of broilers intestinal pathogenic microflora under normal or stressed condition. *Egypt Poult Sci*, 30, 249-270, 2010. DOI:

- WATI T, GHOSH TK, SYED B, HALDAR S. (2015). Comparative efficacy of a phytogetic feed additive and an antibiotic growth promoter on production performance, caecal microbial population and humoral immune response of broiler chickens inoculated with enteric pathogens. *Animal Nutrition*, 1, 213-219. DOI: 10.1016/j.aninu.2015.08.003
- YASAR S, NAMIK D, FATIH G, GOKCIMER A, SELCUK K (2011). Effects of inclusion of aerial dried parts of some herbs in broiler diets. *J Anim Plant Sci*, 21, 465-476, 2011. DOI:
- YESILBAG D, EREN M, AGEL H, KOVANLIKAYA A, BALCI F. (2011). Effects of dietary rosemary, rosemary volatile oil and vitamin e on broiler performance, meat quality and serum SOD activity. *Br Poult Sci*, 52, 472-482, 2011. DOI:10.1080/00071668.2011.599026
- ZENG Z, ZHANG S, WANG H, PIAO X. (2015). Essential oil and aromatic plants as feed additives in non-ruminant nutrition: A review. *J Anim Sci Technol*, 6, 1-10. DOI: 10.1186/s40104-015-0004-5
- ZOU Y, XIANG Q, WANG J, PENG J, WEI H. (2016). Oregano essential oil improves intestinal morphology and expression of tight junction proteins associated with modulation of selected intestinal bacteria and immune status in a pig model. *Biomed Res Int*, 2016. DOI: 10.1155/2016/5436738.

## Probiotic Effect of Yogurt on Caecal Microflora of Quails (*Coturnix coturnix Japonica*)

İsa Coşkun, Figen Saydut, Abdurrahman Korkmaz, Ahmet Şahin

Ahi Evran University, Faculty of Agriculture, Department of Animal Science, 40100

### Abstract

The aim of this study was to determine the probiotic effect of yogurt on caecal microflora of quails. In this study, 20 caecum contents (10 caecum content for per treatment group) were analyzed. Quails consumed basal diet with experimental group drunk water diluted with yogurt. Treatment groups were 1) control, 2) supplemented with yogurt. Yogurt added to drinking water of quails 10 ml per day by diluting 10% at 21 days. Data collected from study analyzed with independent samples T test at SPSS statistical programme. At the end of study, it was determined that lactic acid bacteria population increased statistically in quails consumed yogurt from control. Although there were no difference among the groups, caecal *E Coli*, *Koliform* and *Enterobacteriaceae* population was tend to decrease and yeast was tend to increase in quails consumed yogurt. To conclude, it was determined that yogurt developed gut microflora of quails.

**Key words:** *Yogurt, Quail, Bacteria, Caecum*

### Yoğurdun Bildircinların Sekum Mikroflorası Üzerine Probiyotik Etkisi

#### Özet

Bu çalışmanın amacı bildircin sekum mikroflorası üzerine yoğurdun probiyotik etkisini belirlemektir. Çalışmada 20 bildircin'den alınan sekum içerikleri (10 sekum içeriği her muamele grubu için) analiz edilmiştir. Bildircinler bazal yemle beslenmişler ve bir grubun içme suyuna sulandırılmış yoğurt ilave edilmiştir. Araştırmadaki muamele grupları 1) kontrol, 2) yoğurt ilaveli grup. Yoğurt bildircinların içme sularına %10 sulandırılarak 21 gün süreyle her gün 10 ml verilmiştir. Çalışmada elde veriler SPSS istatistik paket programında bağımsız örneklem T testine tabi tutulmuştur. Çalışmanın sonunda, yoğurt tüketen bildircinların sekum içeriklerinde laktik asit bakteri popülasyonunun kontrol grubuna göre önemli seviyede arttığı belirlenmiştir ( $P<0.01$ ). Maya miktarı değişmemiştir. Gruplar arasında istatistikî farklılık olmamasına rağmen *E Coli*, *Koliform* ve *Enterobakter* miktarları yoğurt tüketen bildircinlarda azalma eğilimi gösterdiği ve maya miktarını artış eğilimi gösterdiği belirlenmiştir. Sonuç

olarak, yoğurdun bildircinların bağırsak mikroflorasını olumlu yönde etkilediği belirlenmiştir.

**Anahtar kelimeler:** Yoğurt, Bildircin, Bakteri, Sekum

### **Introduction**

Gut health is one the most important factor for poultry production. Lactobacillus species as a probiotic have been used to increase gut health by enhancing useful bacteria to suppress pathogenic bacteria in gut. There have been a large number of studies on investigation the effects of lactobacillus species in poultry. Successful probiotic effects in poultry have been found using probiotic mix and Lactobacillus spp (Wang et al., 2017). Although there are a lot of studies including lactobacillus species in literature, probiotic effects of different food additives including lactic acid bacteria need further investigation. Yogurt is one of tis food additives and it is source of lactobacillus species. It contains lactobacilli and other beneficial bacteria that enhances health, digestion and suppress the pathogens by improving the balance of microbes in the digestive tract (Metchnikoff, 1998). Studies on yogurt as a probiyotic in chicks have been finite. In these finite studies, Boostani et al. (2013) reported that dietary yogurt supplementation increased growth performance, developed FCR and decreased caecal E Coli count in broiler chicks. Mahmmod et al., (2014) reported that yogurt powder did not affect broiler performance and caecal total aerobic bacteria and coliforms. And also, the effect of yogurt on beneficial microbes and pathogenic microbes in chicks did not studies. Further investigation must be conducted on the effect of yogurt on caecal microflora in chicks comprehensively. Therefore, The aim of this study was to determine the effect of liquid yogurt on caecal lactic acid bacteria (LAB), Yeast, *Enterobactericaea*, E Coli and Coliform bacteria count of quails caecum.

### **Material and Methods**

Yogurt was provided from local dairy product company in kırşehir province. Yogurt diluted 10% with distilled water and 10 ml added to drinking water of treatment quail chicks for 21 days, control groups quails did not consume water yogurt. At the end of 21 days, 20 caecum contents from quails (10 caecum content for per treatment group) analyzed. Treatment groups were 1) control, 2) supplemented with yogurt. Samples of the caecum contents were collected into sterile glass tubes in which they were kept on ice until subsequent inoculation into agars. MRS agar (MERCK, Darmstadt, Germany, 1.10660) was used for enumeration of lactic acid bacteria (LAB) at 37°C for a 3-d incubation period and malt extract agar (MERCK, Darmstadt, Germany, 1.05398) was used for enumeration of yeast at 30°C for a 3-d incubation period. VRBD (Violet Red Bile Dextrose) (MERCK, Darmstadt, Germany, 1.01406) agar was used for enumeration of *Enterobacteriaceae* at 37°C for an 18 – 20 h incubation period. 3M Petrifilm

TM (3M Microbiology Products St. Paul MN 55114 USA) was used to determine *Escherichia coli* and *Coliform* count in caecal samples. The following manufacturer's instructions for incubation conditions were used to determine the microbial counts of samples: *Escherichia coli*: at 32°C for 24 h; *Enterobacteriaceae*: at 35°C for 24 h. Bacterial colonies were counted by determining the average number of live bacteria per g caecal content. LAB, Yeast, *Enterobacteriaceae*, *E. coli* and *Coliform* bacteria counts of the samples were converted into logarithmic colony forming units (cfu g<sup>-1</sup>). The data were analyzed using the independent samples T test procedure of SPSS software (SPSS 15).

Table1. The effect of yogurt on caecal microflora

	Control	Yogurt	P Value
LAB	6.21±0.29b	6.96±0.12a	0.004
Yeast	6.67±0.22	6.99±0.12	0.36
E Coli	6.83±0.28	6.50±0.42	0.35
Coliforms	7.17±0.45	6.59±0.34	0.36
Enterobacteriaceae	7.15±0.25	6.86±0.26	0.41

a-b: Means in a row with no common superscript letters differ significantly (P<0.05).

## Results and Discussion

The effect of liquid yogurt on caecum LAB, yeast, *Enterobacteriaceae*, *E Coli* and *Coliform* bacteria count of quail's caecum were given in table 1. It was determined that lactic bacteria population increased statistically in quails consumed yogurt from control. Yeast, *Enterobacteriaceae*, *E Coli* and *Coliform* count in caecum did not affect. Although there were no difference among the groups, caecal *E Coli*, *Coliform* and *Enterobacteriaceae* population was tend to decrease and yeast count was tend to increase in quails consumed yogurt. Studies on yogurt as a probiyotic in chicks are finite and in this studies one or two bacteria determined. For instance, Boostani et al. (2013) reported that dietary yogurt supplementation decreased caecal *E Coli* count in broiler chicks. Mahmmod et al. (2014) reported that did not affect caecal total aerobic bacteria and coliforms. This is the first record of yogurt on 2 beneficial bacteria (LAB and Yeast) and 3 pathogenic bacteria (*E Coli*, *Coliform* and *Enterobacteriaceae*) species determination in quail chicks.

Yogurt is produced with the symbiosis two bacteria (*S. thermophiles* and *L. Bulgaricus*) in a sterile environment at a very low temperature (36°C–42°C) for 3–8 h. Both bacterial strains must remain active in the final product with at least 10 million bacteria/g (Fisberg et al., 2015; Bodot et al., 2013). Yogurt includes high level probiotic bacteria. Samli et al. (2007) reported that probiotics in the birds digestive system by supplementing probiotic bacteria to the diet has been shown to prevent growth of pathogen bacteria in broiler chickens. Probiotics facilitates a wall between the intestinal wall and the lumen of gut for the pathogenic bacteria. Probiotics in a bird's digestive tract increases the production of volatile fatty acids which in turn decrease

the pH level in the digestive tract. Lowering the pH level and decreasing high volatile fatty acid create an unfavourable environment for pathogens. The result of our study showed that yogurt has a promising probiotic for livestock.

To conclude, it was determined that yogurt developed gut microflora of quails and it can use as probiotic in chickens. Because liquid yogurt increased beneficial bacteria population and decreased pathogenic bacteria population in caecum. But, further studies must be conducted the effect of yogurt on different bacteria development in different animal species.

## References

- BODOT, V., SOUSTRE, Y., REVEREND, B. Best of 2013: Yogurt Special French National Dairy Council (CNIEL): Scientific and Technical Affairs Division 2013.  
[http://www.idfdairynutrition.org/Files/media/FactSheetsHP/EXE-EN\\_BofYogurt.pdf](http://www.idfdairynutrition.org/Files/media/FactSheetsHP/EXE-EN_BofYogurt.pdf). Accessed 6.2.2018
- BOOSTANI, A., MAHMOODIAN, H. R., ASHAYERIZADEH, FARD, A., AND AMINAFSHAR, M. (2013). "Growth performance, carcass yield and intestinal microflora populations of broilers fed diets containing thepax and yogurt." *Revista Brasileira de Ciência Avícola* 15(1): 1-6.
- ISHAQ, M., ASLAM, A., REHMAN, H. U., and AKHTAR, A. (2012). "Haematological And Immunological Effects Of Yogurt And Garlic Supplementations On Broiler Chicks Vaccinated Against Newcastle." *Pakistan Journal of Science* 64(2)
- FISBERG, M. AND MACHADO, R. (2015) History of yogurt and current patterns of consumption. *Nutrition reviews*, 73(suppl\_1): 4-7.
- MAHMMOD, ZHIAN, A., ABDULRAZAQ, HUREA. S., SALEM, AKHLASi S., SIDEQ, RUBAR, M.. (2014) "Effects of supplementation probiotic and dried yogurt powder on growth performance, carcass characteristics, intestinal micro flora and immunity of broiler chickens." *ZANCO Journal of Pure and Applied Sciences* 26(3): 35-42.
- METCHNIKOFF, E. (1998).*The prolongation of life*.1st Edn., New York: GP Putzman Sons 161-183.
- SAMLI, HASAN. ERSIN., NIZAMETTIN, SENKOYLU., FISUN, KOC., MEHMET, KANTER., AND AYLIN, AGMA. (2007) "Effects of Enterococcus faecium and dried whey on broiler performance, gut histomorphology and intestinal microbiota." *Archives of animal nutrition* 61(1): 42-49.
- WANG, H., NI, X., QING, X., ZENG, D., LUO, M., LIU, L., LI, G., PAN, K., JING, B. (2017) Live probiotics *Lactobacillus johnsonii* BS15 promotes growth performance and lowers fat deposition by improving lipid metabolism, intestinal development, and gut microflora in broilers. *Front. Microbiol.* 8, 1073. doi: 10.3389/fmicb.2017.01073.

## Changes in Embryo Development and Chick Quality from Four Different Egg Sizes in Bronz Turkey

Arda Sözcü, Aydın İpek

Uludag University, Faculty of Agriculture, Department of Animal Science, Gorukle, 16059  
Bursa, Turkey

### Abstract

This study was carried out to determine the changes in embryo development and some chick quality parameters from four different egg sizes in Bronz turkey. A total of 600 turkey eggs with four different egg sizes below 70 g, 71 to 75 g, 76 to 80 g and above 81 g were used in the study. These results showed that egg size have effects on embryo development and hatchability traits in Bronz turkey.

**Keywords:** *Egg Size, Embryo Development, Hatchability, Poult Weight, Turkey.*

## Changes In Embryo Development and Chick Quality From Four Different Egg Sizes in Bronz Turkey

### Özet

Bu çalışma, bronz hindilerde dört farklı yumurta ağırlığında embriyo gelişimi ve bazı civciv kalite parametrelerindeki değişimlerin belirlenmesi amacıyla yürütülmüştür. Çalışmada, 70 g ve altı, 71-75 g, 76-80 g ve 81 g ve üzeri olmak üzere dört farklı ağırlık grubundan toplam 600 yumurta kullanılmıştır. Çalışmadan elde edilen sonuçlar bronz hindilerde yumurta ağırlığının embriyo gelişimi ve kuluçka randımanı üzerine etkisi olduğunu göstermiştir

**Anahtar kelimeler:** *Yumurta Ağırlığı, Embriyo Gelişimi, Kuluçka Randımanı, Civciv Ağırlığı, Hindi.*

### Introduction

The turkey is one of well-known poultry species, especially in western countries, and has shown a development as turkey industry during last decades. The primary goal of turkey industry is to obtain maximum hatchability with a higher poult quality (Anandh et al., 2012). It is known that hatchability is an important economic parameter and affected by factors including breeder age, egg quality, nutrition of breeder flock, egg handling

and storage and incubation conditions (Weis et al., 2011), and one of the most important factors is egg weight (Badowski et al., 2005).

There is an increment trend in egg weight as breeder birds gets older. It is known that a complex relationship between egg weight and hatchability (Ipek and Sozcu, 2015). On the other hand, these factors affect yolk absorption and embryo development during incubation process. Because embryo use nutrients stored in albumen and yolk for its development and growth (Speake et al., 1998).

The objective of the present study was to compare the changes in embryo development and poult quality from four different egg sizes in Bronz turkeys.

### **Materials and Methods**

The research was performed at the Research and Experimental Farm of the Department of Animal Science in Uludağ University in Turkey. A total of 600 hatching eggs were obtained from a breeder bronz turkey flock at 35-36 wk of age. The flock was kept under standard industry practices. Eggs were classified into four different egg size; below 70 g (ES I), 71 to 75 g (ES II), 76 to 80 g (ES III), and above 81 g (ES IV), by weighing with  $\pm 0.1$  precision. Then, each egg was given a special number to follow during experiment.

Eggs were incubated in fully automated ventilation, programmable incubator at 37.5°C temperature and a relative humidity of 55 to 60% during the first 24 d of incubation. The trays were consisted of mixed eggs from different egg weight classes to minimize the effect of location of trays. At d 25 of incubation, a total of 40 eggs (n:10 embryos per egg weight group) were randomly sampled to measure embryo weight, relative embryo weight, yolk weight, and relative yolk weight and body length of embryos (Ipek et al., 2014).

On day 25 of incubation, eggs were transferred to the hatcher. In the hatcher, eggs were maintained at 37.0°C temperature and a relative humidity of 72% during hatching period. At hatch, the poults were pulled out according to standard hatchery procedures. After the completing of hatching process, poults were weighed with  $\pm 0.1$  precision to determine the poult hatching weight. A total of 40 eggs (n = 10 poults per egg weight group) were randomly sampled to measure poult length, residual yolk weight, and relative residual yolk weight (Ipek et al., 2014).

At hatch, poults were classified as saleable (clean, dry, and without deformities) or culls (splayed legs, unhealed navels, and so on; Molenaar et al., 2011). The percentage of saleable and cull poults was expressed as a percentage of fertile eggs (Molenaar et al., 2011). Unhatched eggs were opened to macroscopically determine fertility and embryonic mortality

(early, middle, late). Fertility was calculated as the ratio of total eggs at set to fertile eggs.

Data were subjected to analysis of variance (SAS Institute Inc., Cary, NC) utilizing ANOVA procedures for balanced data. Parameters were analyzed using the general linear model (GLM) procedure. Analyses for percentage datas were conducted after square root of arc sine transformation of the datas. Significant differences among treatment means were determined by Duncan's multiple range test. Data are presented as means  $\pm$  SE. In all cases, a difference was considered significant at  $P \leq 0.05$ .

### Results and Discussion

The effects of egg weight on embryo development parameters on day 25 of incubation are presented in Table 1. Egg weight was found to be as 68.4, 73.2, 78.7 and 84.3 g in ES I, ES II, ES III and ES IV groups, respectively ( $P=0.001$ ). Accordingly, the highest value for embryo weight, relative embryo weight, yolk weight and relative yolk weight were observed in the ES IV group ( $P<0.05$ ). On the other hand, body length was found to be higher in embryos from ES III and ES IV (18.4 and 19.2 cm, respectively,  $P=0.038$ ).

Table 1. The effects of egg weight on embryo development parameters on day 25 of incubation

	EW	EMW	REMW	YW	RYW	BL
ES I	68.4 $\pm$ 1.4 <sup>d</sup>	34.7 $\pm$ 1.4 <sup>d</sup>	50.7 $\pm$ 1.2 <sup>b</sup>	16.0 $\pm$ 1.0 <sup>d</sup>	23.4 $\pm$ 1.8 <sup>b</sup>	16.5 $\pm$ 1.3 <sup>b</sup>
ES II	73.2 $\pm$ 1.6 <sup>c</sup>	37.0 $\pm$ 1.4 <sup>c</sup>	50.5 $\pm$ 1.1 <sup>b</sup>	18.1 $\pm$ 1.0 <sup>c</sup>	24.7 $\pm$ 1.6 <sup>b</sup>	16.8 $\pm$ 1.2 <sup>b</sup>
ES III	78.7 $\pm$ 1.2 <sup>b</sup>	39.7 $\pm$ 1.7 <sup>b</sup>	50.4 $\pm$ 1.2 <sup>b</sup>	20.4 $\pm$ 1.3 <sup>b</sup>	25.9 $\pm$ 1.5 <sup>ab</sup>	18.4 $\pm$ 1.4 <sup>a</sup>
ES IV	84.3 $\pm$ 2.1 <sup>a</sup>	43.9 $\pm$ 2.3 <sup>a</sup>	52.0 $\pm$ 1.5 <sup>a</sup>	22.5 $\pm$ 1.5 <sup>a</sup>	26.6 $\pm$ 1.6 <sup>a</sup>	19.2 $\pm$ 1.7 <sup>a</sup>
P value	0.001	0.001	0.044	0.035	0.022	0.038

EW: Egg weight (g), EMW: Embryo weight (g), REMW: Relative embryo weight (%), YW: Yolk weight (g), RYW: Relative yolk weight (%), BL: Body length (cm), a,b,c Means  $\pm$ SEM in column that possess diferent superscripts differ significantly ( $P<0.01$ ;  $P < 0.05$ )

A total of 10 embryos from each group were randomly sampled for measurements.

$$\text{Relative yolk sac weight (\%)} = (\text{Yolk sac weight/egg weight}) \times 100$$

$$\text{Relative embryo weight (\%)} = (\text{Embryo weight/egg weight}) \times 100$$

The effects of egg weight on hatchability parameters are presented in Table 2. Fertility, hatchability of fertile eggs and hatchability of total eggs were higher in ES II and ES III groups ( $P<0.05$ ). Early, mid and late term embryonic mortalities were lower in the same groups compared to ES I and ES IV groups ( $P<0.05$ ). On the other hand, cull poult rate was found to be the highest with a value of 4.6% in ES IV group ( $P=0.001$ ). Results showed

that the percentage of embryonic mortalities decreased significantly as the weight of egg increased. These results are supported by Sachdev et al. (1985) and Altan et al. (1995). Deterioration of hatchability parameters in ES IV could be related with increasing of embryonic heat production. It is known that embryos from larger eggs produce more heat during incubation, especially second half of incubation (Hulet et al., 2007).

**Table 2. The effects of egg weight on hatchability parameters**

	F	HFE	HTE	EM	MM	LTM	CPR
ES I	85.3 ± 0.3 <sup>b</sup>	85.2 ± 1.4 <sup>b</sup>	72.7 ± 1.5 <sup>b</sup>	4.7 ± 0.3 <sup>b</sup>	3.1 ± 0.4 <sup>b</sup>	7.0 ± 0.7 <sup>a</sup>	2.7 ± 0.2 <sup>b</sup>
ES II	88.0 ± 0.5 <sup>a</sup>	88.6 ± 1.8 <sup>a</sup>	78.0 ± 1.8 <sup>a</sup>	3.0 ± 0.5 <sup>c</sup>	2.3 ± 0.3 <sup>c</sup>	6.1 ± 0.7 <sup>b</sup>	1.7 ± 0.5 <sup>c</sup>
ES III	88.7 ± 0.8 <sup>a</sup>	89.5 ± 1.8 <sup>a</sup>	79.3 ± 2.3 <sup>a</sup>	3.0 ± 0.5 <sup>c</sup>	2.2 ± 0.4 <sup>c</sup>	5.3 ± 0.6 <sup>b</sup>	2.5 ± 0.7 <sup>b</sup>
ES IV	86.7 ± 0.6 <sup>b</sup>	83.1 ± 1.7 <sup>c</sup>	72.0 ± 1.9 <sup>b</sup>	5.4 ± 0.6 <sup>a</sup>	3.8 ± 0.5 <sup>a</sup>	7.7 ± 0.8 <sup>a</sup>	4.6 ± 1.2 <sup>a</sup>
P value	0.024	0.017	0.001	0.042	0.038	0.001	0.001

F: Fertility (%), HFE: Hatchability of fertile eggs (%), HTE: Hatchability of total eggs (%), EM: Early term mortalities (%), MM: Midterm mortalities (%), LTM: Late term mortalities (%), CPR: Cull poult rate (%), a,b,c Means ±SEM in column that possess diferent superscripts differ significantly (P<0.01;P < 0.05)

The effects of egg weight on poult quality parameters are presented in Table 3. Poult hatching weight was the highest in ES IV group (58.3 g, P=0.012), whereas poult weight/egg weight ratio was the lowest in the ES I group (66.5%, P=0.048). Similar results are also found by Oblakova et al. (2008). Poult length and residual yolk weight was the highest in the ES IV group (25.6 cm and 8.8 g, P<0.05).

**Table 3. The effects of egg weight on poult quality parameters**

	PHW	PWEW	PL	RYW	RRYW
ES I	45.1 ± 1.4 <sup>d</sup>	66.5 ± 1.2 <sup>b</sup>	21.8 ± 1.2 <sup>c</sup>	6.5 ± 1.3 <sup>c</sup>	14.2 ± 1.4
ES II	50.4 ± 1.9 <sup>c</sup>	68.1 ± 1.4 <sup>a</sup>	23.2 ± 1.2 <sup>b</sup>	7.4 ± 1.2 <sup>bc</sup>	14.5 ± 1.3
ES III	53.6 ± 1.4 <sup>b</sup>	68.3 ± 1.6 <sup>a</sup>	23.8 ± 1.0 <sup>b</sup>	8.1 ± 1.2 <sup>ab</sup>	14.9 ± 1.4
ES IV	58.3 ± 2.2 <sup>a</sup>	68.5 ± 1.6 <sup>a</sup>	25.6 ± 1.3 <sup>a</sup>	8.8 ± 1.5 <sup>a</sup>	15.3 ± 1.8
P value	0.012	0.048	0.027	0.038	0.832

PHW: Poult hatching weight (g), PWEW: Poult weight/egg weight (%), PL: Poult length (cm), RYW: Residual yolk weight (g), RRYW: Relative residual yolk weight (%), a,b,c Means ±SEM in column that possess diferent superscripts differ significantly (P<0.01;P < 0.05)

## **Conclusion**

In conclusion, the first condition of successful and profitable poultry production depends on accomplished hatchery management and good quality and healthy poult production. Embryo development and hatchability are affected by variation in egg weight as a natural progression of breeders' age. The present results showed that egg size have effects on embryo development and hatchability traits in Bronz turkey. It can be offered that, egg size that range between 71 to 80 g should be recommended for a higher poult weight and hatching performance.

## References

- ALTAN, O., OGUZ, I. and SETTAR, P. (1995) Effect of egg weight and specific gravity of the hatchability characteristics in Japanese quail. *Turk. J. Agric. For.* 19: 219-222.
- ANANDH, M.A., JAGATHEESAN, P.N.R., KUMAR, P.S., RAJARAJAN, G., and PARAMASIVAM, A. (2012) Effect of egg weight on egg traits and hatching performance of turkey (*Meleagris gallopavo*) eggs. *Iranian Journal of Applied Animal Science* 2(4): 391-395.
- BADOWSKI, J., BIELIŃSKA, H., PAKULSKA, E. and WOLC, A. (2005) Relationships between some traits of hatching eggs and body weight of growing geese. *Proceedings of the 17th World's Poultry Science Association*, Kiekrz k, Poznan, pp. 13–14.
- HULET, R., GLADYS, G., HILL, D., MEIJERHOF, R., and ELSHIEKH, T. (2007) Influence of egg shell embryonic incubation temperature and broiler breeder flock age on posthatch growth performance and carcass characteristics. *Poultry Science* 86(12): 408-412.
- IPEK, A. and SOZCU, A. (2015) The effects of broiler breeder age on intestinal development during hatch window, chick quality and first week broiler performance. *J. Appl. Anim. Res.* 43(4): 402-408.
- IPEK, A., SAHAN, U., BAYCAN, S.C. and SOZCU, A. (2014) The effects of different eggshell temperatures on embryonic development, hatchability, chick quality and first-week broiler performance. *Poult. Sci.* 93: 464–472.
- MOLENAAR, R., HULET, R., MEIJERHOF, R., MAATJENS, C.M., KEMP, B., and BRAND, H.V.D. (2011) High eggshell temperatures during incubation decrease growth performance and increase the incidence of ascites in broiler chickens. *Poult. Sci.* 90: 624–632.
- OBLAKOVA, M., LALEV, M., HRISTAKIEVA, P. and GEORGIEVA, S. (2008) Effect of egg weight on the productive traits of hatched turkey poults not later than 16 weeks of age. *Trakia Journal of Sciences*, 6(4): 88-87.
- SACHDEV A.K., AHUJA S.D., THOMAS P.C. and AGARWAL S.K. (1985) Effect of egg weight and duration of storage on the weight loss, fertility and hatchability traits in Japanese quail. *Indian J. Poult. Sci.* 20: 19-22.
- SAS (1998), SAS Institute. SAS user's guide: A user's guide to SAS. Cary (NC): SAS Institute Inc.
- SPEAKE, B. K., MURRAY, A. M., and NOBLE, R.C. (1998). Transport and transformations of yolk lipids during development of the avian embryo. *Prog Lipid Res.* 37: 1-32.
- WEIS, J., HRNCAR, C., PAL, G., BARANSKA, B., BUJKO, J. and MALIKOVA, L. (2011) Effect of the egg size on egg loses and hatchability of the Muscovy duck. *Scientific Papers: Animal Science and Biotechnologies* 44(1): 354-356.

**SESSION-7**  
**MANAGEMENT**

**INVITED PRESENTATION**

## Preparing Broiler Breeder Females for Optimum Production

Zekeriya Yıldırım, Mert Yalçınalp

Cobb Ana Damızlık Ltd.

### Abstract

It is not amazing that numbers of total eggs and chicks from broiler parent stock breeders are nearly 190 eggs and 160 chicks in 40 weeks production period for the flocks in top 5% and 1.60 feed conversion rate, 2700 g live weight at 40 days for the broilers. Foundation is in rearing to achieve peak production, for good persistency and for high productivity. Focus on uniformity, body confirmation (fleshing), body weight profiles, feed management to create ideal preparation of the pullet. First grading at 7 days and three more at 4,12,18 weeks by weighing one by one is essential to achieve 80% uniformity in rearing period. At least 34% body weight gain in the period between 16-20 weeks will accelerate hormonal process and begin to deposit fat for sexual maturity. Fleshing score should be 2-3 until 15 weeks and 3-4 after 16 weeks. Decision of lighting is accordingly 2 cm pelvic bone width and enough abdominal fat deposition. More than 4% double yolk eggs at the 28<sup>th</sup> week means over feed and light stimulation.

**Key words:** *Double Yolk Eggs, Fleshing, Grading, Peak Feed, Feed Withdrawal*

### Etlik Piliç Dişi Damızlıkların Optimum Üretim için Hazırlanması

#### Özet

Broyler damızlıklarında 40 haftalık yumurta dönemi içinde elde edilen toplam yumurta sayısı, en iyi %5 'e giren sürülerde 190, civciv adeti ise 160'ı geçmiştir. Broylerlerde de 40. günde 1.60'a yaklaşan yem dönüşümü ve 2700 gram canlı ağırlıklar, şaşırtıcı olmaktan çıkmıştır. Yetiştirme dönemi, yüksek pik ve sonrasında da düzenli bir yumurta verimi için esas temeli oluşturur. Üniformite, göğüs etlenmesi (fleshing), canlı ağırlık seyri ve yemleme programları büyüme döneminde odaklanması gereken alanlardır. İlki 7 gün olmak üzere, 4, 12 ve 18. haftalarda tek tek tartılarak sınıflamanın yapılması, %80 ve üstü bir üniformite için gereklidir. 16-20. haftalar arası %34 civarı ağırlık artışının sağlanarak, cinsel faaliyetlerin başlamasına yol açacak yeterli karın yağı birikimi gerçekleştirilmelidir. 15. Haftaya kadar göğüs etlenme skorunun 2-3, 16. haftadan sonra ise 3-4 olması lazımdır. Işık uyarımının başlatılmasında 2 cm ve üstü pelvis açıklığı

ile pelvis kemiklerindeki yağlanmanın %80 üzerinde olması durumu, dikkate alınmalıdır. 28.haftada %4 ten fazla çift sarılı yumurta aşırı yem ve ışık uyarımının işaretidir.

**Anahtar kelimeler:** *Çift Sarılı Yumurta, Göğüs Etilenme Durumu, Pik Yem, Yem Çekimi, Sınıflama*

### **Introduction**

There is a range between different countries in point of egg and chick numbers and some of them like Brazil have always better figures than others with the same genetic material. Grading has a major role to get good results in rearing. 4- 5 Times instead of one, and the first one at very early stage is very effective. Grading at seven days, the 4th, 12th, 18th & 20th has a big impact on frame uniformity, sufficient deposition abdominal fat and pelvic width which are must for a good start. Grading by handling each bird one by one is very hard job therefore brand new equipment have already developed to make it semi automatically to save time and to make it easy process. Addition to grading accordingly frame size and uniformity, grading for Fleshing (body conformation) is also very critical parameter what we have to look at. Over stimulation of breast muscles instead of abdominal fat deposition postpones onset of laying and prevent having a good production.to get appropriate amount of increase in body weight in the period between 16-20 weeks is very essential for pelvic- abdominal fat which encourages estrogen hormones production. This is also a must for high peak and persistency. The females must grow at least 34% in that period regardless their live weight at 15 weeks. A pre breeder diet with a high energy level from 16 weeks will make easy the fat deposition. One of the challenging subjects is that breeder managers can hardly control the over body weight between the 20th week and at 5% production. 3 grams of feed increments in that period is enough to keep Weight gain from 5% production till peak should be 18%. It must keep in mind that every 1% less peak cost you 1.6 less eggs. Over stimulation by feed and light definitely will cause heavy hens, extremely high double yolk eggs, egg peritonitis and therefore high mortality. 0.25% weekly mortality is normal and inevitable between 20-30 weeks.

Two main very critical points for optimum production are determining how much feed energy is needed therefore peak feed amount and the age for feed withdrawal. Well accepted aspect that is daily intake of 450 Kcal/ME and 25 grams of protein is enough to support the hens at peak. Feed increases should be slow up to 35-40% and maximum feed should be given at 75% daily production.

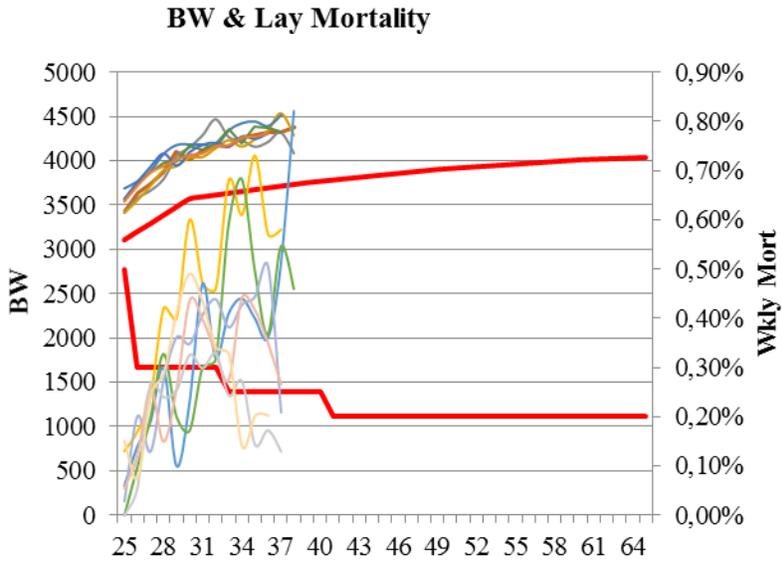


Figure 1. Relation between Weight and mortality, peritonitis

### Frame size and Fleshing (Body condition)

First two grading at the 7th and 28th days are outmost essential to get a uniform skeleton development and frame size. Production results have been improved by the grading at those two ages. It is always usual to see the birds having the same weight but different frame size. The chicks should be sorted into three groups – light, standard and heavy. The standard group should be around 50%-60% of the flock. It is essential that the different groups can be fed differently to manage.

Them according to their bodyweights. At eight weeks, 80% of skeleton is determined. The goal is to have all birds at that age on the same bodyweight Chicks from different ages parents (different categories) must be keep separately at least for two first weeks preferably until second grading at the 4th weeks. All birds should have a fleshing condition between 3-4 above 90 % and should have good fat reserves on the pelvic bones before light stimulation which is at 21-22 weeks.

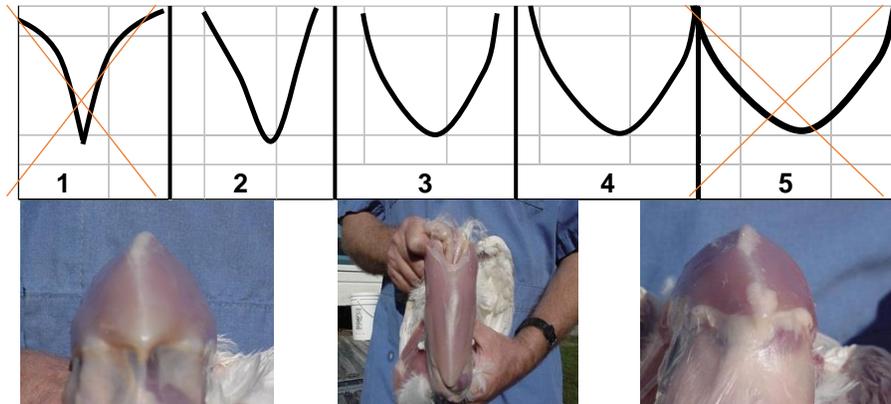


Figure 2. Breast confirmation

Reaching the fleshing targets as 4-3 at the 4th week and 3-4 at 20 week point out that flock managed well. Correct amount of body fat (fat on pelvic bones) and 3-4 fleshing score (must be over 80%) is needed to start first light stimulation.

One of the indispensable conditions is the incremental weight between 16-20 weeks. It must be 35% regardless whatever it is at 16 weeks old. Because, hormonal process starts and females have to increase body weight and abdominal fat deposition. The flocks will not manage to put on 35% weight by end of week 20 weeks will have poor peak and low persistency. Fat deposition is outmost necessary in this period and the birds not too much over fleshed. Onset of production will be delayed due to over fleshing but not fat deposition. A pre breeder feed which has some more energy but less amino acid levels comparing to growing feed is necessary to support

physiological changes. Abdominal fat level at first egg should be 1.0-1.5% of body weight.

### **Peak production - Few key factors?**

One of the difficult periods is that knowing how to control weight between first light stimulation and peak production. Heavy and over fleshed birds will start the production late comparatively the standard ones. Delaying the production will ended heavy females and concluded less peak and high mortality. Over weight females' eggs heavier therefore lay less number of eggs (every 150 grams of more weight means one gram heavier egg). High infertility rate and mortality is also very typical characteristics of heavy ones particularly after 40 weeks. The males are not the only guilty for infertility, over weight females also in charge of nearly 10% about that.

Percent of double yolk egg is one of the key parameters to understand over feed and light stimulation. Double yolk peak is about at the 28th week and shouldn't be more than 4%. Control in % DY will help control pre peak mortality due to egg peritonitis. There is a rank about size of yolks at ovarium which should be different six yolks sized. It is not exception to see even 12-13 yolks which are very close sizes in the over stimulated females. Each 1% mortality between 20-30 weeks means 1% less peak production and therefore 1.25 less eggs for each female.

### **Feeding - Few key reminders**

The peak feed amount at the peak production must be adjusted accordingly 450 Kcal/ME daily intake. It could be 470 Kcal/ME for the very cold season. The birds should have the peak feed at 75 % production. Feed increases should be slow up to 35-40% just to control weight because of slow increments of egg production. It is wise to increase feed increments for every 10% of production rise up and keep 3 days between two increments. The other critical point is feed reduction time after peak. Hen day level off 5-6 consecutively should be accepted as peak and right after reduction must be done. The first two reduction could be 2 grams for each one and 1 gram following weeks until 40 weeks. Total drop of feed should be 13-15% of peak feed amount. Feed clean up time is one of the indicators about feed reducing time. 3 hours for mash and 2 hours for crumble is reasonable. Extended feed consumption period points out much more feed than needed and give rise to double breasted hens which require more feed for maintenance although egg production slow down – poor persistency. 85% of total ME is exerted for maintenance at 55 week while it has been using only 65% of daily energy intake for maintenance at 32 weeks old. The basic principal is not to allow more than 15-20 grams of weekly weight increases in the entire production period of the females. It must be keep in mind that

every feed increment will not reflect its impact on live weight earlier than 12 days.

### **Conclusion**

First sorting at 7 days, BW increase between 16-20 weeks + 35%, from onset to production + 18%. Consecutive feeding program from light stimulation to 35% HD will help reduce high % double yolk, spike hen mortality and production persistency related issues. And peak feed at 75% production must be given. 80% Fleshing score as 3-4 and fat deposition on pelvic bones is essential to start light stimulation about 22 or 23 weeks old. Excellent production results at peak ME intake of 450 Kcal for 2-3 weeks and immediately feed reduction must start after peak. Always stay close to standard body weight in production period and allow maximum 20 grams weekly increments.

### **References**

- BAKER, W. (2011) GP&PS management, 0-24 weeks Cobb Cobb WTS 2011, Arkansas USA.
- CALDAS, J. (2017) The challenge of modern broiler breeders . Nutrition 36-37.
- FERNANDEZ, R., ORLANDO. (2014) Production management Cobb Cobb WTS 2014. Arkansas, USA.
- OOSHUYSEN, P. (2016) Investigation poor performance in Broiler Breeder Production. International hatchery Practice, 30(3).
- WELTEN, P. (2016) Fleshing. World's Poultry Science Journal, 32(6).
- WELTEN, P. (2017) Prepare your breeder hens for optimum production. International Hatchery Practice, 31(7).

**SESSION-7**  
**MANAGEMENT**  
**SHORT ORAL PRESENTATIONS**

## The Current Situation of Free Range Egg Production Farms: The Model of Çanakkale Region

Coşkun Konyalı<sup>a</sup>, Hakan Erdem<sup>b</sup>, Türker Savaş<sup>b</sup>

<sup>a</sup>Department of Chemistry and Chemical Process Technology, Lapseki Vocational School, Çanakkale Onsekiz Mart University, Çanakkale, Turkey,

<sup>b</sup>Department of Animal Science, Faculty of Agriculture, Çanakkale Onsekiz Mart University, Çanakkale, Turkey,

### Abstract

This study was conducted to emphasize the importance of free range production system and to discuss the current situation of the farms in the case of farms located in the Çanakkale region. The consumer demand is an important factor to spread of this system and many entrepreneurs are investing in this sector. The marketshare of free range eggs is expected to arise because of the rearing system code will be placed on the egg with the new labeling method in Turkey. Obtained results were shown that there are serious management errors and the lack of information and it is necessary to improve and to standardize of this system according to local conditions.

**Keywords:** Pasture, *Dermanyssus gallinae*, Layer, Marketing, Barn

### Özet

Bu çalışma gezen tavuk olarak adlandırılan serbest yetiştirme sisteminin önemini vurgulamak ve Çanakkale yöresi ele alınarak mevcut durumun tartışılmasını amaçlamaktadır. Tüketici talepleri bu sistemin yaygınlaşmasında önemli bir faktördür ve çok sayıda girişimci bu sektöre yatırım yapmaktadır. Türkiye’de yetiştirme metoduna göre yeni etiketleme yönteminin uygulamaya konmuş olması gezen tavuk yumurtasına ilişkin pazar payının arttırabileceği ön görülmektedir. Bu çalışmadan elde edilen sonuçlar uygulamada önemli yönetimsel hataların ve bilgi eksikliğinin olduğunu göstermekte ve bölgesel koşullar göz önüne alınarak bu sistemin standardize edilmesi ve iyileştirilmesi gerekmektedir.

**Anahtar kelimeler:** Mera, *Dermanyssus gallinae*, Yumurtacı, Pazar, Kümes

### Introduction

The EU regulation (EU, 1999), which orders a ban on conventional battery cages in the EU starting on 1 January 2012 and this regulation was resulted in improve of barn and production systems. The modifications of conventional barn systems were adjourned to at 2023 in Turkey. But

alternative production systems have become popular in recent years. Besides of animal welfare concerns and ethical approaches, consumer demands were another driver for free-range poultry production worldwide. Consumers have the perception that free-range eggs are a healthy and wholesome food, low in calories and saturated fats, high in protein and vitamins (Miao et al., 2005). The percentage of free range egg production was 14.1% of total egg production according to the data of the year 2016 (Anonim a, 2017). It was estimated that free-range production systems account for about 6-8% of total egg production and 10-12% of supermarket shell egg sales in Australia (McMaster, 1999). Şekeroğlu et al. (2010) was reported that free range system some advantages when compared with deep litter and cages systems. The rearing system code will be placed on the egg with the new labeling method in the egg marketing process since November 2017 in Turkey according to legal regulations. The demand for free-range eggs can be increased after this regulation and this can lead to an increase in the number of farms that produce in this way. But this change has also led to new problems specific to this system. The aim of this study was to discuss the current situation of the farms in the case of farms located in the Çanakkale region.

### **Materials and Methods**

This study was conducted in the Central, Ayvacık, Yenice, Ezine and Çan districts of Çanakkale region. Farms were member of The Association of Çanakkale Free Range Layer Egg Producers and Sellers and the nine farms were surveyed in this study. Farmers were surveyed from descriptive questions and also all farms were assessed on account of several environmental parameters. Additionally, structural characteristics were investigated of barns and it was examined for ectoparasite existence. Environmental conditions were scored such as hygienic conditions, ventilation quality, pasture quality. The obtained data were analyzed in MS Excel program.

### **Results and Discussion**

The average size of the herd was 1973.8 hens and the largest herd size consisted of 4,500 chickens (Table 1.). The maximum barn area was 780 m<sup>2</sup> and the 45% of barns had galvanized roofing material. Concrete was the most commonly used floor material (56%) and one of both farms does not have used litter material. It was found that the density of the barns was within acceptable limits. It was observed that there was average of 6 animals in per square meter in closed area. The most commune used genotype was Lochmann Brown and farms were procured to pullets at 16 weeks old from commercial farms located in Ankara, Bandırma and Afyon regions.

Table 1. The mean, maximum and minimum values of observed parameters regarding to farm characteristics

Parameters	Mean	Maximum	Minimum
Herd size, hen	1973.8	4500	290
Barn closed area, m <sup>2</sup>	330	780	30
Hen number/m <sup>2</sup>	5.8	10.8	1.6
Feed intake, g/hen/day	127.5	180	75
Feed cost, ₺/kg	1.48	1.60	1.40
Pasture area, m <sup>2</sup> /hen	11.3	37.5	0.7
Investment cost, ₺	431857.1	1000000	58000
Investment cost, TL/hen	200.67	246.15	144.44
Egg production, number	1392.5	3500	140
Egg price, ₺/egg	0.45	1	0.40

The amount of daily feed offered was 127.5 g per hen and all farms have purchased feeds from a factory as mixed. The cost of feed was calculated as average 1.48 ₺ per kilogram and it was detected that the feeding management was serious problem in all farms. All farms had free range areas but only 67% of farms had pasture for grazing of hens (Figure 1.). The mean of pastured area per hen was 11.3 m<sup>2</sup> but the 78% of farms were no cultivated in pastured area. It seems that the area offered to the animals is in accordance with the European Union. The most important problems regarding to pastures were the ignorance and the lack of management and irrigation. Animals were in the free range areas for 9 hours during average 10 months.

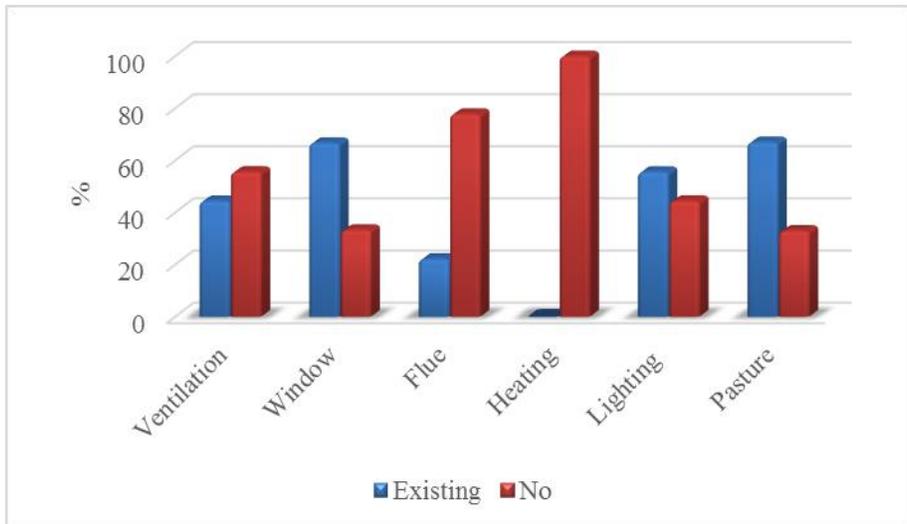


Figure 1. Structural characteristics of farms

It was resulted that hen-housed performance was 68% and the amount of daily egg production of these farms were average 1392.5 eggs. The biggest problem in egg production was that the productivity was very fluctuating during the year. Although the environmental conditions were quite variable in this production system, farmers could not take precautions. In the Figure 1 it was shown that the 44.4% of the all farms did not use artificial lighting. On the other hand, the barn lighting was not use in a stable lighting program and lighting time was changed between 14 and 24 hours. This is a serious problem because of lighting is very important environmental factor for hens. It was seen that the majority farmers did not have any information about the importance of lighting. According the results, 78% of farms did not have flue system in their barns. Additionally, more than half of the barns did not have a ventilation system. According the scoring of barns regarding to quality parameters, ventilation and hygienic conditions of barns were insufficient. Barns had no heating system and the heating was no implemented on any farms. The most common health problem was prolapsus (46%). Also the other most common health problems were cannibalism, feather pecking and respiratory problems. The 67% of barns examined was detected poultry red mite (*Dermanyssus gallinae*). It was noted that farmers have problems with flock management practices, such as veterinary treatments. When we surveyed 'What problems are frequently seen according to your opinion?' that farmers were answered as the lack of legal controlling and unconscious consumers.

### **Conclusion**

There are large or low-budget farms that produce the concept of free range system in Çanakkale. According to the results, the first major problem is the management errors. There is lack of information on technical issues such as lighting, feeding, biosecurity and pasture management. The basis of free range system does not perceive in accordance with European standards. There are important shortcomings in the implementation and supervision of the system even though it has a serious consumer demand. There is a serious variation in terms of barn conditions and implementations. Although this production system was developed with the purpose of the animal welfare concern and the obtaining healthy products, it seems that there are some problems in practice. It is necessary to establish a standardization with respect to the structural and administrative aspects.

### **References**

- ANONİM A, (2017) <http://www.poultryworld.net/Eggs/Articles/2017/9/75-of-EU-egg-production-is-concentrated-in-7-countries-184560E/>.
- MCMMASTER, H. (1999) Australian Egg Industry Association Inc., Memorandum, August.

- MIAO, Z. H., GLATZ, P. C., AND RU, Y. J. (2005) Free-range Poultry Production - A Review. Asian-Australasian Journal of Animal Sciences 2005;18(1): 113-132.
- SEKEROGLU, A., SARICA, M., DEMİR, E., ULUTAS, Z., TILKI, M., SAATCI, M., AND OMED, H., (2010) Effects of different housing systems on some performance traits and egg qualities of laying hens. Journal of Animal and Veterinary Advances 9 (12), 1739-1744

## **Positive impact of AviPlus®P on the growth performance of broiler chickens exposed to a mild necrotic enteritis challenge model with *C. perfringens* and re-used litter.**

**Benedetta Tugnoli, Antonino Messina, Andrea Piva, Ester Grilli**

Vetagro S.p.A – via Porro 2, 42124 – Reggio Emilia, Italy

### **Abstract**

The study evaluated the effect of the treatment with AviPlus®P, a microencapsulated blend of organic acids and botanicals, in broiler chickens using a mild necrotic enteritis (NE) model with re-used litter and oral *Clostridium perfringens* (CP) challenge over a 35-days cycle. Although not impacting mortality and FCR, the inclusion of a high dose AviPlus®P during the severe CP challenge (500 ppm until 21 days) allowed significantly heavier birds at D35, thus preventing the loss of weight generally due to NE.

**Key words:** *Broiler Chickens, Clostridium Perfringens, Microencapsulated Organic Acids And Botanicals, Necrotic Enteritis.*

### **Introduction**

Necrotic enteritis (NE) is an intestinal disease which impacts the global poultry production with important economic losses. It is caused by the proliferation of toxigenic strains of *Clostridium perfringens* (CP), a spore-forming anaerobic bacterium, with the mucosal damage due to coccidia infections being the best-known predisposing factor (Timbermont et al., 2011). Currently, the international poultry industry is experiencing an increase in NE as a result of banning the use of growth-promotant antibiotics and for this reason non-antibiotic strategies to improve growth of the animals by supporting the intestinal health in challenging conditions are needed.

AviPlus®P is a microencapsulated blend of organic acids and botanicals authorized in EU as zootechnical feed additive to improve growth performance of poultry (EFSA, 2012; European Commission, 2012). This mixture of organic acids and botanicals has been shown to exert a direct effect on the intestinal mucosa by reducing the inflammatory stress and enhancing the barrier properties, two key-factors for a proper intestinal functionality and health (Grilli et al., 2015).

The aim of this study was to determine the effectiveness of AviPlus®P to reduce the negative effects of a toxigenic *Clostridium perfringens* on broiler chickens in a mild NE challenge model on re-used litter.

## Materials and Methods

Five hundred (500) day-of-hatch birds (Cobb x Cobb) were assigned to the following two groups (250 birds per group, 10 pens per treatment, 25 birds per pen): CTR: control, T1: AviPlus®P included at 500 ppm in phase 1, 300 ppm in phase 2

AviPlus®P is a microencapsulated blend of organic acids and botanicals manufactured by Vetagro S.p.A. (Reggio Emilia, Italy).

Rations were fed *ad libitum* from date of chick arrival as follows: phase 1 - D0 until D21, phase 2 - D21 to D35 (end of the study). Rations consisted of non-medicated commercial-type diets compounded according to NRC guidelines and were fed as crumbles (phase 1) or pellets (phase 2).

In this study a mild NE challenge model with re-used litter was used (according to Hofacre et al., 1998). At D0 birds were vaccinated with a commercially available coccidia vaccine at the normal recommended dosage and then raised on homogenized reused litter from a previous NE study. At D14 they were challenged with one dose ( $2 \times 10^8$  CFU/mL) of *Clostridium perfringens* in the feed after 4-hour feed withdrawal. All birds were weighed by pen on D0, 21, and 35 and growth performance calculated. From D14 to the end of the study all mortality cases were necropsied for presence of NE.

Data were analyzed with T-test using Statistix 10 and differences were considered significant at  $P < 0.05$ .

## Results and Discussion

Growth performance results are presented in Table 1. No effects were observed in the feed intake and FCR data, but the treatment T1 allowed to significantly increase the weight gain at D35 compared to control. Mortality was not affected by treatments.

Table 1 – Growth performance data

	Treatments <sup>1</sup>	
	CTR	T1
Overall D0-D21		
Feed Intake (kg / pen)	29.82A	28.94A
Adjusted FCR	1.87A	1.86A
Weight Gain (kg / bird)	0.68A	0.69A
Overall D0-D35		
Feed Intake (kg / pen)	72.80A	74.00A
Adjusted FCR	1.80A	1.82A
Weight Gain (kg / bird)	1.82A	1.92B

<sup>1</sup> Treatments: CTR: control, no treatment, T1: AviPlus®P included at 500 ppm in phase 1, 300 ppm in phase 2, Phases: phase 1 (D0 to D21), phase 2 (D21 to D35), Birds were raised on re-used litter from a previous NE study and at D14 they were challenged with *C. perfringens* ( $2 \times 10^8$  CFU/mL), A-B Within a row, means without a common superscript differ ( $P < 0.05$ ).

This study involved a moderate NE challenge on built-up litter from a previous NE study and one dose ( $2 \times 10^8$  CFU/mL) of CP at 14 days of age, that is the peak time for the reaction of the coccidia vaccine the animals received at D0. This model was chosen in order to reproduce the subclinical form of NE, which is very common worldwide and is generally associated with loss of growth rate (lower body weight for age) and elevated feed conversion, whereas the clinical NE is an acute form with peaks of mortality up to 50% (Caly et al., 2015). In our study, the average mortality for NE was 9.0% indicating that the model was effective, but the treatment did not have an effect compared to controls. However, generally the major cost to the poultry producer is loss of growth and elevated FCR. In this study, treatment with a high dose of AviPlus®P during the severe CP challenge (500 ppm until 21 days) had significantly heavier birds, although not improving the FCR. This “protective effect” on body weight during the challenge period was evident at 35 days of age and this can be particularly interesting to help in reaching the slaughter age weight for “short” production cycles of 35 days.

### **Conclusion**

This study demonstrated that a high dose of AviPlus®P (500 ppm) during the critical NE challenge period can be effective in preventing the loss of body weight commonly associated with NE.

### **References**

- CALY, D.L., R. D'INCA, E. AUCLAIR, and D. DRIDER. (2015). Alternatives to Antibiotics to Prevent Necrotic Enteritis in Broiler Chickens: A Microbiologist's Perspective. *Front Microbiol.* 6:1336.
- EFSA (2012). Scientific Opinion on the safety and efficacy of AviPlus® as feed additive for chickens and minor avian species for fattening and reared for laying and minor porcine species (weaned). *EFSA Journal.* 10(5): 2670 [11 pp.].
- EUROPEAN COMMISSION (2012). Commission Implementing Regulation (EU) No 849/2012 of 19 September 2012 concerning the authorisation of the preparation of citric acid, sorbic acid, thymol and vanillin as a feed additive for chickens for fattening, chickens reared for laying, all minor avian species for fattening and reared for laying and weaned Suidae other than *Sus scrofa domesticus* (holder of the authorisation Vetagro SpA). *OJ L 253*, p. 8–10.
- GRILLI, E., B. TUGNOLI, J. L. PASSEY, C. H. STAHL, A. PIVA, and A. J. MOESER. 2015. Impact of dietary organic acids and botanicals on intestinal integrity and inflammation in weaned pigs. *BMC Vet. Res.* 11:96.

- HOFACRE, C.L., R. FROYMAN, B. GAUTRIAS, B. GEORGE, M.A. GOODWIN, and J. BROWN. (1998). Use of Aviguard and other intestinal bioproducts in experimental *Clostridium perfringens*-associated necrotizing enteritis in broiler chickens. *Avian Diseases*. 42: 579-584.
- TIMBERMONT, L., F. HAESBROUCK, R. DUCATELLE, AND F. VAN IMMERSEEL. (2011). Necrotic enteritis in broilers: an updated review on the pathogenesis. *Avian Pathol*. 40: 341-347.

## **The Consumption and Consumer Preferences of Poultry Meat and Egg: The Case of the University of Niğde Ömer Halisdemir**

**Betül Gürer, Ethem Akyol**

The University of Niğde Ömer Halisdemir, The Faculty of Agricultural Sciences and Technologies

### **Abstract**

Today, per capita consumption of animal products has become an important criterion to be taken into account when comparing development levels of countries. Food demand and consumption habits of a society can vary depending on the quality of products, the characteristics of price and hygiene, the distribution of national income in the country, the differences in the socio-economic characteristics of the consumer, such as education and income level. In this study, poultry meat and egg consumption, which is an important source of animal protein in our country, were examined according to various socio-economic characteristics of consumers and it was given some information about consumer preferences. According to the results of the survey conducted in Niğde Ömer Halisdemir University with 270 students and 100 university personnel, income and education level were affected the poultry meat and eggs consumption and consumer preferences.

**Key words:** *Poultry meat, Egg, Consumption, Consumer Preference*

### **Özet**

#### **Kanatlı Eti ve Yumurta Tüketimi ve Tüketici Tercihleri: Niğde Ömer Halisdemir Üniversitesi Örneği**

Günümüzde hayvansal ürünlerin kişi başına düşen tüketim miktarları, ülkelerin gelişmişlik düzeylerinin karşılaştırılmasında dikkate alınan önemli bir kriter haline gelmiştir. Bir toplumun gıda talebi ve tüketim alışkanlıkları; ürünlerin kalitesine, fiyat ve hijyen özelliklerine, ülkedeki milli gelir dağılımına, tüketicinin eğitimi, gelir düzeyi gibi sosyo-ekonomik özelliklerindeki farklılıklara bağlı olarak değişebilmektedir. Bu çalışmada hayvansal protein açısından ülkemizde önemli bir kaynak olan kanatlı eti tüketimi ve yumurta tüketimi, tüketicilerin çeşitli sosyo-ekonomik özelliklerine göre incelenmiş ve tüketici tercihleri konusunda bilgi verilmiştir. Niğde Ömer Halisdemir Üniversitesinde 270 öğrenci ve 100 personel ile yapılan anket çalışma sonuçlarına göre. kanatlı eti ve yumurta tüketimi ve tercihlerinde gelir seviyesi ve eğitimin etkili olduğu görülmüştür.

**Anahtar kelimeler:** *Kanatlı eti, yumurta, tüketim, tüketici tercihleri.*

## **Introduction**

Adequate protein intake is critical for health and development. Generally, protein of animal origin is of higher quality for humans owing to its amino acid pattern and good digestibility. Moreover, proteins from animal foods are more easily digestible and hence available to humans. For instance, egg protein has often been used as a reference to rate the biological value of other proteins.

In spite of recent growth in consumption, many people are still deficient in the nutrients that can be provided by animal source foods, which are complete, nutrient-dense and important for the high quality protein and bio-available micronutrients they contain. Even quite small amounts of animal source foods are important for improving the nutritional status of low-income households (FAO, 2011).

Experts suggest that the average protein requirement of the individuals in a day for healthy and balanced nutrition must be average 70 gr, of which at least 35-40 gr must be provided from animal source foods (1,2). Today, per capita consumption of animal products has become an important criterion to be taken into account when comparing development levels of countries. According to FAO, the per capita animal protein consumption of Turkey was 36.3 gr in 2013. This figure is comparatively low in comparison to that of 70 gr and 60 gr for USA and EU, respectively.

Globally, the supply of and demand for poultry products has shown a very rapid upward trajectory, with poultry now providing 37 percent of all meat (FAO, 2018). Poultry meat and eggs are acceptable foods in many cultures, and poultry can be raised at home even by families with very little land or capital, making them easily accessible to the poor.

Poultry products make up 24.6 percent the average animal protein consumption of 36.3 gr per person per day in Turkey. Especially chicken farming has been a significant sub-sector of food production in Turkey in terms of meeting the meat needs of population (Anonymous, 2007; Türkoğlu, 1998). The sector is one of the most rapidly developed among the animal production ones (Anonymous, 2009; Erdem, 2006), and the production has increased considerably thanks to contracted farming and establishing large-scale integrated facilities, which was initiated at the later years of 1980s (Sariozkani, et.al., 2009; Büyüknisan, 2008; Dağdemir et. al., 2006). Thus, the consumers have been provided with more diverse and higher quality of chicken meat products resulting in higher added-value to Turkish economy. Nearly 80 % of total chicken meat production is processed in modern entegrated facilities, which are compatible to European Union Countries (Civaner, 2007).

Food demand and consumption habits of a society can vary depending on the quality of products, the characteristics of price and hygiene, the distribution

of national income in the country, the differences in the socio-economic characteristics of the consumer, such as education and income level. In this study, it is aimed to determine the consumption level and preferences of poultry meat and egg in the University of Niğde Ömer Halisdemir.

### **Materials and Methods**

The primary data were collected from a comprehensive survey through face to face interviews with 370 consumers selected through random sampling method in the in the university of Niğde Omer Halisdemir. This survey was carried out by the authors from January to February in 2017. Sample size consisted of 270 students and 100 university personnel. The questionnaire was designed to analyze consumers' preferences and consumption level for poultry meat and egg. Data obtained through the questionnaires were analyzed using the descriptive statistics and frequency tables in the Statistical Package for the Social Sciences (SPSS 17).

### **Results and Discussion**

Consumers surveyed were consisted of male by 43.8% and female 56.2%. Of the consumers, the average age is 25.3 and the duration of urban live is about 4 years. Looking at the monthly average income are 609.1 TL and 5846 TL for students and university personnel, respectively. Monthly expenditures are about 512 TL for students and 4459 TL for university personnel, of which about 27% consists of food expenditure.

23.7% of students have consumed chicken meat at least once a week, while 21.9% of them have consumed that at least two or more a week. On the other hand, 42% of university personnel have consumed chicken meat at least two or more a week, while 25% of them have consumed that at least once a week. There are specific differences between two group in terms of turkey meat consumption. For example, 76% of university personnel do not consume turkey meat, while 18% of students consume that at least once a year. Besides that, 27.9% of students eats eggs at least two or more times a week, while 62% of university personnel eat egg every day.

Chicken meat consumption per capita is 3.62 kg and 2.17 kg monthly for university personnel and students, respectively. Similarly, turkey meat consumptions per capita for two groups are 0.09 kg for university personnel and 0.30 kg for students monthly. Egg consumption per capita is 26.91 pieces and 15.54 pieces for university personnel and students, respectively.

In terms of purchasing type of poultry meat for university personnel, 47% of them prefer to consume it as poultry breast, 24% of them as leg, 16% of them as whole and 13% of them as wings. Students prefer to consume it mostly as whole (49%).

According to the information obtained from university personnel, consumers are buying mostly (43%) in the form of weight account and 28% of them are

buying it with package with plate from the market. On the other hand, students are buying mostly it from charcuterie (47%) by weight. They also prefer to buy it from market with package (30%).

About 65% of consumers prefer to consume egg for breakfast (more than 80% of monthly egg consumption). University personnel mostly prefer to buy egg from market with package (45.9%), while students prefer mostly to buy from open market and grocery (46.8%). In the issue of the preference of packed egg without shell, %83 of university personnel prefer to never consume in this form, while this rate is 67.8% in the students.

In consumer's opinion about price of poultry meat and egg, 39.3% of students stated its price as expensive and 34% of them as normal for poultry meat. On the other hand, 68.1% of university personnel stated as normal. Similarly, for eggs prices, although 34.1% of students stated as expensive and 36.6% of them stated as normal, 63.3% of university personnel stated its prices as normal.

The factors affecting poultry meat consumption preference changes for each two consumer groups. Price of the products is the most determinant factor for 37.2% of the students, while this factor affected only 6% of university personnel. For university personnel, the most affecting factors on poultry meat consumption preferences are taste (36%) and fat rate (20%).

## **Conclusion and References**

As a result of the research, it was examined how the education and income level differences of consumers changed poultry meat and egg consumption levels and consumption preferences. According to the findings obtained in the research, it was determined that turkey meat and eggs were not consumed sufficiently by the consumers and estimated values were below the average of the country.

It has been observed that education level and income are influential in poultry meat consumption preferences. Criteria such as the quality and taste of the product are important factors to buy them for university personnel with high income level.

Recently, excessive price increases in red meat have led to consume chicken meat particularly in the middle and lower income groups as an alternative source of protein. This situation has led to an excessive increase in the demand of chicken meat.

Findings from the research results provide information to the political decision-making bodies to revise their existing policies. Besides that, it is thought that it would be important for the companies in the sector to revise their current production and marketing strategies in this direction for sustainability of them in the market. Proper definition of target consumers and consideration of consumer demands will lay the foundation for more

effective and efficient operation and sustainability of the production-marketing-consumption process.

When the role of animal food consumption in a country is considered as a balanced and sufficient nutritional requirement for the individual, the importance of this and similar researches on all levels of society is great.

## References

- ANONYMOUS, (2007) Turkish Republic Prime Ministry State Planning Organization '9th Development Plan 2007-2013' *Animal Private Speciality Commission Report*. Publication No. 2717 PSCR:670.
- ANONYMOUS, (2009) [http://www.tarim.gov.tr/uretim/Hayvansal\\_Uretim\\_Tavukculuk.html](http://www.tarim.gov.tr/uretim/Hayvansal_Uretim_Tavukculuk.html)
- BÜYÜKNISAN, O. (2008) 'The Structure of Chicken Meat in Urban Areas of Adana Province', University of Çukurova, Institute of Natural and Applied Sciences (Ms.c Thesis). Adana
- CIVANER, E.Ç. (2007) 'Poultry Meat'. Turkish Republic, Foreign Trade Ministry, Centre of Export Development Edute Publications, Ankara, Turkey.
- DAĞDEMİR, V. SAKLICA, A. AND KUMBASAROĞLU, H. (2006) The Situation of Broiler Chicken Sector and its Comparison with European Union Countries, VIIIth Agricultural Economics Congress, 13-15 September, Antalya.
- ERDEM, P.(2006).Is Turkish Chicken Sector Ready for European Union, İzmir Commerce Chamber, İzmir.
- FAO, (2011). World Livestock 2011 – Livestock in Food Security. Rome.
- FAO, (2018). Food Security Statistics. FAOSTAT ( <http://faostat.fao.org/>)
- SARIOZKAN, S. YALCIN, C. CEVGER, Y. ARAL, Y. AND SIPAHI, C. (2009)'The financial impacts of the avian influenza outbreaks on Turkish table egg producers'*World's Poultry Science, Journal*, Vol. 65. 91-95.
- TÜRKOĞLU, M. (1998) 'The Production of Chicken Products', The Symposium on the Development of Agri-Business throughout of 2000s and the Role of Agricultural Engineers in This Sector, Turkish Higher Agricultural Engineers'Association and Foundation, Ankara 37-42.

**SESSION-8**  
**PRODUCT QUALITY**  
**SHORT ORAL PRESENTATIONS**

## Quality Attributes of Chicken Nuggets Produced by Using Different Gluten-Free Ingredients

Burcu Öztürk, Meltem Serdaroğlu, Merve Karabıyıkolu

Ege University Engineering Faculty Food Engineering Department Bornova Izmir

### Abstract

This study aimed to investigate chemical and technological quality features of chicken nuggets treated with different gluten-free batter formulations. Nuggets were produced by coating with batters including rice flour (RF), chickpea flour (CF), oat fiber (OF) or Jerusalem artichoke powder (JAP). Utilization of OF and JAP decreased moisture, RF and OF increased protein, JAP decreased fat and OF decreased carbohydrate content of the samples. Samples with OF and JAP was effective to provide equivalent cooking yield to wheat flour samples. JAP samples had the lowest oil absorption among treatments. The results showed that dietary fiber-sourced ingredients improved overall quality of gluten-free chicken nuggets.

**Key words:** *celiac disease, chicken nugget, gluten-free, Jerusalem artichoke powder, oat fiber*

### Özet

#### Gluten İçermeyen Farklı Bileşenlerin Kullanımı ile Üretilen Tavuk Nuggetların Kalite Karakteristikleri

Bu çalışmada, gluten içermeyen farklı bileşenler ile muamele edilen tavuk nuggetların kimyasal ve teknolojik kalite kriterlerinin incelenmesi amaçlanmıştır. Nuggetlar, pirinç unu (PU), nohut unu (NU), yulaf lifi (YL) veya yer elması tozu (YET) içeren sıvı kaplama hamurları ile kaplanarak üretilmiştir. YL ve YET kullanımı örneklerin nem miktarını azaltmış, PU ve YL kullanımı protein miktarını arttırmış, YET kullanımı yağ miktarını ve YL kullanımı ise karbonhidrat miktarını azaltmıştır. YL ve YET içeren örneklerin pişirme veriminin buğday unu içeren örneklere eşdeğer olduğu tespit edilmiştir. Deneme grupları içerisinde en düşük yağ emilim miktarı YET örneklerinde kaydedilmiştir. Sonuç olarak, diyet lifi kaynaklı bileşenlerin gluten içermeyen tavuk nuggetların genel kalitesini geliştirdiği bulgulanmıştır.

### Introduction

Today ready-to-eat poultry products are still a popular choice among consumers as a consequence of modern busy lifestyles. However, increased

awareness of food-borne diseases like celiac disease has been causing higher consumer demand for gluten-free food products (Taşbaş et al., 2016). Celiac disease is a chronic immune-mediated pathology of the small intestine triggered by dietary gluten (Gobbetti et al., 2017). Since limited options are available for gluten-free and ready-to-eat poultry products, it is important to investigate the incorporation of alternative coating ingredients in formulation of these kind of products. In this study, we aimed to determine the quality of gluten-free chicken nuggets formulated with batters containing rice flour (RF), chickpea flour (CF), oat fiber (OF) or Jerusalem artichoke powder (JAP) as wheat flour replacers.

### Materials and Methods

For production of nugget dough, fresh boneless post-rigor chicken breast muscles were minced through 8 mm plate and mixed with 1% NaCl. Seven different batter formulations were prepared as follows: First control treatment (C1) was formulated with 90% wheat flour, 3% spice mix, 2% sunflower oil, 2% sugar, 2% sodium carbonate and 1% NaCl. Other two control treatments (C2 and C3) were chosen as standard industrial batter mixtures containing wheat-flour and other ingredients. Gluten-free treatments were formulated with 70% RF, CF, OF or JAP by addition of 19% potato starch, 1% carrageenan and other ingredients used likewise in control treatments. The ingredients were homogenized in different ratios of water to obtain batters. Nugget dough was shaped using elliptical metal molds, the nuggets were pre-dusted with potato starch, then coated with batter. The samples were finally coated with corn flour and deep-fat fried at  $180\pm 2^{\circ}\text{C}$  for 3 min. The samples were cooled at  $4^{\circ}\text{C}$  prior to analyses. Total moisture, fat, ash (AOAC, 2012) and protein content (AOCS, 2004) were determined. Carbohydrate content was calculated from total chemical composition. pH value was measured by using a pH-meter with penetration electrode (WTW, Germany). Cooking yield (CY) was calculated according to Murphy et al. (1975) by using the equation below:

$$\text{CY (\%)} = [(\text{Cooked sample weight}) / (\text{Raw sample weight})] \times 100$$

Oil absorption (OA) of the samples were calculated from the difference between fat contents of the coated samples before and after deep-fat frying process. Statistical evaluation of the data was performed by using SPSS software (IBM, USA) Analysis of Variance (ANOVA) and Duncan Post-Hoc tests.

### Results and Discussion

Chemical composition and pH values of nugget samples are presented in Table 1. Total moisture, protein, fat, carbohydrate and ash content were

between %56.45-59.60, 17.88-20.56%, 6.80-11.56%, 7.45-10.59% and 1.66-2.04, respectively. The lowest moisture content was recorded in C2 samples among control treatments, and RF samples had higher moisture than C2, C3, OF and JAP samples ( $P<0.05$ ). It was showed that samples with OF and JAP lead to decrements in moisture compared to C1 samples with wheat flour ( $P<0.05$ ), that is probably due to the increase in dry matter content with fiber inclusion. Contrarily, Gökçe et al. (2016) found no differences between moisture content of chicken nuggets formulated with wheat, corn, soy or rye flour. Use of gluten-free RF and OF resulted in increments in protein content compared to C2 and C3 samples ( $P<0.05$ ) and thereby lead improvement in nutritional value of the product. The highest fat content was recorded in C2 samples, while the lowest fat content was recorded in JAP samples among all treatments ( $P<0.05$ ). The remained fat contents from high to low were belonged to CF, OF, C1 and RF samples, respectively ( $P<0.05$ ). Fat results showed that utilization of JAP and RF had considerable impact on fat reduction of gluten-free nuggets. Kılıncceker (2013) reported that fat content of chicken meatballs increased with increased amounts of oat flour used in batter formulations. The lowest carbohydrate content was recorded in samples formulated with OF ( $P<0.05$ ), meaning that utilization of OF in batters has the potential to decrease the caloric value of the product. CF, RF and C2 samples had higher ash content compared to others ( $P<0.05$ ). pH values of the samples were between 6.11-6.26, the highest pH value was recorded in C3, whilst the lowest pH value was recorded in JAP samples ( $P<0.05$ ). Despite the differences, pH values of all treatments were within acceptable ranges. Taşbaş et al. (2016) reported that the use of gluten-free wheat flour, cellulose, egg powder, whey powder and pectin was not found to affect final pH of chicken nuggets.

CY and OA of chicken nuggets are presented in Figure 1. CY of the samples were between 81.72-98.05%, where CF samples had the lowest value among treatments ( $P<0.05$ ). Although the other samples had similar CY, RF group had lower values compared to OF, C2 and C3 groups ( $P<0.05$ ). This data indicated that use of OF and JAP provided equivalent cooking behaviors to control samples. Kılıncceker (2013) found that adhesion and yield values of chicken meatballs increased by increasing oat flour in battering mixes, but frying loss increased with increasing levels. OA of the samples ranged from 5.78% to 10.58%, where utilization of JAP in batter formulations had a significant effect on reduction of absorbed oil during deep-fat frying ( $P<0.05$ ). Nevertheless, the highest OA among samples was recorded in C2 group ( $P<0.05$ ), in addition CF samples had higher OA than C1 and C3 samples ( $P<0.05$ ). The differences in OA of the samples could be probably due to the variances between chemical composition, size, porosity and density of the ingredients used in batter formulations.

Table 1. Chemical composition (%) and pH value of chicken nuggets

T	Moisture	Protein	Fat	Carbohydrate	Ash	pH
C1	59.40 <sup>ab</sup> ±0.42	20.56 <sup>a</sup> ±0.38	7.75 <sup>d</sup> ±0.52	9.59 <sup>b</sup> ±0.62	1.66 <sup>c</sup> ±0.15	6.24 <sup>b</sup> ±0.01
C2	56.45 <sup>d</sup> ±0.19	18.39 <sup>cd</sup> ±0.33	11.56 <sup>a</sup> ±0.32	10.18 <sup>ab</sup> ±0.27	1.96 <sup>ab</sup> ±0.11	6.23 <sup>b</sup> ±0.01
C3	58.96 <sup>c</sup> ±0.27	17.88 <sup>d</sup> ±0.25	8.30 <sup>cd</sup> ±0.36	10.59 <sup>a</sup> ±0.38	1.36 <sup>d</sup> ±0.09	6.26 <sup>a</sup> ±0.01
RF	59.60 <sup>a</sup> ±0.33	20.30 <sup>a</sup> ±0.48	7.97 <sup>d</sup> ±0.34	9.59 <sup>b</sup> ±0.63	1.96 <sup>ab</sup> ±0.06	6.23 <sup>b</sup> ±0.01
CF	59.25 <sup>abc</sup> ±0.20	19.06 <sup>bc</sup> ±0.15	9.44 <sup>b</sup> ±0.27	9.95 <sup>ab</sup> ±1.13	2.04 <sup>a</sup> ±0.06	6.23 <sup>b</sup> ±0.01
OF	56.87 <sup>d</sup> ±0.44	19.80 <sup>ab</sup> ±0.96	8.80 <sup>c</sup> ±0.26	7.45 <sup>c</sup> ±0.72	1.80 <sup>bc</sup> ±0.07	6.13 <sup>c</sup> ±0.01
JAP	58.71 <sup>c</sup> ±0.20	18.92 <sup>bc</sup> ±0.57	6.80 <sup>e</sup> ±0.23	9.48 <sup>b</sup> ±0.60	1.73 <sup>c</sup> ±0.07	6.11 <sup>d</sup> ±0.02

T: Treatments, \* a, b, c, ....: means with the different letters in the same column are significantly different ( $P<0.05$ ).

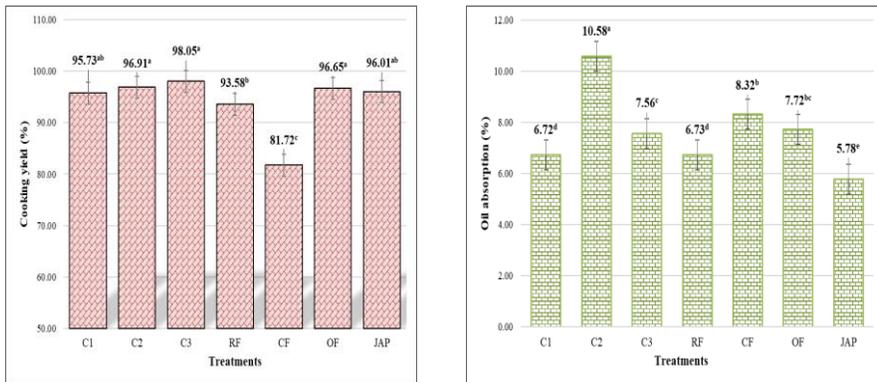


Figure 1. Cooking yield and oil absorption of chicken nuggets

\* a, b, c, ....: means with the different letters indicate significant difference ( $P<0.05$ ).

## Conclusion and References

The results of our study showed that utilization of various gluten-free ingredients in batter formulations had considerable impact on chemical composition, final pH value and technological quality of chicken nuggets. The findings indicated that especially dietary fiber sources could present an opportunity to formulate gluten-free poultry products that have equivalent cooking characteristics to standard products, meanwhile improving health profile.

*Authors would like to thank to Republic of Turkey, Ministry of Science, Industry and Technology with Project No: 0764.STZ.2014 (SAN-TEZ Program).*

AOAC (2012) Official Methods of Analysis, 19th ed., Association of Official Analytical Chemists, Gaithersburg, MD, USA.

AOCS (2004) Official Methods and Recommended Practices of the AOCS, 5th ed., American Oil Chemists' Society, Champaign, USA.

- GOBBETTI, M., PONTONIO, E., FILANNINO, P., et al. (2017) How to improve the gluten-free diet: The state of the art from a food science perspective. *Food Research International*, in press.
- GÖKÇE, R., AKGÜN, A.A., ERGEZER, H. and AKCAN, T. (2016) Farklı kaplama bileşenleriyle kaplamanın derin yağda kızartılan piliç nuggetların bazı kalite karakteristikleri üzerine etkileri, *Tarım Bilimleri Dergisi*, 22: 331-338.
- KILINCCEKER, O. (2013) Utilization of oat flour as edible coating material on fried chicken meat balls, *Focusing on Modern Food Industry*, 2(1): 36-42.
- MURPHY, E.W., CRINER, P.E. and GREY, B.C. (1975) Comparison of methods for calculating retentions of nutrients in cooked foods. *Journal of Agricultural and Food Chemistry*, 23: 1153-1157.
- TAŞBAŞ, H., OSANMAZ, E., ÖZER, C.O. and KILIÇ, B. (2016) Quality characteristics and storage stability of gluten-free coated chicken nuggets, *Carpathian Journal of Food Science and Technology*, 8(4): 91-102

## Performances of fast, medium and slow growing broiler chickens reared barn and free-range production systems

Musa Sarıca<sup>a</sup>, Umut Sami Yamak<sup>a</sup>, Mehmet Akif Boz<sup>b</sup>, Kadir Erensoy<sup>a</sup>

<sup>a</sup>: Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun, Turkey

<sup>b</sup>: Yozgat Bozok University, Faculty of Agriculture, Department of Animal Science, Yozgat, Turkey

### Abstract

In this study, produced via selection and crossing of broiler performance in a project (TÜBİTAK109O334), commercial fast and slow growing broilers performances in intensive and free range production systems have been demonstrated. Live weight, feed consumption, feed conversion rate, slaughter and carcass traits and outdoor access ratio of genotypes were determined for 12 weeks growth period. Three and four-way crossing has been shown to produce broilers that differ in growth and feather color. Feed conversion ratio of these broilers which reached the weight of slaughter weight in different periods decreased in parallel with the increase in slaughter age. It was observed that rate of outdoor access decreases due to the increase of the live weight.

**Key words:** Fast growing broilers, medium growing broilers, slow growing broilers, performance traits

### Hızlı, orta ve yavaş gelişme özelliklerine sahip etlik piliçlerin kapalı ve serbest-gezinmeli üretim sistemlerindeki performansları

### Özet

Bu çalışmada bir projede (TÜBİTAK109O334) seleksiyon ve melezleme ile üretilen etlik piliçlerin, ticari hızlı ve yavaş gelişen piliçlerle kapalı ve serbest gezinmeli üretim sistemlerindeki performansları ortaya koyulmuştur. 12 haftalık büyüme periyodunda canlı ağırlık, yem tüketimi, yemden yararlanma oranları, kesim ve karkas özellikleri ile genotiplerin gezinme alanına çıkma düzeyleri saptanmıştır. Elde edilen bulgular üçlü ve dörtlü melezleme ile gelişme ve tüy renkleri bakımından farklılık gösteren piliçler üretilebileceği ortaya çıkmıştır. Farklı dönemlerde kesim ağırlığına ulaşan bu piliçlerin yemden yararlanma düzeyleri kesim yaşının artmasına paralel olarak düşmüştür. Canlı ağırlık düzeyindeki artışa göre gezinme alanına çıkma oranının düştüğü görülmüştür.

*Anahtar kelimeler: Hızlı gelişen piliçler, orta düzeyde gelişen piliçler, yavaş gelişen piliçler, performans özellikleri*

## **Introduction**

Broiler production has increased in recent years to the level of meat produced more than pig meat in the world, and poultry meat rate in total meat is continuously increasing (Sarica et al., 2017). In some countries where pig meat is not consumed, the share of chicken meat consumption reached 65-70% (Sarica et al., 2014a). Standard production method applied in chicken production in all countries, low price and fat-free product are the most important factors on the increase in demand on chicken meat (Arthur and Albers, 2003; Sarica et al., 2016). Despite advantages in terms of development, feed efficiency and carcass traits in genotypes with rapid growth of broilers, metabolic disorders and mortality rates are increasing (Bessei, 2006; Shim et al., 2012). On the other hand, some consumers could prefer slow growing broilers due to longer production period, animal welfare and the negativities caused by press and publications (Yamak et al., 2014, Sarica et al., 2014b).

In this study, broiler genotypes with medium, slow or low growth rates produced from a study supported by TUBITAK, were compared with commercial slow growing hybrid in two production systems (intensive and free-range). Live weight, feed conversion ratio, access to outdoor, some slaughter and carcass traits were evaluated in the study.

## **Material And Method**

Six genotypes developed for using in alternative broiler production and commercial two genotypes with fast and slow growth traits were compared in intensive and free range production systems in terms of growth, feed conversion ratio, viability and carcass traits in a 12 weeks of rearing period. Commercial fast-growing Ross hybrids and commercial slow-growing Sasso brown broilers were compared with Ross(RIRxRoss), Ross(BARxRoss), (RossxRIR) x (RossxRIR), (RossxBAR)x(RossxBAR), (RossxRIR)RIR, (RossxBAR)BAR which are 6 hybrid broiler genotypes in the same house conditions. The house consisted of 18 units which are 9 closed and 9 open to the outside and 60 broilers were reared in each unit from each genotypes mixed with male-females. The broiler in the outdoor-access pens had access to outdoor during the daytime (from 8 am to 5 pm) from 28 days on. In the experiment weekly live weights, coloration status of broilers, feed consumption, feed conversion ratio, mortality, slaughter and carcass traits at different slaughter ages and outdoor-access rates at different weeks were determined. In this paper, the age of reaching 2 kg which is taken as the slaughter weight of the genotypes, some carcass traits and feed conversion ratio at this age are discussed. In the evaluation of the data, variance analysis

was performed in randomized block trial design, genotype and growth system effects were determined. Analyzes were performed with the SPSS statistical program.

**Results**

Since all genotypes were grown indoors at first 4 weeks, there was no analysis according to the production systems in this period. Differences between genotype groups were found to be important in this period (Table 1). The fast-growing commercial genotype had the highest live weight, reached the fastest slaughtering age and the carcass yield was the highest. On the other hand, it is found that viability is lower than other genotypes and the rate of outdoor-access is very low. The two cross genotypes have reached to slaughter weight at 49 days, but the feed conversion ratio has been higher than commercial fast-growing genotype. However, these genotypes have a high level of outdoor access. SASSO and two low growing genotypes had similar traits in carcass yield, viability and use of outdoor. The other two developed genotypes have shown lower growth and reached slaughter weight at 77 days, and the feed conversion ratio decreased, but the outdoor-access ratio was found very high in these genotypes.

Table 1. Growth traits of first 4 weeks in broilers with different growth levels

Genotype	Live weight (g)	Feed consumption (g)	FCR	Viability (%)
ROSS	1156.6 a	1807.7a	1.556a	97
SASSO	809.3 d	1625.0c	1.792bc	98
ROSSx(RIRxROSS)	965.5 b	1685.6b	1.784bc	99
ROSSx(BARxROSS)	895.9 c	1462.6d	1.609a	98
(ROSSxRIR)x(ROSSxRIR)	762.4 d	1328.3e	1.744bc	98
(ROSSxBAR)x(ROSSxBAR)	768.6 d	1322.7e	1.716b	99
(ROSSxRIR)xRIR	521.1 e	935.5f	1.795bc	100
(ROSSxBAR)xBAR	518.0 e	932.7f	1.819c	99
SEM	9.401	4.462	0.014	0.001
Effects				
Genotype	**	**	**	NS

SEM, standard error of means; NS, not significant; \*\*P < 0.01, a, b, c: Means within columns with no common superscript letter differ significantly (P < 0.05).

**Conclusion**

This study has revealed that three-way or four-way crossings of commercial broiler parents and layer parents (RIR:Rhode Island Red, BAR:Barred Plymouth Rock) could be used as broilers in alternative production systems with different growth levels. Depending on the live weight and fast-growing, it has become clear that the outdoor-access ratio has decreased and the viability has declined. This indicates that fast-growing broilers, especially in

terms of organic chicken meat, will not be able to provide the condition of outdoor-access required by the system.

Table 2. Some traits of broilers with different growth levels in closed and free-range production systems

<i>Genotype</i>	<i>PS</i>	<i>SA</i> (day)	<i>LW</i> (g)	<i>FC</i> (g)	<i>FCR</i>	<i>V</i> (%)	<i>CY</i> (%)*	<i>OAR</i> (%)**
ROSS	FR	42	1941	3834	1.97	97	73.5	18
	B		2029	3771	1.86	98	73.8	
SASSO	FR	56	2143	5242	2.47	98	70.4	65
	B		2059	4783	2.38	99	72.4	
ROSSx(RIRxROSS)	FR	49	2331	4929	2.12	99	72.1	54
	B		2257	4853	2.15	100	73.2	
ROSSx(BARxROSS)	FR	49	2033	4193	2.04	99	71.4	57
	B		2138	4456	2.09	98	74.4	
(ROSSxRIR)x(ROSSxRIR)	FR	56	1987	4615	2.31	100	68.4	67
	B		1926	4693	2.43	100	70.8	
(ROSSxBAR)x(ROSSxBAR)	FR	56	1991	4810	2.37	99	72.5	69
	B		1971	4701	2.38	100	72.8	
(ROSSxRIR)xRIR	FR	77	1990	6448	3.24	100	68.5	94
	B		1892	6358	3.36	100	70.3	
(ROSSxBAR)xBAR	FR	77	1939	5994	3.15	100	70.0	98
	B		1906	6089	3.20	99	70.9	

PS: Production system; FR:Free-range; B:Barn; SA:Slaughter age; LW:Live weight; FC:Feed consumption; FCR:Feed conversion ratio; V: Viability; CY:\* Carcass yield at 56th day; OAR:\*\*Outdoor-access ratio between 29th days and slaughter age.

## References

- ARTHUR, J.A. and ALBERS, G.A.A., (2003) Industrial perspective on problems and issues associated with poultry breeding. *Poultry Genetics, Breeding and Biotechnology (Edited by W.M. Muir and S.E. Aggrey)*, 1-12, CABI Publishing, USA.
- BESSEI, W., (2006) Welfare of broilers: A review. *World's Poultry Science Journal*, 62: 455-466
- SARICA, M., YETER, B., OGUZHAN, E., CAGLAK, S., OZKAN, I. and CENGİZ, A., (2017) Etlik Piliç Ebeveyn Hatlarının Bazı Performans Özellikleri ve Heterosis Elde Etme Olanakları. *4. Uluslararası Beyaz Et Kongresi*, 26-28 Nisan Antalya,
- SARICA, M., TURKOGLU, M. and YAMAK, U.S., (2014a) Tavukçuluktaki gelişmeler ve Türkiye Tavukçuluğu: *Tavukçuluk Bilimi; Yetiştirme, Besleme Hastalıklar (Editörler M.Türkoğlu, M.Sarıca)*, s:1-39, Bey Ofset, Ankara.
- SARICA, M., YAMAK, U.S., TURHAN, S., BOZ, M.A., SARICAOGLU, F.T. and ALTOP, A., (2014b) Comparing slow-growing chickens produced by two- and three-way crossings with commercial genotypes. 2. Carcass quality and blood parameters. *Europ.Poult.Sci.*, 78.

- SARICA, M., CEYHAN, V., YAMAK, U.S., UÇAR, A. and BOZ, M.A., (2016) Yavaş Gelişen Sentetik Etlik Piliç genotipleri ile Ticari Etlik Piliçlerin Büyüme, Karkas Özellikleri ve Bazı Ekonomik Parametreler Bakımından Karşılaştırılması. *Tarım Bilimleri Dergisi, (Journal of Agricultural Sciences)*, 22:20-31.
- SHIM, M.Y., TAHIR, M., KARNUAH, A.B., MILLER, M., PRINGLE, T.D., AGGREY, S.E. and PESTI, G.M., (2012) Strain and sex effects on growth performance and carcass traits of contemporary commercial broiler crosses. *Poultry Science*, 91: 2942-2948
- YAMAK, U.S., SARICA, M., BOZ, M.A., (2014) Comparing slow-growing chickens produced by two- and three-way crossings with commercial genotypes. 1. Growth and carcass traits . *Europ.Poult.Sci.*, 78.

## Effects of a Meal Feeding Regimen and the Availability of Fresh Alfalfa on Meat and Bone Quality of Broiler Genotypes

Bahattin Koçer<sup>a</sup>, Mehmet Bozkurt<sup>b</sup>, Gökhan Ege<sup>a</sup>, Ahmet Engin Tüzün<sup>c</sup>,  
Osman Olgun<sup>d</sup>, Ramazan Konak<sup>a</sup>

<sup>a</sup>Fig Research Institute, Department of Poultry, Aydın, Turkey

<sup>b</sup>Adnan Menderes University Faculty of Agriculture Department of Animal, Aydın, Turkey,

<sup>c</sup>Adnan Menderes University, Kocanlı Vocational Scholl, Aydın, Turkey

<sup>d</sup>Selcuk University Faculty of Agriculture Department of Animal Science, Konya, Turkey.

### Abstract

The aim of this study was to identify a feeding regimen that encourages good pasture use in slow (SG) and fast (FG) growing broiler genotypes under free-range management. SG and FG birds fed either an ad libitum (ADB) or a meal feeding (MEF) programme were given free outdoor access with or without fresh alfalfa from day 22 to 72 and from day 22 to 45, respectively. In two consecutive trials, eight hundred birds of each genotype were included in a factorial design using groups of 40 birds replicated 5 times. The MEF regimen with a strong feed limitation significantly increased ( $P<0.05$ ) crop and gizzard weight in both genotypes. In FG birds, water holding capacity, drip loss, cooking loss and pH<sub>45</sub> in the breast and thigh meat were adversely affected by MEF; however, feed restriction demonstrated benefits with significant decreases ( $P<0.01$ ) in muscle fat accumulation. In SG birds, decreases ( $P<0.05$ ) in protein and dry matter content of the breast and thigh muscle with meal feeding were conclusive. In both genotypes, there was no treatment-related effect on meat yield, the mineral composition of the meat, or bone mechanical properties.

**Keywords:** *Free-Range System, Food Restriction, Meat and Bone Quality, Mineral Composition Of Muscle.*

### Özet

Bu çalışmanın amacı, otlaklı sistemde etlik piliç yetiştiriciliği koşullarında gezinme alanındaki bitki örtüsünün kullanımını teşvik edebilecek yemleme yöntemlerinin araştırılmasıdır. Bu amaçla ad libitum veya öğünlü yemlenen hızlı gelişen (HG) ve yavaş gelişen (YG) ticari piliç hatlarına sırasıyla 22-44 ve 22-72 günler arasında yeşil yonca tesis edilen veya edilmeyen gezinme alanına serbest çıkış imkânı verilmiştir. Faktöriyel düzende yürütülen denemede her bir genotipten 800 adet etlik civciv 5 tekerrürlü 4 gruba rastgele dağıtılmıştır.

Öğünlü yemleme yöntemi her iki genotipte kursak ve taşlık oransal ağırlıklarını önemli düzeyde arttırmıştır ( $P<0.05$ ). Hızlı gelişen piliçlerin göğüs ve but etlerindeki su tutma kapasitesi, damla kaybı, pişirme kaybı ve  $pH_{45}$  değerleri öğünlü yemleme uygulamasından önemli derece etkilenmiş, buna karşılık but eti yağ içeriğinde öğünlü yemleme sonucu önemli azalma gerçekleşmiştir ( $P<0.01$ ). Göğüs ve but etinin protein ve kuru madde içeriği YG piliçlerde öğünlü yemlemeden olumsuz yönde etkilenmiştir. Her iki genotipte de kesim randımanı, karkas parçalarının oransal ağırlıkları, kemik biyomekanik özellikleri ve etin mineral bileşimi üzerine muamelelerin önemli bir etkisi belirlenmemiştir ( $P>0.05$ ).

**Anahtar Kelimeler:** *Serbest otlaklı sistem, öğünlü yemleme, et ve kemik kalitesi, doku mineral bileşimi.*

### **Introduction**

Free-range and organic systems, which are the most widely practised non-intensive poultry rearing systems, are commonly characterized by outdoor access and pasture availability (Horsted et al., 2005; Sossidou et al., 2011; Bogosavljević-Bošković et al., 2012). Consumers often believe that farm animals reared in alternative systems should be raised in conditions as close to natural conditions as possible, preferring free-range systems (Harper and Henson, 2001). Slow-growing broiler strains are preferred for free-range production conditions due to their better adjustment to forage use (Castellini et al., 2002a,b; Ponte et al., 2008a,b; Sirri et al. 2010). In addition, there are cases where fast-growing genotypes are also used for this purpose (Castellini et al., 2002a, 2016; Fanatico et al., 2005a,b). There is lack of information with regard to influence of restricted feeding and pasture intake on performance and meat quality of slow growing broiler genotypes which was subjected to the current experiment.

### **Materials and Methods**

Two experiments were conducted in the spring of two consecutive years of 2015 (experiment 1; between 30<sup>th</sup> of March and 20<sup>th</sup> of May) and 2016 (experiment 2; between 20<sup>th</sup> of April and 12<sup>th</sup> of May) at Aydın, Turkey, using the same trial design to determine the effects of fresh alfalfa presence in the yard and meal feeding regimen on the percentage of outdoor access, growth performance, meat yield, meat quality characteristics and bone mechanical properties of two broiler genotypes. In the experiment 1, a commercial slow growing breed (Hubbard Red JA 87) was used (here termed SG). This genotype is well known for adapting to free-range environments. In the latter work (experiment 2), a commercial fast growing genotype, here termed FG (Ross 308), was used.

At 22 d of age, the formal experiment started. Broiler groups of each genotype did not differ in 22 d body weight ( $P>0.05$ ). Each experiment used a 2 x 2 factorial design of 2 feeding regimens [ad libitum (ADB) versus meal feeding (MEF)] and the presence of fresh alfalfa (available versus unavailable). The birds were randomly assigned to 1 of 4 treatments with 5 replications of 40 broilers of mixed sex (20 males + 20 females) per treatment group, for a total of 200 broilers.

The birds in the ADB group were allowed ad libitum access to feed throughout the experiment. The birds in MEF group were allowed access to an unrestricted amount of feed during two periods of 2 h (08:00 to 10:00, 20:00 to 22:00 h).

### **Results and Discussion**

The MEF programme led to an increase of 10% ( $P<0.05$ ) in the percentage weight of an empty gizzard in the SG and FG genotypes when compared to those in the ADB programme. This effect was much more pronounced in an empty crop weight, with increased over 40% as a response to the MEF programme. The relative weight of the pancreas and the length of the small intestines were not affected by either feeding programme or alfalfa intake ( $P>0.05$ ). Meal feeding induced significant reductions ( $P<0.01$ ) in the percentage weight of abdominal fat pad weight in SG and FG birds, reaching up to levels of 40 and 17 %, respectively.

The yield of carcass (%) and the proportion (%) of the primal carcass cut into parts, including the breast, leg, back and wing, did not significantly differ between treatments.

In the FG genotype, the MEF programme increased ( $P<0.01$ ) dry matter content in the breast meat compared to that in the ADB regimen. However, in SG birds, MEF reduced ( $P<0.05$ ) dry matter and protein content in the breast and thigh meat relative to those on the ADB programme. The determined decrease in the breast meat protein content was much more pronounced (1.86%) than that in the thigh meat (0.34%). In both genotypes, there was no treatment-related effect on the mineral composition of the thigh meat and tibia bone mechanical properties.

### **Conclusion**

In conclusion, MEF, irrespective of alfalfa intake, may be able to contribute to the production of chickens with lean carcasses but was not capable of improving overall meat quality. The unresponsiveness to meal feeding with severe feed restriction and outdoor access with pasture intake stressed that slow growing chickens hardly effected by marked differences in feeding regimen.

## References

- BOGOSAVLJEVIĆ-BOŠKOVIĆ, S., RAKONJAC S, DOSKOVIĆ V., AND. PETROVIĆ M. D. (2012). "Broiler rearing systems: A review of major fattening results and meat quality traits." *World's Poultry. Science Journal* 68: 217–228.
- CASTELLINI, C., C. MUGNAI, and A. DAL BOSCO. (2002A). "Effect of organic production system on broiler carcass and meat quality." *Meat Science* 60: 219–225.
- FANATICO, A. C., P. B. PILLAI, L. C. CAVITT, C. M. OWENS, and J. L. EMMERT. (2005A). "Evaluation of slow-growing broiler genotypes with and without outdoor Access: Growth performance and carcass yield." *Poultry Science* 84: 1321-1327.
- FANATICO, A. C., L. C. CAVITT, P. B. PILLAI, J. L. EMMERT, AND C. M. OWENS. (2005B). "Evaluation of slow-growing broiler genotypes grown with and without outdoor access: Meat quality." *Poultry Science* 84: 1785–1790.
- HARPER, G, and S. HENSON.( 2001). "Consumer concerns about animal welfare and the impact on food choice." *EU FAIR CT98-3678 Final Report*.
- HORSTED, K., J. HENNING, and J. E. HERMANSEN. (2005) "Growth and sensory characteristics of organically reared broiler differing in strain, sex and age at slaughter". *Acta Agriculturae Scandinavica, Section A-Animal Science* 55: 149-157.
- PONTE, P. I. P., S. P. ALVES, R. J. B. BESSA, L. M. A. FERREIRA, L. T. GAMA, J. L. A. BRÁS, C. M. G. A. FONTES, AND J. A. M. PRATES. (2008C). "Influence of pasture intake on the fatty acid composition, and cholesterol, tocopherols, and tocotrienols content in meat from free-range broilers." *Poultry Science* 87: 80–88.
- SIRRI, F., C. CASTELLINI, A. RONCARATI, A. FRANCHINI, AND A. MELUZZI. (2010). "Effect of feeding and genotype on the lipid profile of organic chicken meat." *European Journal of Lipid Science and Technology* 112: 994-1002.
- SOSSIDOU, E. N., A. DAL BOSCO, H. A. ELSON, AND C. M. G. A. FONTES. (2011). "Pasture-based systems for poultry production: Implications and perspectives." *World's Poultry Science Journal* 67: 47–58.

## Ultrasound Treatment of Fresh Eggs: Effects on Microbial Quality

Muhammed Yüceer<sup>a</sup>, Cengiz Caner<sup>b</sup>

<sup>a</sup>Department of Food Processing, Canakkale Onsekiz Mart University, Turkey, 017020

<sup>b</sup>Department of Food Engineering, Canakkale Onsekiz Mart University, Turkey, 017020

### Abstract

Eggs are high in protein and are highly vulnerable to microbial growth in a short span of time. Fresh eggs are highly-perishable and limited shelf life. Novel preservation technologies are an interesting option to produce high-quality food products with an extended shelf life including ultrasound. Ultrasound, a form of energy by sound waves of frequencies, that could be an alternative to thermal-processing. This study investigated bacterial reduction (Total aerobic mesophilic bacteria mold-yeast, *Enterobacteriaceae*, *S. aureus* and Salmonella) of eggs using ultrasound treatments at powers of 200W-300W-450W with exposure times of 2 and 5 min for 6 weeks at 24°C.

**Key Words:** *Egg, Microbial Quality, Ultrasound, Shelf Life, Storage.*

### Taze Yumurtanın Ultrases ile Muamelesi: Mikrobiyel Kalite Üzerindeki Etkileri

#### Özet

Yumurta, protein açısından zengin ve mikrobiyel bozulmaya karşı ise oldukça hassastır. Taze yumurta hızlı bayatlama ile bozulabilen ve sınırlı raf ömrüne sahip bir gıda maddesidir. Yenilikçi muhafaza teknolojileri ilgi gören ve gıda ürünlerinde yüksek kaliteli ve raf ömürlü ürünlerin üretimine imkân sağlamakta olup, ultrases bu metotlar arasında yer almaktadır. Ultrases, frekansların ses dalgalarıyla oluşturduğu bir enerji şekli olup ısıl işleme tekniğine alternatif olabilecek niteliktedir. Bu çalışmada yumurta of 200W-300W-450W gücündeki ultrases 2 ve 5 dk. süre ile muamele edilerek 6 hafta boyunca 24°C'de depolama sürecinde bakteriyel popülasyon (Toplam mezofilik aerobik bakteri sayımı, küf-maya, *Enterobacteriaceae*, *S. aureus* ve Salmonella) üzerindeki etkisi araştırılmıştır.

**Anahtar Kelimeler:** *Yumurta, Mikrobiyel Kalite, Ultrases, Raf Ömrü, Depolama.*

## Introduction

Eggs are high in protein and are highly vulnerable to microbial growth in a short span of time. Eggs, like other protein foods such as meat, fish and poultry, can be contaminated with bacteria which, if allowed to grow, can cause food poisoning. Fresh eggs are highly perishable and limited shelf life. Development of emerging technology is necessary for maintaining the qualities of perishable foods such as fresh eggs. Environmentally friendly, green novel technologies are nowadays interest of industry due to the expectations of consumers. Novel preservation technologies are an interesting option to produce high quality food products with an extended shelf life including ultrasound. Ultrasound, is an emerging technique that could be an alternative to existing thermal processing techniques and traditional food-processing methods. Application of ultrasonic method in food processing has widely attracted attentions in recent years. Ultrasonic treatment is one of these emerging techniques that could be the alternative to existing thermal processing techniques. It is based on the transmission of ultrasonic sound waves (20 – 100 kHz frequency) through a medium. It enhances convective heat transfer as well as generates bubble explosions, which produce local hot spots that could cause inactivation of microorganisms and destruction of enzymes by cavitation (Caner ve Yuceer, 2015). Ultrasound is defined as sound waves having frequency that exceeds the hearing limit of the human ear (~20 kHz). Ultrasound is one of the emerging technologies that were developed to minimize processing, maximize quality and ensure the safety of food products. A process such as the application of an ultrasonic treatment could preserve the internal freshness of eggs by sealing pores and thus reducing the mass transfer of gas and moisture. A considerable amount of published work on ultrasonic treatment has dealt with functional properties on perishable foods. With respect to the use of ultrasound in the fresh eggs, there have been many studies conducted that show benefits of functional properties (Aygun ve Sert, 2012; Cabeza, ve ark., 2011; Gélvez-Ordoñez, ve ark., 2009; Manuel, ve ark., 2009; Sert, ve ark., 2011; Stefanovic, ve ark., 2017; Wladyka, ve ark., 1963).

This study aimed to investigate on bacterial reduction (Total aerobic mesophilic bacteria mold-yeast, *Enterobacteriaceae*, *S. aureus* and Salmonella) to increased shelf life of fresh eggs using ultrasound treatments at different powers with different exposure times during storage for 6 weeks at 24 °C. The effects of different ultrasound powers (200 W-50 Amp, 300 W-70 Amp, and 450 W-90 Amp) with exposure times of 2 min and 5 min on microbiological quality on eggs were investigated at ambient temperature. *Enterobacteriaceae*, *Staphylococcus aureus*, total colony, yeast and mold populations were determined on the eggs surface at weekly intervals during storage (6 weeks at 24°C).

## Materials and Methods

### *Egg*

White shell (Lohmann White laying hen breed, 41 weeks of age), unwashed, large size (AA), unfertile, freshly laid (1-day-old) clean (faces-free) eggs supplied by A.B. Foods Inc. (Bandirma, Turkey) were used in the study.

### *Ultrasound Treatments*

For ultrasonic treatment, an Industrial Ultrasonic Processor UIP1000hd (Hielscher Ultrasonics GmbH, Teltow, Germany) with 1000 W of power with BS2d18 probe was used. During the experiment five shell eggs at ambient temperature were sunk into an ultrasonic bath filled with water of 24°C and treated with ultrasonic power at 200 W, 300 W and 450 W for 2 and 5 min in each time. The water for the ultrasonic unit was changed between treatments. Control eggs were handled in water without ultrasonic treatment of the holding time (2 and 5 min). The treatments were control, 200 W for 2 min (200–2), 200 W for 5 min (200–5), 300 W for 2 min (300–2), 300 W for 5 min (300–5), 450 W for 2 min (450–2), and 450W for 5min (450–5). After the treatments, all eggs screened for cracks and leakage, and all cracked eggs were removed from the experiment and replaced with another treated intact egg. The eggs were subsequently placed in open molded plastic egg trays for storage at 24°C for 6 weeks until tested (Caner ve Yuceer, 2015).

### *Microbiological Analysis*

The serial dilution for whole egg samples prepared using mixing with 25 ml sterile phosphate buffer (Bagmixer-400, InterScience, Nom la Bretèche, France). Total mesophilic aerobic bacteria (total viable microorganisms) were analyzed using PCA at 37°C for 48 hour, Enterobacteriaceae counts VRBDA at 37°C for 48 hour, *S. aureus* counts BPA + RPF at 37°C for 48 saat, yeast-mold counts DRBC Agar at 25°C for 5-7 day (Yüceer ve Caner, 2016). The study investigated the effect of new preservation technique (ultrasound) for extending shelf life of fresh shell eggs. Total mesophilic aerobic bacteria (total viable microorganisms), mold-yeast, *Enterobacteriaceae*, *S. aureus* and *Salmonella* spp. were performed during storage weekly. Eggs were stored under room temperature conditions during six weeks.

## Results and Discussion

Ultrasound application has provided a significant reduction on Enterobacteriaceae, *Staphylococcus aureus*, total colony, yeast and mold populations. It was determined that effectiveness on microbial inactivation increased with increasing exposure time and ultrasound power-amplitude.

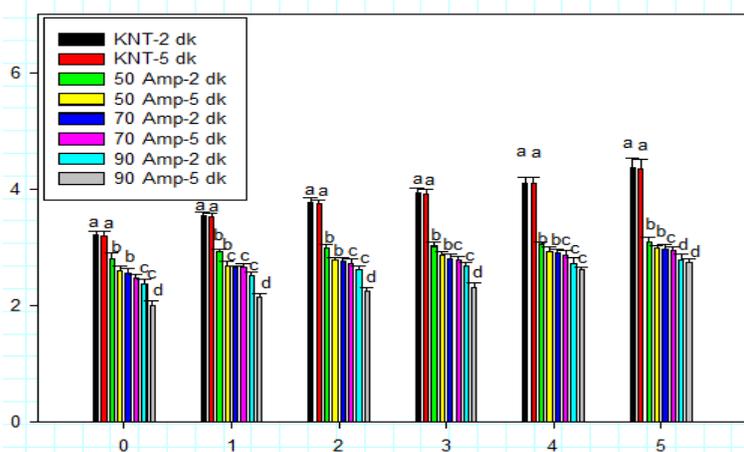


Figure 1. Effect of different ultrasound concentrations on total colony count (log/egg) of the eggs during storage period (storage time: week;0-5) Egg total colony counts (0-6.0), KNT: Control, untreated

Microbial load of eggs compared to the control group of ultrasound applications were decreased to about 2 logs comparing to the control group during storage, and the inhibitory effect of applications on the microorganisms were significant. Although the applications of ultrasound were reduced quickly the microbial flora on the eggs, microbial growths were continued during storage, but the number of microorganisms remained below the growth rate of the control group.

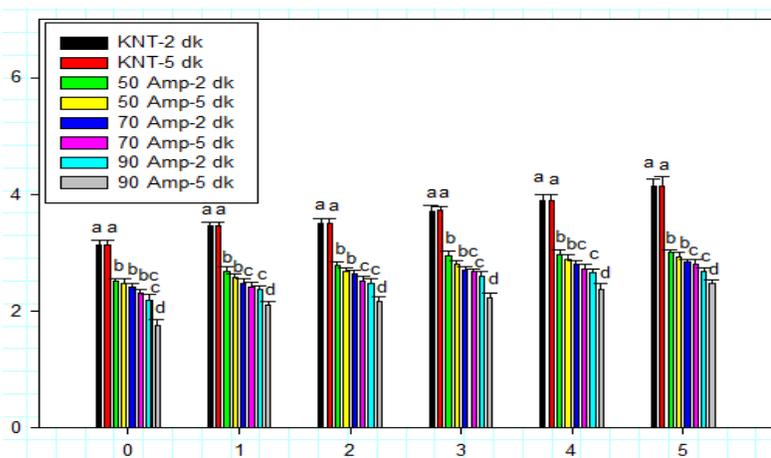


Figure 2. Effect of different ultrasound concentrations on yeast and mold count (log/egg) of the eggs during storage period (storage time: week;0-5) Egg yeast and mold counts (0-6.0) KNT: Control, untreated

During storage, it was observed that ultrasound applied fresh shell eggs had lower microbial counts than control group indicating the strong inhibition/inactivation effect of ultrasound on microorganisms. Even though *Salmonella* spp. was not isolated from eggs, antimicrobial coating had significantly reduced Enterobacteriaceae, coagulase positive *S. aureus*, TMAB and yeast-mold and high ultrasound concentrations and exposure times resulted with increased inhibitions according to Figure 1,2,3 and 4. Particularly, 450 W – 5 min. ultrasound application significantly decreased the surface microbial flora and therefore showed better conservative aspects on internal quality attributes. According to these findings, it was concluded that ultrasound application can induce a positive effect on shelf life of fresh eggs.

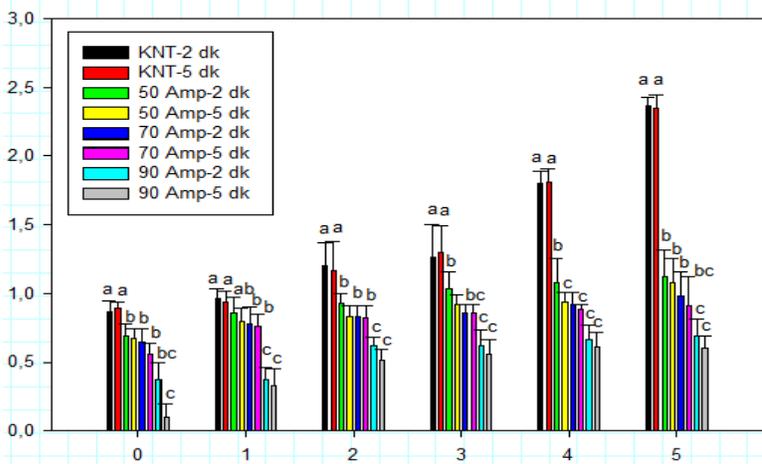


Figure 3. Effect of different ultrasound concentrations on *S. aureus* count (log/egg) of the eggs during storage period (storage time: week;0-5) Egg *S. aureus* counts (0-3.0) KNT: Control, untreated

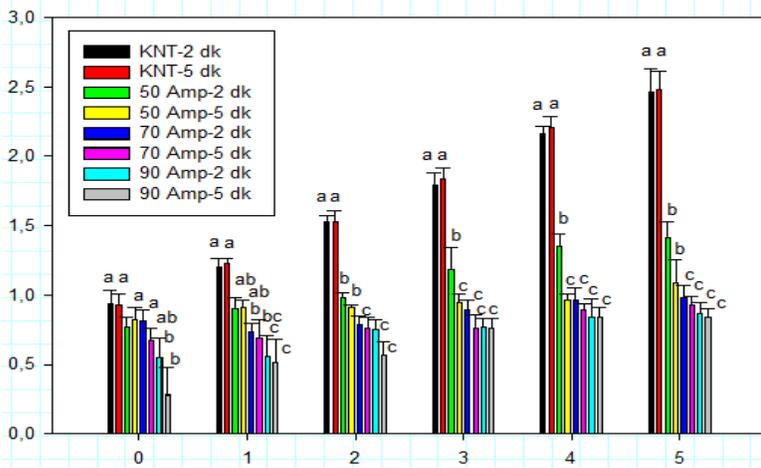


Figure 4. Effect of different ultrasound concentrations on Enterobacteriaceae count (log/egg) of the eggs during storage period (storage time: week;0-5) Egg Enterobacteriaceae counts (0-3.0) KNT: Control, untreated

According to results of microbiological analyses, treatment of ultrasound on eggs resulted in inhibitory effects on some microorganisms including total mesophilic aerobic bacteria, yeast-mold, Enterobacteriaceae and *S. aureus* leading to an increase in the shelf life of the eggs when compared with the control group. Increased ultrasound powers resulted in reduced microbial loads (Enterobacteriaceae, *S. aureus*, TMAB and yeast-mold) than the control group which indicates that the inhibition effect of ultrasound application was effective on suppressing surface bacterial growth.

### Conclusion and References

The results from such analysis were examined in order to investigate the effect of treatments on the microbial characteristics. The effects of ultrasound application on the shelf life of eggs were investigated at different ultrasound power's (200W-300W-450W) and exposure times (2 and 5 min.). Even though ultrasound application swiftly reduced the microbial flora fast at right after the treatment, microbial growth continued during storage. However, in any circumstance it was lower than the control group.

In conclusion, it was determined that a positive effect on the shelf life of the eggs of ultrasound treatments during storage. Ultrasound has potential to become significant breakthrough in the industry and in preserving egg during ambient room temperature storage. Ultrasonic treatments may be used to reduce microbial loads and extend shelf life of fresh eggs during storage periods. Ultrasound processing techniques may also be used in egg washing prior egg breaking or egg coating application for reduction of microbial growth and cleaning egg surfaces.

## References

- AYGUN, A., AND SERT, D. (2012). Effects of ultrasonic treatment on eggshell microbial activity, hatchability, tibia mineral content, and chick performance in Japanese quail (*Coturnix coturnix japonica*) eggs. *Poult. Sci.* 91:732-738
- CABEZA, M. C., CAMBERO, M. I., DE LA HOZ, L., GARCÍA, M. L., AND ORDÓÑEZ, J. A. (2011). Effect of the thermoultrasonic treatment on the eggshell integrity and their impact on the microbial quality. *Inn. Food Sci. & Emerg. Technol.* 12:111-117
- CANER, C., AND YUCEER, M. (2015). Maintaining functional properties of shell eggs by ultrasound treatment. *J Sci Food Agric* 95:2880-2891
- GÉLVEZ-ORDÓÑEZ, V., MENDOZA-GALVIS, F., AND DELGADO, J. (2009). The Effect of ultrasonic Treatment on Some Sunctional Properties of Egg White. *Revista Científica, FCV-LUZ XIX*:71-76
- MANUEL, G.-O. V., FRANKLIN, M.-G., AND ORLANDO, D. J. (2009). The Effects of Ultrasonic Tratment on Some Functional Properties of Egg White. *Revista Científica XIX*:71-76
- SERT, D., AYGUN, A., AND DEMIR, M. K. (2011). Effects of ultrasonic treatment and storage temperature on egg quality. *Poult. Sci.* 90:869-875
- STEFANOVIC, A. B., JOVANOVIC, J. R., DOJCINOVIC, M. B., LEVIC, S. M., NEDOVIC, V. A., BUGARSKI, B. M., AND KNEZEVIC-JUGOVIC, Z. D. (2017). Effect of the Controlled High-Intensity Ultrasound on Improving Functionality and Structural Changes of Egg White Proteins. *Food and Bioprocess Technology* 10:1224-1239
- WLADYKA, E. J., DAWSON, L. E., AND WALKER, R. W. (1963). The Influence of Ultrasonic Treatment on Egg Quality. *Poult Sci*:1154-1161
- YÜCEER, M., AND CANER, C. (2016). Ozon Uygulamasının Taze Yumurtanın Mikrobiyel Kalitesi Üzerine Depolama Süresince Etkisinin Belirlenmesi. *Gida / the Journal of Food* 41:15-22

## Acknowledgements

This work was supported by The Ministry of Industry, Contract Number 00729.STZ.2010-2 SAN-TEZ.

# **SESSION-8**

# **PRODUCT QUALITY**

**5 MINUTES ORAL PRESENTATIONS**

## Reducing Gut Lesions Caused by Bacterial Enteritis with A Specific Blend of Esterified Fatty Acids

Krzysztof Kozłowski<sup>a</sup>, Angelo Lauwaerts<sup>b</sup>, Jan Jankowski<sup>a</sup>

<sup>a</sup>University of Warmia and Mazury in Olsztyn, Oczapowskiego 5, 10718 Olsztyn, Poland,

<sup>b</sup>Proviron Industries NV, Georges Gilliotstraat 60, 2620 Hemiksem, Belgium

### Abstract

Modern turkey breeds remain vulnerable to enteric diseases. Maintaining optimal gut functions throughout the whole rearing period is essential. The efficacy of Optigut™ on gut health and overall performance was tested in turkeys. Day old females were divided into a negative and positive control group (PC) and two groups with either a high or low (LD) Optigut™ supplementation. All birds were inoculated with a bacterial and Eimeria cocktail. Animals were evaluated on macroscopic intestinal and coccidiosis lesions. LD trends for lower coccidiosis and bacterial enteritis. LD and PC have significantly lower flaccidity and LD trends towards lower inflammation.

**Key words:** *Bacterial Enteritis, Coccidiosis, Monobutyryn, Monolaurin*

### Introduction

Modern turkey breeds remain vulnerable to enteric diseases and bacterial challenges such as *E.coli*, *Salmonella* and *Clostridium*. Therefore it is essential to create a healthy intestine from the very start and to maintain optimal gut functions under high pressure conditions throughout the whole growth period. The efficacy of Optigut™, a specific combination of esterified butyric and lauric acid, on gut health and overall performance was tested in turkeys.

### Materials and Methods

A total of 1400 healthy one-day-old turkey females Hybrid Converter were randomly divided into 4 treatment groups with 7 replications each. The experimental groups comprised of a negative control group (NC), fed a basal, commercial diet; a positive control group (PC), fed the same basal diet, but receiving antibiotics via the drinking water throughout the entire experiment and two treatment groups receiving a feed with either a high (HD) or low (LD) degressive supplementation of Optigut™. All birds were individually orally inoculated with a bacterial and Eimeria cocktail during 3 consecutive days from the age of 19 days. They were reared up to 105 days. On day 26, three animals per pen were evaluated for intestinal gut health and coccidiosis. A macroscopic intestinal lesion scoring system, as an

assessment of the macroscopic pathology and physical damage caused by bacterial enteritis, was combined with lesion scoring for coccidiosis, as subclinical coccidiosis plays a major role in the development of bacterial enteritis.

### Results and Discussion

The LD treatment shows a near-significant trend for a lower coccidiosis scoring compared to the HD, as well as for a lower bacterial enteritis scoring compared to both HD and NC. Higher butyrate concentration reduces the mucin production. A thinner mucosa layer may allow parasites and pathogenic bacteria, like *Clostridium perfringens*, to reach the gut wall easier and inflict more damage. Glycerol monolaurate reduces immune cell proliferation at high concentrations, whereas it increases the proliferation of T-cells at lower concentrations.

Table 1. Results of Coccidiosis & Bacterial Enteritis scoring

T	NC	HD	LD	PC	SEM	P
Coccidiosis						
EM	0.886±0.323	0.971±0.169	0.829±0.382	0.914±0.284	0.025	0.253
EA	0.914 ± 0.284	0.971 ± 0.169	0.857 ± 0.355	0.943 ± 0.236	0.023	0.333
CT	1.80 <sup>xy</sup> ± 0.41	1.94 <sup>y</sup> ± 0.24	1.69 <sup>x</sup> ± 0.58	1.86 <sup>xy</sup> ± 0.36	0.036	0.073
Bacterial Enteritis						
Overall						
GB	0.829 <sup>b</sup> ±0.382	0.857 <sup>b</sup> ±0.355	0.800 <sup>b</sup> ±0.406	0.543 <sup>a</sup> ±0.505	0.036	0.001
UF	0.457 <sup>y</sup> ±0.505	0.171 <sup>x</sup> ±0.382	0.286 <sup>xy</sup> ±0.458	0.371 <sup>y</sup> ±0.490	0.040	0.066
Cranial						
IB	0.714 <sup>xy</sup> ±0.458	0.771 <sup>y</sup> ±0.426	0.543 <sup>x</sup> ±0.505	0.800 <sup>y</sup> ±0.406	0.039	0.081
F	0.543 <sup>ab</sup> ±0.505	0.714 <sup>b</sup> ±0.458	0.343 <sup>a</sup> ±0.482	0.371 <sup>a</sup> ±0.490	0.042	0.001
AC	0.943 ± 0.236	0.971 ± 0.169	0.943 ± 0.236	0.886 ± 0.323	0.021	0.528
TTF	0.200 ± 0.406	0.400 ± 0.497	0.229 ± 0.426	0.229 ± 0.426	0.037	0.214
Caudal						
IBD	0.743 ± 0.443	0.743 ± 0.443	0.600 ± 0.497	0.714 ± 0.458	0.039	0.517
F	0.371 ± 0.490	0.314 ± 0.471	0.257 ± 0.443	0.343 ± 0.482	0.040	0.772
AC	0.657 ± 0.482	0.686 ± 0.471	0.686 ± 0.471	0.514 ± 0.507	0.041	0.390
TTF	0.457 ± 0.458	0.286 ± 0.458	0.229 ± 0.426	0.257 ± 0.443	0.037	0.941
BET	5.74 <sup>yz</sup> ± 2.16	5.91 <sup>z</sup> ± 1.70	4.91 <sup>x</sup> ± 2.15	5.03 <sup>xy</sup> ± 1.58	0.164	0.070

T: Treatment, EM: *E. meleagridis*, EA: *E. adenoids*, CT: *E. adenoids*, GB: Gut ballooning, UF: Undigested feed, IB: Inflammation/ blood vessels dilated, F: Flaccid, AC: Abnormal Contents, TTF: Thickness/ Translucency/ Fragility, IBD: Inflammation/ blood vessels dilated, BET: Bacterial Enteritis total. Values in same row with no common superscript (<sup>a</sup>, <sup>b</sup>) are significantly different (P<0.05); values between 0.05<P<0.10 considered a near-significant trend (superscripts <sup>x</sup>, <sup>y</sup>, <sup>z</sup>).

Moreover, flaccidity in LD and PC is significantly lower than in HD groups and the LD groups show a trend towards lower inflammation compared to HD and PC, which may be due to overstimulation of the immune system at higher concentration of glycerol monolaurate. Also, antibiotics perturb

commensal microbial communities and affect susceptibility to infection by intestinal pathogens and development of inflammatory bowel diseases.

### **Conclusion**

An impact of Optigut™ on parameters characterising gut health under challenging conditions of bacterial enteritis combined with coccidiosis is observed for the lower dosage scheme of Optigut™, whereas the positive impacts disappears at higher dosage.

### **References**

- AOAC. (2000) Official Methods of Analysis (17<sup>th</sup> Ed.) Association of Official Analytical Chemists, Arlington, VA, USA.
- BARCELO, A., CLAUSTRE, J., MORO, F., CHAYVIALLE, J.-A., CUBER, J.-C., & PLAISANCIÉ, P. (2000). Mucin secretion is modulated by luminal factors in the isolated vascularly perfused rat colon. *Gut*, 46, 218-224.
- JOHNSON, J., & REID, W. M. (1970). Anticoccidial drugs: Lesion scoring techniques in battery and floor-pen experiments with chickens. *Experimental Parasitology*, 28(1), 30-36.
- TEIRLYNCK, E., GUSSEM, M. D. E., DEWULF, J., HAESEBROUCK, F., DUCATELLE, R., & VAN IMMERSEEL, F. (2011). Morphometric evaluation of “dysbacteriosis” in broilers. *Avian Pathology: Journal of the W.V.P.A.*, 40(July 2014), 139-144.
- UBEDA, C., & PAMER, E. G. (2012). Antibiotics, microbiota, and immune defense. *Trends in Immunology*, 33(9), 459-466.
- WITCHER, K. J., NOVICK, R. P., & SCHLIEVERT, P. M. (1996). Modulation of immune cell proliferation by glycerol monolaurate. *Clinical and Diagnostic Laboratory Immunology*, 3(1), 10-3.

## Investigation of Emulsion Capacity of Game Bird Meat

Süleyman Baytur, Hasan Murat Veliöglu

Namık Kemal University, Faculty of Agriculture, Department of Agricultural Biotechnology,  
Tekirdağ

### Abstract

The unique geographic location of Turkey offers great opportunities for hunting. However, there is not enough scientific study on the properties of game animal meat. Game birds such as quail (*Coturnix coturnix*) and woodcock (*Scolopax rusticola*) are the common hunting animals and in the present paper, emulsion capacities of the meat obtained from these birds were investigated. According to the findings, emulsion capacities of woodcock thigh and breast meat were found as 148.5 and 125 ml oil/g protein, respectively. The results for quail meat were 182.8 and 179 ml oil/g protein for thigh and breast meat, respectively.

**Keywords:** *Emulsion Capacity, Quail, Woodcock, Meat*

### Özet

Türkiye'nin sahip olduğu eşsiz coğrafik konum avcılık açısından önemli fırsatlar sunmaktadır. Buna karşın av hayvanı etlerinin özellikleri hakkındaki bilimsel çalışmalar oldukça sınırlıdır. Bildircin (*Coturnix coturnix*) ve çulluk (*Scolopax rusticola*) avcılığı en yaygın yapılan av kuşlarıdır ve sunulan çalışmada bu kuşlara ait etlerin emülsiyon kapasiteleri araştırılmıştır. Çalışmanın sonuçlarına göre, çulluk but ve göğüs etinin emülsiyon kapasitesi değerleri sırasıyla 148,5 ve 125 ml yağ/g protein olarak tespit edilmiştir. Diğer taraftan bildircin but ve göğüs etine ait değerler 182,8 ve 179 ml yağ/g protein olarak bulunmuştur.

**Anahtar kelimeler:** *Emülsiyon kapasitesi, bildircin, çulluk, et*

### Introduction

Hunting is a tradition in Turkey and, nowadays, it is also called as touristic activity. In our country animal hunting is done in certain regions and time intervals<sup>(2)</sup>. Hunting tourism has a great potential from the economical point of view for the country. On the other hand, consumption of game bird meat has gained increasing favor among consumers who appreciate its texture and flavor as well as the low fat and cholesterol. Finally, there is a global demand for alternative meat sources and game birds should be taken into consideration for this purpose. While there is a great increase in awareness about game bird meat in the country, scientific information is still very

limited about the meat quality indicators<sup>(6)</sup>. In the present research, emulsion capacity of the meat obtained from hunted woodcock and quail was investigated. The emulsion is called a mixture of two liquids which are insoluble in each other. Emulsion capacity is defined as the maximum amount of fat (ml) that a unit protein can emulsify<sup>(5)</sup>. During the production of salami and sausage type emulsified meat products, the formation of the emulsion is one of the most important process steps in practice. The high quality of the protein used during formation of the emulsion is also a positive effect on the properties of the product to be obtained<sup>(3)</sup>. During preparation of the emulsion of meat protein with functional properties can be a significant impact on physical and chemical conditions in the various emulsion parameters.

### **Materials and Methods**

Hunted quail and woodcock meat was used as a material. The hunting animals were obtained from Tekirdag region. Emulsion capacity was detected by using [Ockerman's (1985)] model system. For the determination of emulsion capacity, 25 g of the minced sample was put in a laboratory blender (Waring Commercial Laboratory Blender – USA), and then 100 ml of salt-phosphate solution was added. After that, mixing was done at high speed for 2-3 s. 12.5 g of the obtained homogenate was transferred to another jar and mixed with 37.5 ml of salt (2.5% NaCl) + phosphate (0.5% K<sub>2</sub>HPO<sub>4</sub>) solution at  $4 \pm 2$  ° C for 15 seconds at low speed, then 50 ml of cooled refined sunflower oil was added, the specially prepared electrode was immersed in the blender jar and the connections with the ohm-meter were made and then the high-speed emulsification process was started. The last point determination is done with the help of electrical conductivity measure Ohm- meter, developed by the [Webb and et all. (1970)]. With circulating water bath, refined sunflower oil with a temperature of 8 ° C was added to the medium with a flow rate of 1 ml / sec. During oil addition, the viscosity of the emulsion began to increase and the viscosity remained unchanged for a while after reaching a certain value, and the addition of oil to the point where the peak produced by the millivolt meter was suddenly decreased was stopped immediately. The amount of oil initially added and the amount of oil added during the emulsification process were calculated to determine the total amount of oil consumed<sup>(1)</sup>.

### **Result**

As a result, emulsion capacity was calculated to give the amount of emulsified fat in 1 g muscle protein<sup>(1)</sup>. As a result of this research, the emulsion capacity of woodcock thigh meat was 148,5 ml oil/g protein and the emulsion capacity of breast meat was 125 ml oil / g protein were found. Additionally, the findings showed that the emulsion capacity of the quail thigh meat was 182,8 ml oil/ g protein and the breast meat was 179 ml oil / g protein.

The study by [Karakaya (2003)] expressed the EC for partridge meat, quail meat, poultry meat and turkey meat as 205, 215, 222 and 200 ml fat / g protein, respectively. Also, Karakaya et al. (2004) found emulsion capacity values of quail, partridge, chicken and turkey meat as 198, 224 and 198 ml fat / g protein, respectively. On the other hand, Velioglu et al. (2016) reported that the EC of raised quail meat were 331 and 371 ml oil/g protein for breast and thigh, respectively.

Compared with the literature, it was determined that the hunting animals had lower emulsion capacities than the animals raised. It may be because of the differences in feeding practices and the environmental effects between hunted and raised birds.

### Conclusion

There is a great interest of alternative meat sources. Wild animals are at the center of this search and domestication of quail, woodcock, partridge and other game birds is important. However, there is a need for scientific studies on meat quality of these game birds. The results of the present study could be used in further researches on physicochemical and technological properties of game bird meats.

### References

- GOKALP Y.H., KAYA M., TÜLEK Y. and ZORBA Ö., (1999) Et ve Ürünlerinde Kalite Kontrolü ve Laboratuvar Uygulama Kılavuzu. *Atatürk Üniversitesi Ziraat Fakültesi Ofset Tesisi*, Erzurum,
- HUS S., GÖKSEL E., (1981) Türkiye Av Hayvanlarının Yayılış Yerleri. *Orman Fakültesi Dergisi*, Volume 31, Number 2, İstanbul University,
- KARAKAYA M., (1996) The Effects of The Different Oil Temperatures on The Characteristics of The Emulsions Obtained from The Quail and Pekin Duck Meats. *Selçuk Üniversitesi Gıda Dergisi*, 21. Volume, Number 2, Page 75-81 Konya,
- OCKERMAN, H. W., (1985) Quality Control of Postmortem Muscle Tissue. Vol.3.Ed. *The Ohio State Univ Department of Anim Sci*, Columbus, OH., USA
- POLAT N. (2015) Bazı Soya Türevlerinin Sığır Ve Tavuk Etlerinin Emülsiyon Karakteristikleri Üzerine Etkisi. *Selçuk University, Department of Food Engineering*, Konya
- VELIOGLU M.H., BAYTUR S. and BEZGIN T., ( 2016 ) Investigating the Emulsion Capacity of Quail Meat. *International Congress on Food of Animal Origin Industry Partnershi*, Near East University, Cyprus, 10-13 November
- WEBB, N.B., IVEY, J.F., CRAIG, H.B., JONES, V.A. AND MONROE, R.J., ( 1970 ) The measurement of emulsifying capacity by electrical resistance. *J. Food Sci.*, 35. Volume, Number 501

## A Note on Seroprevalence of *Toxoplasma gondii* in Turkeys\*

Cahit Babür<sup>a</sup>, Bilge Karatepe<sup>b</sup>, Selçuk Kılıç<sup>a</sup>, Mustafa Karatepe<sup>b</sup>, Gül Ergün<sup>c</sup>

<sup>a</sup>Ministry of Health, Ankara Refik Saydam National Institute of Hygiene, Ankara-Türkiye

<sup>b</sup>Niğde Ömer Halisdemir University, Bor Vocational School, Bor/Niğde-Türkiye

<sup>c</sup>Hacettepe University, Faculty of Science, Department of Statistics, Ankara-Türkiye

\*The study was published in *Indian Veterinary Journal*, 85:994.

### Abstract

The present study was conducted to investigate the prevalence of *Toxoplasma gondii* specific antibodies in turkeys (*Meleagris gallopavo*) which were obtained from Niğde Ömer Halisdemir University poultry. Blood samples were collected out of 355 turkeys, which consisted of 175 female and 180 male. The sera were tested for *T. gondii* antibodies by using Sabin-Feldman Dye Test (SFDT). Five out of 355 (1.40%) turkeys were found to be seropositive for *T. gondii* antibodies at the titer of 1/16. This is the first serological report on toxoplasmosis in turkeys from Niğde of Turkey.

**Key words:** *Sabin-Feldman Dye Test, Meleagris gallopavo, Toxoplasma gondii, Turkeys*

### Hindilerde *Toxoplasma gondii*'nin Seroprevalansı

#### Özet

Bu çalışma, Niğde Ömer Halisdemir Üniversitesi uygulama kümesinde yetiştirilen hindilerde (*Meleagris gallopavo*) *Toxoplasma gondii* antikorlarının prevalansının araştırılması için yapılmıştır. Kan örnekleri 175'i dişi ve 180'i erkek olmak üzere toplam 355 hindiden alınmış ve elde edilen serumlar *T. gondii* antikorları yönünden Sabin-Feldman Dye Test (SFDT) ile analiz edilmiştir. İncelenen 355 hindinin 5'inde (%1.40) 1/16 dilüsyonda *T. gondii* antikorları yönünden seropozitiflik tespit edilmiştir. Bu çalışma ile Niğde yöresinde hindilerde toxoplasmosis ilk kez araştırılmıştır.

**Anahtar kelimeler:** *Sabin-Feldman Dye Test, hindi, Meleagris gallopavo, Toxoplasma gondii*

#### Introduction

Infections with *Toxoplasma gondii*, an intracellular protozoon parasite, are widely prevalent in mammals and birds. The definitive hosts are domestic

cats, including wild felidae. Various warm-blooded animals serve as intermediate hosts. *Toxoplasma gondii* causes subclinical infections in many bird species, including turkeys (Dubey and Beattie, 1988; Dubey, 2010).

Chicken and turkey are the most important sources of meat in Turkey and their meat can also serve as source of *T. gondii* infection for humans when meat from these animals is consumed undercooked or uncooked. In the only one report related to toxoplasmosis in turkeys in Turkey, *T. gondii* antibodies were not found in 60 turkeys in Ankara, Bursa and Cankiri province by SFDT (Inci et al., 1998).

Aim of the present study was to extend the study to *T. gondii* in turkeys from Nigde province of Turkey.

### **Materials and Methods**

The present study was carried out on turkeys (*Meleagris gallopavo*) of Nigde province, in middle of Turkey, where toxoplasmosis was not previously recognized. In this place, because of subtropical climate, summers are warm and dry and the winters are cold and snowy.

The turkeys were obtained from Niğde Ömer Halisdemir University poultry. The birds were approximately 4-5 months old and were kept for meat. Of 355 turkeys used for collection of blood samples, 175 were female and 180 were male. Blood samples were collected from punctured wing vein (vena cutenea ulnaris) in a sterile tube. Sera were obtained by centrifugation at room temperature (25°C), at 4000 rpm for 10 minutes and stored at -20°C until used. Serum samples were tested for toxoplasmosis by using vigorous antigen and methylene-blue dying at Ankara Refik Saydam National Institute of Hygiene (Sabin and Feldman, 1948). The SFDT result was regarded as positive if more than 50% of tachyzoites did not accept the dye (unstained) when examined under the light microscope (x 400). The threshold was stated at 1/16 dilution.

#### **Statistical analysis**

The Z test was used for making comparison and analyzing the difference between the proportions of female and male seropositivities. The test statistic was found to be  $Z=1.38$  and then it was concluded that there was no significant difference between two proportions. Seropositivity was ascertained at 1/16 dilution. So that, there was no chance to compare the proportions of subgroups statistically according to different dilutions.

### **Results and Discussion**

Antibodies to *T. gondii* were found in 5 out of 355 (1.40%) turkeys tested at the titer of 1/16. From the 1 out of 180 (0.55%) male turkeys and the 4 out of 175 (2.28%) female turkeys were detected anti-*T. gondii* antibodies (Table 1).

Table 1. Prevalence of antibodies to *Toxoplasma gondii* in turkeys of Nigde by the SFDT

Groups	NTT	NSS	S	SFDT titer	
				1/16	1/64
Female	175	4	2.28	4	0
Male	180	1	0.55	1	0
TOTAL	355	5	1.40	5	0

NTT: Number of turkeys tested, NSS: Number of seropositive sera, S: Seropositivity (%)

*Toxoplasma gondii* parasitizes birds and mammals and occurs worldwide. One of the main sources of *T. gondii* infection in humans, is bird meat, so besides another indicators to detect the distribution of *T. gondii* oocysts in the environment, the determination of *T. gondii* prevalence in domestic birds is of great importance (Dubey et al., 2003). The prevalence of *T. gondii* in turkeys is largely unknown and clinical toxoplasmosis is considered rare in wild turkeys. However, spontaneous fatal toxoplasmosis have been described in wild turkeys (Howerth and Rodenroth, 1985; Quist et al., 1995). Susceptibility of some wild turkeys has been tested by experimental infections. Turkeys were found relatively resistant to *T. gondii* infection and no clinical signs of toxoplasmosis were found in them (Sedlak et al., 2000). Seroprevalence of *T. gondii* infection in turkeys given varying picture; 24.0% with IHA in Iran (Ghorbani et al., 1990), 10% with MAT from 21 locations in the United States (Quist et al., 1995), 59.5% with MAT in Egypt (El-Massry et al., 2000), 76.63% with LAT in Iraq (Butty, 2009) and 4.1% with MAT in Nigeria (Ayinmode et al., 2017). In our study, seroprevalence of *T. gondii* was found to be 1.40% in turkeys from Nigde province in Turkey. This prevalence rate (1.40%) was higher compared to that of Inci et al. (1998) in Ankara, Bursa and Cankiri areas of Turkey. Variation may be ascribed to variation in number of animals studied, the geographic distribution of the protozoa and type of serological tests.

### Conclusion

In Turkey, epidemiology of toxoplasmosis has not been extensively investigated and little is known on the distribution and prevalence of the diseases in turkeys. However, *T. gondii* prevalence was reported in domestic (*Columba livia domestica*), wild (*Columba livia livia*) pigeons and quails with SFDT as %0.95, %0.90 and 0%, respectively in Nigde province (Karatepe et al. 2011; Kılıç et al. 2017). In our study, seroprevalence of *T. gondii* was found to be 1.40% in turkeys from Nigde province in Turkey. In spite of low seropositivity, *T. gondii* infection in turkeys may be of epidemiologic importance because raw or undercooked turkey meat can serve as sources of *T. gondii* infection. We recommend that turkey meat and its products should be adequately processed before human consumption. Besides, more extended studies are required to determine the seroprevalence rates in human and animals, and its implications for both animal and human health in the Nigde of Turkey.

## References

- AYINMODE, A.B., OBEBE, O.O. and AIKI-RAJI, C.O. (2017) Detection of *Toxoplasma gondii* Antibodies in Farmed Turkeys (*Meleagris gallopavo*). *Folia Veterinaria*, 61: 5-10.
- BUTTY, E.T. (2009) Diagnostic study of *Toxoplasma gondii* in turkey (*Meleagris gallopavo*) in some regions in Ninevah governorate, Iraq. *Iraqi Journal of Veterinary Sciences*, 23: 57-62.
- DUBEY, J.P. and BEATTIE, C.P. (1988) *Toxoplasmosis of Animals and Man*. CRC Press Inc Boca Raton, Florida.
- DUBEY, J.P., GRAHAM, D.H., DAHL, E., HILALI, M., EL-GHAYSH, A., SREEKUMAR, C., KWOK, O.C.H., SHEN, S.K. and LEHMANN, T. (2003) Isolation and molecular characterization of *Toxoplasma gondii* from chickens and ducks from Egypt. *Vet. Parasitol.* 114: 89-95.
- DUBEY, J.P. (2010) *Toxoplasmosis of Animals and Humans* CRC Press, Taylor & Francis Group Boca Raton, London New York.
- EL-MASSRY, A., MAHDY, O.A, EL-GHAYSH, A. and DUBEY, J.P. (2000) Prevalence of *Toxoplasma gondii* antibodies in sera of turkeys, chickens and ducks from Egypt. *J Parasitol.* 86: 627-628.
- GHORBANI, M., GHARAVI, M.J. and KAHNAMOUI, A. (1990) Serological and parasitological investigations on *Toxoplasma* infection in domestic fowls in Iran. *Iranian J Publ Health*, 19: 9-17.
- HOWERTH, E.W. and RODENROTH, N. (1985) Fatal systemic toxoplasmosis in a wild turkey. *J. Wildl. Dis.* 21: 446-449.
- İNCİ, A., BABÜR, C., DİNÇER, S. and ERDAL, N. (1998) Türkiye'nin bazı illerinde evcil kanatlılarda Sabin-Feldman boya testi ile anti-toxoplasma gondii antikorlarının saptanması. *Türkiye Parazitoloj Derg.* 22: 420-423.
- KARATEPE, M., KILIÇ, S., KARATEPE, B. and BABÜR, C. (2011) Prevalence of *Toxoplasma gondii* Antibodies in Domestic (*Columba livia domestica*) and Wild (*Columba livia livia*) Pigeons in Niğde region, Turkey. *Türkiye Parazitoloji Dergisi*, 35: 23-26.
- KILIÇ, S., KARATEPE, M., BABÜR, C. and KARATEPE, B. (2017) Niğde Yöresinde Bildircinlarda (*Coturnix coturnix japonica*) *Toxoplasma gondii*'nin Seroprevalansı. *Kocatepe Vet J*, 10: 129-133.
- QUIST, C.F., DUBEY, J.P., LUTTRELL, M.P. and DAVIDSON, W.R. (1995) Toxoplasmosis in wild turkeys : a case report and serologic survey. *J Wildl Dis.* 31: 255-258.
- SABIN, A.B. and FELDMAN, H.A. (1948) Dyes as Microchemical Indicators of a New Immunity Phenomenon Affecting a Protozoon Parasite (*Toxoplasma*). *Science*, 108: 660-663.

SEDLAK, K., LITERAK, I., VITULA, F. and BENAK, J. (2000) High susceptibility of partridges (*Perdix perdix*) to toxoplasmosis compared with other gallinaceous birds. *Avian Pathol.* 29: 563-569.

## Effects of Photoperiod Length and Light Intensity on Performance and Some Carcass Characteristics in Broilers

Evrım Dereli Fidan

Adnan Menderes University, Faculty of Veterinary Medicine, Department of Animal Science, 09016, Aydın-TURKEY

### Abstract

The aim of this study was to investigate the effects of photoperiod length and light intensity on performance, and carcass characteristics in broilers. A total of 272 1 day-old male broiler chicks were randomly assigned to four treatment groups based on the photoperiod length (23L:1D or increasing duration of light) and light intensity (20 lux vs. a dim, reducing intensity). The effects of photoperiod length and light intensity on performance traits were not significant. The carcass weights and whole breast meat and wing weights were found lower in the dim, reducing light intensity group than 20 lux light intensity group.

**Key words:** *Broiler, Carcass, Light intensity, Performance, Photoperiod*

### Özet

#### **Etlik piliçlerde Fotoperiyot Uzunluğu ve Işık Şiddetinin Performans, ve Bazı Karkas Özellikleri Üzerine Etkileri**

Bu çalışmanın amacı fotoperiyot uzunluğu ve ışık şiddetinin etlik piliçlerde performans ve karkas özellikleri üzerine etkilerinin araştırılmasıdır. Bir günlük yaşta toplam 272 adet (Ross 308) erkek civcivler fotoperiyot uzunluğu (23A:1K veya giderek artan aydınlık süre) ve ışık şiddeti (20 lüks veya giderek azalan ışık şiddeti) faktörlerine göre dört gruba rastgele olarak dağıtılmıştır. Performans özellikleri üzerine, fotoperiyot uzunluğu ve ışık şiddetinin etkileri önemsiz bulunmuştur. Karkas ağırlık ortalaması, bütün göğüs eti ve kanat ağırlık ortalaması değerleri giderek azalan ışık şiddeti grubunda, 20 lüks ışık şiddeti grubuna göre daha düşük olarak belirlenmiştir.

**Anahtar kelimeler:** *Etlik piliç, Fotoperiyot, Işık şiddeti, Karkas, Performans*

### Introduction

Light is an important factor in the regulation and control of production, reproduction and health of poultry. Growth rate and welfare of the broiler is influenced to a great degree by at least three components of light:

photoperiod, intensity and color or wavelength of the light (Deep et al., 2010; Ahmad et al., 2011; Olanrewaju et al. 2015). Broiler chickens have usually been reared under continuous (24L:0D) or near-continuous (23L:1D) photoperiods to maximize feed consumption (FC) and growth rate. It has been reported that broilers exposed to continuous or near-continuous lighting programs to provide constant visual access to feed and water, resulting in maximum FC, increased live weight gain and growth rate (Downs et al., 2006; Schwean-Lardner et al., 2012). However, several studies indicated that, using continuous lighting programs might result in inadequate sleep and as a result of sleep deprivation physiological stress responses were increased (Kliger et al. 2000; Campo and Davila, 2002). The effect of light intensity (ranging from 1 to 150 lx) on body weight (BW), FC, feed conversion ratio (FCR) and mortality in broiler chickens was reported as statistically nonsignificant by some studies (Kristensen et al., 2006; Lien et al., 2007; Blatchford et al., 2009).

### **Materials and Methods**

A total of 272 1-d old male broilers (Ross 308) obtained from a commercial hatchery were used in the study. Birds were fed with a starter diet from 1 to 21 d of age (3060 kcal ME/kg, 23% crude protein) and a grower diet from 22 to 42 d of age (3200 kcal ME/kg, 21.5% crude protein). A 2 X 2 factorial design was used with two levels of photoperiod length and light intensity treatment groups for which have four photoperiod and light intensity subgroups. Photoperiod lengths were either near-continuous (CPL) (23L:1D from 1 to 42 d) or increasing photoperiod (IPL) (23L:1D from 1 to 8 d, 14L:10D from 9 to 15 d, 16L:8D from 16 to 22 d, 18L:6D from 23 to 29 d, 20L:4D from 30 to 36 d, followed by 23L:1D from 37 to 42 d). Light intensities were either bright (BLI) or dim, reducing (DRLI). Broilers in the BLI group were exposed to 20 lux from d 1 to 42 d while those in dim, reducing DRLI group were exposed to 5 lux from d 1 to 8, 2.5 lux from d 9 to 15 and 1.25 lux from d 16 to 42. Individual BW and FC were recorded on d 8, 15, 22, 29, 36 and 42. According to collected data, FCR was also calculated. Mortality from which cumulative mortality ratio was calculated (0-42 d) recorded at daily basis. At 42 d of age, eight broilers from each pen, a total of 128 broilers were randomly selected for processing. In statistical analyses (SPSS), GLM procedure was designed to reveal the effects of photoperiod length and light intensity on performance and carcass characteristics. Chi-square test was performed for mortality.

### **Results and Discussion**

On d 15, average BW was 24.68 g (4.50%) less in IPL group than CPL ones (Table 1). This difference at BW's can be explained by the suppression of FC's for birds subjected to increasing light IPL group. It was determined that

Table 1. Influences of photoperiod length and light intensity on body weights of broilers<sup>1</sup>

Treatment main effects	n	Body weight (g)										
		d 8	n	d 15	n	d 22	n	d 29	n	d 36	n	d 42
Expected mean ( $\mu$ )	272	195.72	271	536.64	271	1009.38	271	1683.61	271	2322.17	271	2932.04
Photoperiod length												
Near Continuous (CPL)	136	194.57	135	548.98 <sup>a</sup>	135	1020.22	135	1685.79	135	2315.23	135	2916.72
Increasing (IPL)	136	196.87	136	524.30 <sup>b</sup>	136	998.55	136	1681.42	136	2329.11	136	2947.36
Light intensity												
Bright (BLI)	136	198.70 <sup>a</sup>	136	543.45 <sup>a</sup>	136	1004.71 <sup>b</sup>	136	1688.43	136	2318.32	136	2944.70
Dim, reducing (DRLI)	136	192.74 <sup>b</sup>	135	529.83 <sup>b</sup>	135	1014.05 <sup>a</sup>	135	1678.78	135	2326.03	135	2919.38
SEM <sup>2</sup>		0.91		2.47		4.62		8.78		13.75		17.24
Significance												
						P value						
Photoperiod length		0.209		0.006		0.314		0.583		0.779		0.463
Light intensity		0.001		0.001		0.020		0.803		0.614		0.375

<sup>1</sup> Data presented as the least square means, <sup>a,b</sup> Means with different superscript letters in the same row differ (P<0.05). <sup>2</sup> Standart Error Mean.

Table 2. The least square means for cumulative feed consumption and feed conversion between days 8 and 42

Treatment main effects	n	Cumulative feed consumption (g/bird)						Cumulative feed conversion (g of feed/g of gain)					
		d 0-8	d 0-15	d 0-22	d 0-29	d 0-36	d 0-42	d 0-8	d 0-15	d 0-22	d 0-29	d 0-36	d 0-42
Expected mean ( $\mu$ )	16	164.68	691.22	1356.78	2376.64	3563.73	4771.23	1.09	1.41	1.41	1.45	1.56	1.65
Photoperiod length													
Near- Continuous (CPL)	8	163.55	699.19 <sup>a</sup>	1363.47	2374.00	3544.81	4732.49	1.09	1.39 <sup>b</sup>	1.40	1.45	1.56	1.65
Increasing (IPL)	8	165.81	683.26 <sup>b</sup>	1350.10	2379.28	3582.66	4809.98	1.09	1.43 <sup>a</sup>	1.42	1.44	1.56	1.64
Light intensity													
Bright (BLI)	8	169.14 <sup>a</sup>	688.01	1356.83	2398.85	3583.19	4797.75	1.09	1.38 <sup>b</sup>	1.41	1.46	1.58	1.65
Dim, reducing (DRLI)	8	160.22 <sup>b</sup>	694.43	1356.74	2354.44	3544.27	4744.71	1.08	1.44 <sup>a</sup>	1.40	1.43	1.54	1.64
SEM <sup>1</sup>		1.40	3.32	5.88	13.72	23.85	33.97	0.01	0.01	0.00	0.01	0.01	0.01
Significance		P value						P value					
Photoperiod length		0.434	0.033	0.278	0.851	0.443	0.276	0.854	0.011	0.055	0.722	0.837	0.809
Light intensity		0.008	0.352	0.995	0.132	0.430	0.450	0.582	0.001	0.155	0.068	0.082	0.472

<sup>a,b</sup> Means with different superscript letters in the same row differ (P<0.05), <sup>1</sup> Standart Error Mean.

the increasing photoperiod treatment had caused a decrease in FC, which resulted in reduced BW at d 0-15. On d 42, average BW was 30.64 g less in CPL group than IPL ones. There was no significant difference between photoperiod groups in terms of final BW, FC and FCR. This finding was found to be consistent with other studies (Renden et al., 1993; Lott et al., 1996; Lien et al., 2009). It was determined that the increasing photoperiod length had led to an increase in hot and cold carcass weight, whole leg and abdominal fat pad weights and a decrease in whole breast weights, but this has not reached statistically significance. These findings were in consistent with other studies reporting that decreases in breast meat and increases in wing and leg weights were caused from increasing photoperiod programs (Downs et al., 2006; Renden et al., 1993). Similarly, as reported in a study that the extension of the light period from 18 h to 23 h resulted in heavier whole breast (Lien et al., 2007). At d 42, light intensity was not determined to have significant effect on BW. Similarly, Kristensen et al.(2006), Blatchford et al.(2009), Deep et al.(2010), Ahmad et al.(2011) reported that light intensity has no significant effects on BW at market age. BW differences can be attributed to increased activity of broilers exposed to high bright light. The cold carcass weight of broilers reared at BLI group was higher (2258.66 g) than DRLI group (2231.83 g). Similarly, Lien et al.(2007) reported that higher cold carcass weight has been reported in broilers reared under 10.76 lux compared to 1.08 lux. Parallel to this result, several authors reported that there were no significant differences in abdominal fat pad weight among light intensity groups (Deep et al., 2010; Downs et al., 2006; Lien et al., 2009).

### **Conclusion**

Increasing photoperiod and 20 lux light intensity would appear to produce the best BW benefits for the commercial broiler producers, as well as the 20 lux light intensity did promote heavier whole breast meat and wing weights. In conclusion, it can be said that body weight, feed consumption, feed conversion ratio, whole breast meat and wing weights were increased by providing the increasing photoperiod used with a 20 lux light intensity in broiler breeding.

### **References**

- AHMAD, F., HAQ, A.U., ASHRAF, M., ABBAS, G. and SIDDIQUI, M.Z. (2011) Effect of different light intensities on the production performance of broiler chickens. *Pakistan Veterinary Journal* 31 (3): 203-206.
- BLATCHFORD, R.A., KLASING, K.C., SHIVAPRASAD, H.L., WAKENELL, P.S., ARCHERAND, G.S. and MENCH, J.A. (2009) The effect of light intensity on the behavior, eye and leg health and immune function of broiler chickens. *Poultry Science* 88: 20-28.

- CAMPO, J.L. and DAVILA, S.G. (2002) Effect of photoperiod on heterophil to lymphocyte ratio and tonic immobility duration of chickens. *Poultry Science* 81: 1637-1639.
- DEEP, A., SCHWEAN-LARDNER, K., CROWE, T.G., FANCHER, B.I. and CLASSEN, H.L. (2010) Effect of light intensity on broiler production, processing characteristics and welfare. *Poultry Science* 89: 2326-2333.
- DOWNS, K.M., LIEN, R.J., HESS, J.B., BILGILI, S.F. and DOZIER, W.A. (2006) The effects of photoperiod length, light intensity and feed energy on growth responses and meat yield of broilers. *Journal of Applied Poultry Research* 15: 406-416.
- KLIGER, C.A., GEHAD, A.E., HULET, R.M., ROUSH, W.B., LILLEHOJ, H.S. and MASHALY, M.M. Effect of photoperiod and melatonin on lymphocyte activities in male broiler chickens. *Poultry Science* 79: 18-25.
- KRISTENSEN, H.H., PERRY, G.C., PRESCOTT, N.B., LADEWIG, J., ERSBOLL, A.K. and WATHES, C.W. (2006) Leg health and performance of broiler chickens reared in different light environments. *British Poultry Science* 47: 257-263.
- LIEN, R.J., HESS, J.B., MCKEE, S.R., BILGILI, S.F. and TOWNSEND, J.C. (2007) Impact of light intensity and photoperiod on live performance, heterophil to lymphocyte ratio and processing yields of broilers. *Poultry Science* 86: 1287-1293.
- LOTT, B.D., BRANTON, S.L. and MAY, J.D. (1996) The effect of photoperiod and nutrition on ascites incidence in broilers. *Avian Disease* 40: 788-791.
- LIEN, R.J., HOOIE, L.B. and HESS, J.B. (2009) Influence of long- bright and increasing-dim photoperiods on live and processing performance of two broiler strains. *Poultry Science* 88: 896-903.
- OLANREWAJU, H.A., MILLER, W.W., MASLIN, W.R., COLLIER, S.D., PURSWELL, J.L. and BRANTON, S.L. (2015) Influence of photoperiod, light intensity and their interaction on health indices of modern broilers grown to heavy weights. *International Journal of Poultry Science* 14 (4): 183-190.
- RENDEN, J.A., BILGILI, S.F. and KINCAID, S.A. (1993) Research Note: Comparison of restricted and increasing light programs for male broiler performance and carcass yield. *Poultry Science* 72: 378-382.
- SCHWEAN-LARDNER, K., FANCHER, B.I. and CLASSEN, H.L. (2012) Impact of day length on the productivity of two commercial broiler strains. *British Poultry Science* 53: 7-18.

## Effect of Dietary Supplementation of Kefir on Body Measurements, Gibleet Weight and Gut Morphology in Geese

Abdur Rahman<sup>\*a</sup>, Ibrahim Sadi Cetingul<sup>b</sup>, Cangir Uyarlar<sup>b</sup>,  
Abdul Burhanettin Akkaya<sup>b</sup>, Eyup Eren Gultepe<sup>b</sup>,  
Aykut Ulucan<sup>c</sup>, Ismail Bayram<sup>b</sup>

<sup>a</sup>Department of Animal Nutrition, University of Veterinary and Animal Sciences, (Jhang Campus) Pakistan.

<sup>b</sup>Department of Animal Nutrition, Afyon Kocatepe University, Afyonkarahisar, 03200, Turkey.

<sup>c</sup>Department of Medical Services and Techniques, BingolUniversity, 12000, Bingol, Turkey

### Abstract

A total of 54 birds were divided into 3 groups having 18 birds in each and each group was divided into 3 subgroups containing 6 birds in each. Group A served as control while B and C were offered kefir treated drinking water @ 2.5% and 7.5% respectively. Results revealed non-significant effect of kefir supplementation on body measurements, spleen weight, bursa weight and gut morphology at both levels of supplementation as compared to control group. It can be concluded that Kefir can be used in poultry feed with an inclusion rate of 7.5% for its various other known beneficial effects without imposing any adverse effect on the performance parameters, body structures and gut morphology.

**Key words:** *Geese, Gut Morphology, Kefir, Probiotic*

### Introduction

Provision of safe food is always a primary concern for biological researchers. Alongwith many other feed additives, the antibiotics retained their complementary position as growth promoters in livestock feeding for decades. Besides the many beneficial effects associated with antibiotic inclusion in poultry feed, the drug resistance has become a challenging issue for humans because of significant drug residues in food. Probiotics are considered to be the possible solution in order to substitute the antibiotics safely from poultry feed without hampering their growth. Probiotics are not only destined to replace antibiotics but also have a benifical effect to enhance organism's gut health and its immunity. Kefir refers to the product produced after fermentation of milk alongwith Kefir grains, which is thought to have potential effect on the growth and other parameters in poultry feed. Regarding its potentials, the present study was designed to evaluate the effect of kefir administration in geese through drinking water on its body measurements, gibleet weight and gut morphological patterns. Kefir is one of

products of probiotics being used in the poultry industry. It contains lactic acid bacteria and yeast (Marshall and Cole 1985). Kefir is made from the fermentation of milk or from kefir grains fermentation by using a starter culture (Liu et al., 1983). It contains alcohol and pH is slightly acidic and milky in appearance. It well known that probiotics have potential effect on growth performance of poultry including body weight gain, FCR (Huang et al., 2004) and improved some other parameters like meat and carcass quality (Pelicano et al., 2003; Kalavathy et al., 2006). While in some other studies, it was observed that probiotics were not effective in enhancing growth performance or meat production (Molnar et al., 2005). Kefir has been studied in many other poultry species extensively but still there is lack of literature to explore the effect of kefir as probiotic in ducks. Keeping in view the above mentioned facts, the present study was designed to investigate the effects of supplementation of kefir in geese on body measurements, gible weight and intestinal morphology.

### **Materials and Methods**

This study was conducted at the commercial farm in the Afyonkarahisar Turkey. A total of 54 goslings 21 days old were procured from the known hatchery and placed on floor pens containing wood dust as litter. Birds were divided into 3 groups having 18 birds in each and each group was further divided into 3 subgroups having 6 birds in each. Group A was offered normal drinking water without any supplementation as control group while group B and C received 2.5% and 7.5% kefir in drinking water respectively. During 3-6 weeks of age goslings were fed with a starter diet containing 22% CP, 2900 MJ/kg ME and then grower diet was offered during 7-12 weeks of age having CP 15% and 2900MJ/kg ME. Experiment duration was 63 days. Following parameters were measured: Body length, neck length, wing length, and chest circumference, weight of spleen and bursa, and tissue samples from intestine were taken to check gut morphology as described by Awad *et al.*, (2011).

### **Results and Discussion**

In the current study, it was found that supplementation of kefir at 2.5% and 7.5% did not show any significance effect on different organs like body length, neck length, wing length and chest circumference as compared to non-supplemented group. Likewise, Kandir and Yardimci (2015) observed no effect of kefir supplementation with respect to head and foot size at the same dose level in ducks. The weight of spleen and bursa was also not affected by kefir supplementation at any level. Some other researchers also claimed no increase in gible weight in geese fed kefir supplemented diet (Sahin and Yardimci 2009). Likewise Karademir and Unal (2008) observed no difference in gible organ weight in broiler offered diet having kefir.

**Table 1 Body Measurements of Geese from 3-12 weeks (63 days) of age offered different Kefir treatment**

Body measurements	A		B		C		P-value
	Mean	SEM	Mean	SEM	Mean	SEM	
Body Length (cm)	33.00	0.37	32.20	1.20	33.00	0.68	0.69
Neck Length (cm)	20.50	0.50	20.20	1.11	22.17	0.31	0.13
Wing Length (cm)	45.67	0.95	45.20	1.46	46.00	1.06	0.88
CC	36.00	0.68	36.40	0.81	35.83	0.79	0.87

CC: Chest Circumference (cm)

**Table 2 Visceral organs Weight of Geese from 3-12 weeks (63 days) of age offered different Kefir treatment**

Visceral measurements (g)	A		B		C		P-value
	Mean	SEM	Mean	SEM	Mean	SEM	
Spleen	1.83	0.07	1.98	0.14	1.92	0.29	0.86
Bursa	1.93	0.20	1.93	0.13	2.45	0.34	0.31

**Table 3 Villus Height, Crypt Depth and Tunica Muscularis Thickness of Geese Intestine from 3-12 weeks (63 days) of age offered different Kefir treatment**

	A		B		C		P-value
	Mean	SEM	Mean	SEM	Mean	SEM	
<b>Muscular Layer Thickness</b>							
Duodenum	184.13	8.95	172.80	20.75	187.57	11.60	0.63
Ileum	187.77	29.85	204.39	8.37	212.09	20.21	0.52
Cecum	181.68	8.33	198.43	6.40	198.98	10.05	0.29
Colon	373.11	28.45	388.83	28.84	310.21	26.87	0.15
<b>Crypt Depth</b>							
Duodenum	86.88	3.75	98.93	10.49	93.89	2.85	0.43
Ileum	81.56	2.39	89.96	5.85	81.24	4.24	0.37
Cecum	66.79	6.11	63.69	7.16	59.17	4.10	0.65
Colon	75.26	4.33	80.96	1.93	80.50	2.59	0.34
<b>Villus Length</b>							
Duodenum	394.83	46.11	491.00	18.28	420.64	6.71	0.16
Ileum	460.35	39.32	434.42	10.10	364.65	40.17	0.16
Cecum	263.49	47.39	192.71	14.37	186.36	9.06	0.19
Colon	417.91	34.91	424.02	16.02	416.69	16.38	0.94

Similarly Yenice et al., (2014) reported no increase in heart weight but contrary to our results they declared increase in live and gizzard weight in kefir supplemented groups. In our study, as there was no increase or decrease in weight of spleen and bursa which might be related with feed consumption as feed intake was also remained unchanged in kefir treated groups. Based on the discussion and findings it could be stated that kefir have neither beneficial nor adverse effects if supplemented in geese via

drinking water. As some studies indicated that use of kefir is beneficial to enhance immunity, improved gut microbiota or blood parameters (Thoreux and Schmucker 2001; Marquina et al., 2002; Vinderola 2006; Urdaneta et al., 2007). Therefore it is advisable to use kefir for desired purposes without imposing negative effects on growth performance and other body measurements or intestinal morphology remained unaffected.

### Conclusion

The use of kefir in drinking water at 2.5% and 7.5% has shown no effect on growth parameters, body measurements and gut morphology. It can be recommended to use kefir in geese for other described beneficial purposes upto 7.5% without causing adverse effects on geese body structure or performance.

### References

- AWAD WA, GHAREEB K, BÖHM J. (2011). Evaluation of the chicory inulin efficacy on ameliorating the intestinal morphology and modulating the intestinal electrophysiological properties in broiler chickens. *J Anim Physiol Anim Nutr (Berl)*. 95(1):65-72.
- HUANG M.K., CHOI, Y.J., HOUDE R., LEE, J.W., LEE, B. AND ZHAO, X. (2004). Effects of Lactobacilli and an Acidophilic Fungus on the production performance and immune responses in Broiler chickens. *Poult. Sci.*, 83:788-795.
- KALAVATHY R., ABDULLAH N., JALALUDIN S., WONG M.C.V.L. AND HO Y.W. (2006). Effects of Lactobasillus feed supplementation on cholesterol, fat content and fatty acid composition of liver, muscle and carcass of broiler chickens. *Anim. Res.*, 55:77-82, INRA, EDP Sciences.
- KANDIR EH AND M YARDIMICI (2015). Effects of Kefir on Growth Performance and Carcass Characteristics in Pekin Ducks (*Anas platyrhynchos domestica*). *Journal of Animal Research*; 5: 2, 207-2012.
- KARADEMIR G. AND UNAL Y. (2008). The Use of Kefir as Probiotic in Broiler, *Journal of Lalahan Livestock Res. Ins.*, 49 (1): 47-54.
- LIU J. A. P., MOON N. J.: KEFIR . A .NEW. FERMENTED MILK PRODUCT. CULTURED DAIRY PRODUCTS J. (1983), 18, 11-12.
- MARSHALL V.M. AND COLE W.M. (1985). Methods for making kefir and fermented milks based on kefir. *J. Dairy Res.*, 52: 451-456.
- MOLNAR A., KÖRÖSI PODMANICZKY B., KURTI P., JUHÁSZ Z., MØERK JENSEN M., GERENDAI D. AND SZABÓ Z. (2005). Influence of *Bacillus subtilis* on broiler performance. WPSA, 15th European Symposium on Poultry Nutrition, Balatonfüred, Hungary, 25-29 September.

- MARQUINA D, A. SANTOS, I. CORPAS, J. MUNˆOZ, J. ZAZO AND J.M. PEINADO (2002). Dietary influence of kefir on microbial activities in the mouse bowel. *Etters in Applied Microbiology* 35, 136–140.
- PELICANO E.R.L., SOUZA P.A., SOUZA H.B.A., OBA A., BOIAGO M.M., ZEOLA N.M.B.L., SCATOLINI A.M., BERTANHA V.A. AND LIMA T.M.A. (2003). Carcass and cut yields and meat qualitative traits of broilers fed diets containing probiotics and prebiotics. *Braz. J. Poult. Sci.*, 7 (3):169-175.
- SAHIN E.H. AND YARDIMCI M. (2009). Effect of Kefir as a Probiotic on Growht Performance and Carcass Characteristics in Geese (*Anser anser*). *J. Anim Vet. Adv.*, 8 (3): 562-567.
- THOREUX K and DL SCHMUCKER. (2001) Kefir Milk Enhances Intestinal Immunity in Young but Not Old Rats. *J. Nutr.* vol. 131 no. 3 807-812.
- URDANETA E, JAIONE BARRENETXE, PATRICIA ARANGUREN, AURORA IRIGOYEN, FLORENCIO MARZO, FRANCISCO C. IBÁÑEZ. (2007) Intestinal beneficial effects of kefir-supplemented diet in rats. *Nutrition Research* 27 653–658.
- VINDEROLA G, GABRIELA PERDIGON, JAIRO DUARTEA, DEEPA THANGAVEL, EDWARD FARNWORTH, CHANTAL MATAR. (2006). Effects of kefir fractions on innate immunity. *Immunobiology* 211,149–156.
- YENICE G., CELEBI D., YORUK, M.A., UCAR O, SAGLAM Y.S., TUNC M.A. and ALTUN S. (2014). Effect of Kefir upon the Performance, Intestinal Microflora and Histopathology of Certain Organs in Laying Hens. *Journal of the Faculty of Veterinary Medicine, Kafkas Univ.*, 20 (3):363-370.

## The Effects of Melatonin on Poultry

Süleyman Çalışlar<sup>a</sup>, Beyhan Yeter<sup>a</sup>, Mustafa Duman<sup>b</sup>, Ahmet Şekeroğlu<sup>c</sup>

<sup>a</sup>Kahramanmaraş Sutcu Imam University, Department of Animal Science, Kahramanmaraş / Turkey

<sup>b</sup>University of Niğde Ömer Halisdemir, Bor Vocational School, Department of Laboratory and Veterinary Health, Bor, Niğde/Turkey

<sup>c</sup>University of Niğde Ömer Halisdemir, Ayhan Şahenk Faculty of Agricultural Sciences and Technologies, Department of Animal Production and Technologies, Niğde/Turkey

### Abstract

Melatonin is one of the important hormones that prevent metabolic and physiological disorders in poultry, but does not attract attention. ML regulates the brain's biological clock, acts on respiration, circulation, excretion, reproduction and immunity system. ML helps feed consumption and energy metabolism, regulates body temperature, and eliminates free radicals from the body. ML allows growth by stimulating the secretion of growth hormones, and thus positively affects the general performance of poultry. It is considered necessary to focus more effectively on the melatonin hormone, which positively contributes to the animal welfare by correcting metabolic-physiological disorders in poultry. In this review, the definition and production of melatonin, its interaction with other hormones, its effects on the physiological and metabolic functions of poultry have been examined.

**Key words:** *Melatonin, Poultry, Animal Welfare*

### Kanatlılarda Melatoninin Etkileri

#### Özet

Kanatlı hayvanlarda metabolik ve fizyolojik düzensizlikleri önleyen ancak dikkat çekmeyen önemli hormonlardan birisi de melatonin'dir. Melatonin (ML), beynin biyolojik saatini ayarlar, solunum, dolaşım, boşaltım, üreme ve bağışıklık sistemi üzerinde etkili olur. Yem tüketimini, enerji metabolizmasını, vücut ısısını düzenler ve serbest radikallerin vücuttan atılmasına yardım eder. Büyüme hormonunun salgılanımını uyararak büyümeyi teşvik eder, üreme kalitesini yükseltir ve kanatlı hayvanların genel performansına olumlu etkide bulunur.

Kanatlı hayvanlarda metabolik ve fizyolojik bozuklukların düzeltilmesi yoluyla hayvan refahına olumlu katkıda bulunan ML hormonu üzerinde daha etkili odaklanmanın gerekli olduğu düşünülmektedir.

Bu derlemede, melatonin'in tanıtımı, diğer hormonlarla interaktif ilişkileri, kanatlı hayvanlarının fizyolojik ve metabolik fonksiyonlarına etkisi incelenmiştir.

**Anahtar Kelimeler:** *Melatonin, Kanatlı, Hayvan Refahı*

### **Introduction**

Poultry have a pineal gland that varies greatly in size, shape and localization (Prusik et al., 2015). The chemical events, hormone production and 24-hour cycle of metabolism in the organism is regulated by the circadian oscillator (rhythm generator) in the epiphysis (Csernus, 2006). In the body, secretions are produced that can be modulated by light, darkness and temperature changes. One of these secretions is melatonin (ML). ML is a neurogenic hormone synthesized in the dark in the epiphysis and in the light in retina (Ambriz-Tututi et al., 2009). In addition, the skin, testes, bone marrow, thrombocytes, lymphocytes and gastrointestinal tract also secrete ML. Due to its lipophilic nature, ML (Bubenik, 2002), which easily passes through biological membranes and is rapidly transported to organs, participates in various physiological processes in the organism (Lamosova et al., 1997). ML plays a crucial role in the regulation of neural and endocrine processes synchronized with the daily changes of the illumination period (Lazar et al., 2015).

### **Production of Melatonin and Amount in Poultry**

There is a need for tryptophan to synthesize ML (N-acetyl 5-methoxytryptamine) and serotonin (SR) (El-Slamoney et al., 2010). The tryptophan passing from the plasma to the pineal gland is converted to 5-hydroxytryptophan (5-HTP) by the action of the hydroxylase enzyme (Natesan et al., 2002). 5-HTP is converted to SR by decarboxylation and N-acetyl serotonin by N-acetyl transferase enzyme. ML is produced from N-acetyl serotonin as a result of a reaction that catalyzed by the enzyme hydroxindole-o-methyltransferase (Jackson and Lovenberg, 1971). Approximately 80% of the amount of ML in blood circulation is produced by the epiphyseal gland (Şener, 2010).

Tryptophan is required for the production of ML. Grains such as corn, wheat and barley usually contain tryptophan at low levels (Takada and Otsuka, 2007). There is ML in different parts of various plants (leaf, stem, root, flower, fruit, seed etc.). *Spergula diandra*, oat, sweet corn, rice and barley contain 5288.1 pg / g, 1796.1 pg / g, 1336.1 pg / g, 1006 ng / g and 378.1 ng / g ML, respectively (Hattori et al., 1995).

After 4.5 hours in a 10-hour dark period in poultry, blood serum reaches its highest ML level (Pablos et al., 1998). The serum ML level of pigeons exposed to light for 80 minutes was decreased by 85% (Vakkuri et al.,

1985). 16 hours light: 8 hours dark or 20 hours light: 4 hours dark; serum concentrations of ML in egg-laying hens were 40-100 pg / mL in the light, and 150-390 pg / mL in the dark (Liou et al., 1987).

### **Metabolic and Physiological Functions of Melatonin in Poultry**

The morphological organization of ML differs between reptiles and birds. ML provides adaptation to changing environmental conditions by taking part in the control of many physiological processes, behavioral activities, daily and seasonal rhythms (Lewczuk and Przybylska-Gornowicz 2013). Serum ML levels reflect environmental lighting conditions and allow information to be transmitted to the entire organism (Zeman et al., 2001). The light-sensitive ML has an important role in controlling the circadian rhythm associated with the light period (Underwood et al., 2001). ML provides the regulation and management of the internal biological clock of the brain in poultry. Daily and seasonal rhythms, reproduction, urinary, blood pressure, immunity, thermoregulation, neuroendocrine and physiological systems, sleeping regime, heart and lungs are regulated by ML (Apeldoorn et al., 1999, Ambriz-Tututi et al., 2009; Schwean-Lardner et al., 2013).

ML affects immune parameters by stimulating the proliferation of lymphocytes (Kliger et al., 2000) and by increasing (Zheng et al., 2013) antibody formation (Da Rosa et al., 2015). ML improves the yield performance of poultry by stimulating tissue uptake of lipids, proteins and carbohydrates (Ahmed et al., 2005). ML which has a higher antioxidant effect (Çağlıkülekcı et al., 2006) than vitamin E and glutathione, prevents inflammation (Cuesta et al., 2010). ML helps free radicals to be removed from the body (Zheng et al., 2013). ML, which provides epithelial regeneration, protects the gastrointestinal mucosa from ulceration (Bubenik, 2002) and reduces the formation of gastric ulcers (Khan et al., 1990). ML improves nutrient utilization efficiency and feed conversion ratio (Osei et al., 1989) by stimulating growth hormone (GH) in poultry (Zeman et al., 1999). ML affects the energy metabolism (Apeldoorn et al., 1999) and thermoregulation mechanisms (Sahin et al., 2004). Feeding rations containing ML reduced mortality in fast-growing and acutely heat stressed broilers (Hassanzadeh et al., 2016). ML affected the calcium absorption in the duodenum of poultry (Sjöblom et al., 2003). ML application reduced the incidence of bone diseases, and ML deficiency was partially responsible for malformations in the bones (Machida et al., 1995).

### **Results and Recommendations**

Poultry farm animals are sometimes exposed to stress conditions at various stages of their lives. Stress conditions cause a number of irregularities in the hormone and enzyme systems. These irregularities lead to significant metabolic and physiological dysfunctions in poultry. The methods applied

for correction of metabolic and physiological dysfunction sometimes be quite expensive and sometimes do not provide the desired result. In cases where drug therapy is necessary that both animal and human health can be adversely affected. For this reason, it is important for health to use methods which have no side effects in eliminating possible metabolic and physiological disorders in poultry. It is considered necessary to focus a little more on ML in eliminating metabolic and physiological abnormalities in the 21<sup>st</sup> century, where the use of drugs (antibiotics, etc.) is limited day by day, natural and organic animal production and animal welfare priority increases.

## References

- AHMED, H.H., ESSAWY, G.S., SALEM, H.A. AND ABDEL DAIM, M.A. (2005) Melatonin has a strong antioxidant activity and improves liver and kidney functions in broiler chicks. *Egypt. J. Basic and Appl. Physiol.* 4(1): 77-92.
- AHMED, H.H., ESSAWY, G.S., SALEM, H.A. AND ABDEL DAIM, M.A. (2006) Effect of melatonin on productive performance and some biochemical parameters in broiler chicks. *Egypt. J. Basic and Appl. Physiol.*, 5(2): 365-380.
- AMBRIZ-TUTUTI, M., ROCHA-GONZALEZ, H.I., CRUZ, S.L., GRANADOS-SOTO, V. (2009) Melatonin: a hormone that modulates pain. *Life Sci.* 84(15-16): 489-498.
- APELDOORN, E.J., SCHRAMA, J.W., MASHALY, M.M. AND PARMENTIER, H.K. (1999) Effect of melatonin and lighting schedule on energy metabolism in broiler chickens. *Poultry Sci.* 78(2):223-229.
- BARRENETXE, J., DELAGRANGE, P. AND MARTINEZ, J.A. (2004) Physiological and metabolic functions of melatonin. *J. Physiologic. Biochem.* 60(1):61-72.
- BUBENIK, G.A. (2002) Gastrointestinal melatonin: localization, function, and clinical relevance. *Dig. Dis. Sci.* 47(10): 2336-2348.
- CASSONE, V.M., BROOKS, D.S., KELM, T.A. (1995) Comparative distribution of 2[125] iodomelatonin binding in the brains of diurnal birds: outgroup analysis with turtles. *Brain Behav. Evol.* 45(5):241-256.
- CSERNUS, V. (2006) The avian pineal gland. *Chronobiol Int.* 23(1-2):329-339.
- CUESTA, S., KIREEV, R., FORMAN, K., GARCÍA, C., ESCAMES, G., ARIZNAVARETA, C. (2010) Experimental Gerontology Melatonin improves inflammation processes in liver of senescence-accelerated prone male mice (SAMP8) *Exp Gerontol.*, 45(12):950-956.
- ÇAĞLIKÜLEKÇİ, M., BILGIN, Ö., CANBAZ, H., DIRLIK, M., BAĞDATOĞLU, Ö., ÜSTÜNŞOY, B. (2006) Deneysel hepatik iskemi reperfüzyon modelinde melatonin uygulamasının kan ve karaciğer doku lipid peroksidasyonuna etkisi. *Ulusal Cerrahi Derg.* 22(3): 93-98.

- DA ROSA, D.P., FORGIARINI, L.F., E SILVA, M.B., FIORI, C.Z., ANDRADE, C.F., MARTINEZ, D. (2015) Antioxidants inhibit the inflammatory and apoptotic processes in an intermittent hypoxia model of sleep apnea. *Inflamm. Res.* 64(1): 21-29.
- EL-SLAMONEY, A.E., BATTAA, A.M.E.N., HASSAAN, S.F., RAGA E.A.E.K AND ABDULLA, E.H. (2010) Effect of photoperiod and tryptophan amino acid supplementation on pineal gland hormone (melatonin) and its relation to performance in local strain. 1- Effect on laying hen performance. *Egypt. Poult. Sci.* Vol (30) (IV): (927-960).
- HASSANZADEH, M., MOGHIMI NIAKI, A.A., BABAPOUR, V., MOHIT, A., MIRZAIIE, S. (2016) A study of the employment of melatonin supplementation and darkness regime on reducing the negative effects of acute heat stress and mortality in broiler chickens. *Iranian Journal of Veterinary Medicine.* 10(1):7-17.
- HATTORI, A., MIGITAKA, H., IIGO, M., ITOH, M., YAMAMOTO, K., OHTANI KANEKO, R., HARA, M., SUZUKI, T., REITER, R.J. (1995) Identification of melatonin in plants and its effects on plasma melatonin levels and binding to melatonin receptors in vertebrates. *Biochem. Mol. Biol. Int.* 35(3): 627-634.
- JACKSON, R.L., LOVENBERG, W. (1971) Isolation and characterization of multiple forms of hydroxyindole-o-methyltransferase. *J. Biol. Chem.* 246(13):4280-4285.
- KHAN, R., DAYA AND POTGIETER, B. (1990) Evidence for a modulation of the stress response by the pineal gland. *Experientia.* 46(8): 860-862.
- KLIGER, C.A., GEHAD, A.E., HULET, R.M., ROUSH, W.B., LILLEHOJ, H.S. AND MASHALY, M.M. (2000) Effects of photoperiod and melatonin on lymphocyte activities in male broiler chickens. *Poultry Sci.* 79(1):18-25.
- LAMOSOVA, D., ZEMAN, M. AND JURANI, M. (1997) Influence of melatonin on chick skeletal muscle cell growth. *Comp. Biochem. Physiol.* 118(3): 375-379.
- LAZAR, R., SOLCAN, C., Creta, C., LASER, M., MUNTEAN, C., BOISTEANU, P.C. (2015) Characterization of the relations between morphology and physiological status of the pineal gland in connection with the somatic development level in turkeys reared in Romania. *Brazilian Journal of Veterinary and Animal Science,* 67(3):763-770.
- LEE, P.P., PANG, S.F. (1992) Identification and characterization of melatonin binding sites in the gastrointestinal tract of ducks. *Life Sci.* 50(2):117-125.
- LEWCZUK, B., PRZYBYLSKA-GORNOWICZ, B. (2013) Gross anatomy of the pineal complex in animals. In: Turgut M (ed) Step by step

- experimental pinealectomy techniques in animals for researchers. Nova Sciences Publishers, Inc, New York, pp 1-32.
- LIU, S.S., COGBURN, L.A., BIELLIER, H.V. (1987) Photoperiodic regulation of plasma melatonin levels in the laying chicken (*Gallus domesticus*). *Gen. Comp. Endocrinol.* 67(2):221-226.
- MACHIDA, M., DUBOUSSET, J., IMAMURA, Y., IWAYA, T., YAMADA, T. (1995) Role of melatonin deficiency in the development of scoliosis in pinealectomised chickens. *J. Bone Joint Surg. Br.* 77(1):134-138.
- NATESAN, A., GEETHA, L., ZATZ, M. (2002) Rhythm and soul in the avian pineal. *Cell Tissue Res.* 309 (1):35-45.
- OSEI, P., ROBBINS, K.R., SHIRLEY, H.V. (1989) Effects of exogenous melatonin on growth and energy metabolism in chickens. *Nutr. Res.* 9(1):69-81.
- PABLOS, M.I., REITER, R.J., ORTIZ, G.G., GUERRERO, J.M., AGAPITO, M.T., CHUANG, J.I. AND SEWEYNEK, E. (1998) Rhythms of glutathione peroxidase and glutathione reductase in brain of chick and their inhibition by light. *Neurochemistry International.* 32(1): 69-75.
- PRUSIK, M., LEWCZUK, B., ZIÓŁKOWSKA, N., PRZYBYLSKA-GORNOWICZ, B. (2015) Regulation of melatonin secretion in the pineal organ of the domestic duck - an in vitro study. *Polish Journal of Veterinary Sciences.*18(3): 635-644.
- SAHIN, N., ODERCI, M., SAHIN, K., GURSU, M.F. AND SMITH, M.O. (2004) Ascorbic acid and melatonin reduce heat-induced performance inhibition and oxidative stress in Japanese Quails. *Br. Poult. Sci.* 45(1):116-122.
- SCHWEAN-LARDNER, K., FANCHER, B.I., GOMIS, S., VAN KESSEL, A., DALAL, S. AND CLASSEN, H.L. (2013). Effect of day length on cause of mortality, leg health, and ocular health in broilers. *Poult. Sci.* 92(1):1-11.
- SJÖBLOM, M., SÄFSTEN, B., FLEMSTRÖM, G. (2003) Melatonin-induced calcium signaling in clusters of human and rat duodenal enterocytes. *Am. J. Physiol. Gastrointest. Liver Physiol.* 284(6):G1034-1044.
- ŞENER, G. (2010) Karanlığın hormonu: melatonin. *Marmara Eczacılık Dergisi.*14(1):112-120.
- TAKADA, R., OTSUKA, M. (2007) Effects of feeding high tryptophan GM-rice on growth performance of chickens. *International Journal of Poultry Science.* 6(7):524-526.
- UNDERWOOD, H., STEELE, C.T. AND ZIVKOVIC, B. (2001) Circadian organization and the role of the pineal in birds. *Microscopy Research and Technique.* 53(1):48-62.

- VAKKURI, O., RINTAMÄKI, H., LEPPALUOTO, J. (1985) Plasma and tissue concentrations of melatonin after midnight light exposure and pinealectomy in the pigeon. *Journal of Endocrinology*. 105(2):263-268.
- YU, Z.H., LU, Y., PANG, S.F. (1991) [125] iodomelatonin binding sites in spleens of birds and mammals. *Neurosci Let.*125(2):175-178.
- ZEMAN, M., BUYSE, J., LAMOSOVÁ, D., HERICHOVÁ, I., DECUYPERE, E. (1999). Role of melatonin in the control of growth and growth hormone secretion in poultry. *Domestic Animal Endocrinology*. 17(2-3):199-207.
- ZEMAN, M., BUYSE, J., HERICHOVÁ, I., DECUYPERE, E. (2001) Melatonin decreases heat production in female broiler chickens. *Acta Vet. Brno*. 70(1):15-18.
- ZHENG, L., MA, Y.E., GU, L.Y., YUAN, D., SHI, M.L., GUO, X.Y., ZHAN, X.A. (2013) Growth performance, antioxidant status, and nonspecific immunity in broilers under different lighting regimens. *Journal of Applied Poultry Research*. 22(4):798-807.

## Growth Performance and Carcass Characteristics of Slow Growing Broilers Grazed on Pasture Covered with Chicory, White Clover or Purslane

Zekeriya Kiyma<sup>a</sup>, Ahmet Akdağ<sup>b</sup>, Yasin Altay<sup>a</sup>, Süleyman Avcı<sup>c</sup>

<sup>a</sup>Department of Animal Science, Faculty of Agriculture, Eskisehir Osmangazi University, Eskisehir, Turkey

<sup>b</sup>Department of Animal Science, Faculty of Agriculture, Ondokuz Mayıs University, Samsun, Turkey

<sup>c</sup>Department of Field Crops, Faculty of Agriculture, Eskisehir Osmangazi University, Eskisehir, Turkey

### Abstract

In this study, effects of different forage crops on growth performance and some carcass characteristics of slow growing broilers raised in free-range system were investigated. In total, 500 Hubbard-Red-JA mixed-sexed chicks were allocated to 4 groups (4 replicates/group) in randomized experimental design. Chicory, white clover or purslane did not have any effect on body weight ( $P>0.05$ ). Feed conversion ratio (FCR) was higher in control group at 0-42 and 0-63 d periods of the study ( $P<0.05$ ). The forage crops had almost the same effects on growth performance.

**Key Words:** *Free-Range, Forage Crops, Growth Performance, Slow Growing Broiler*

### Introduction

Increasing awareness of consumers to attain healthier products, welfare and pollution issues in intensive rearing systems induced alternative rearing systems in poultry production. One of these rearing systems is free-range. In the direction of changing consumer demands, sense of quality for broiler products has gained more importance. Therefore, rearing environment and nutritional factors effecting meat quality need to be critically clarified. Slaughter age, genotype, rearing system, physical activity, forage intake and nutritional factors have effects on meat quality (Castellini et al., 2008). Grashorn, (2006) has stated that rearing system has effects on meat quality but the main reason of the differences in meat quality is genotype. Slow growing broilers have lower performance than fast growing broilers but they can be used in organic and free-range rearing systems due to their adaptation ability to environmental conditions (Lewis et al., 1997; Castellini et al., 2002b). Besides behavioural advantages, free-range system facilitates sunlight, fresh air and low stocking density. Therefore, free-range system allows a healthier and less stressful production. Free-range broiler

production systems, consisting 15% of the total broiler production, has been preferred by consumers due to the perception of free-ranged broiler meats are more delicious in France (Quentin et al., 2003). Besides the vegetation of free-range area, worms, flatworms, larvae and insects can increase the benefit due to the nutritional content (Horsted, 2007)

In this study, plants covering the pasture were selected after evaluating their economical sustainability, yields and stamina. Aim of the current study is to investigate growth performance and carcass characteristics of slow growing broilers grazing on pasture covered chicory, white clover or purslane.

### **Material and Methods**

In total, 500 feather sexed slow growing broiler chicks (0 day-old, Hubbard-Red-JA) with similar weight were allocated randomly into four experimental groups (Chicory, white clover, purslane and control (without access to free range area)) according to randomized experimental design. Each group consisted of 4 replications of 35 chicks each (except the control group had replicates of 20 chicks due to restricted space reasons). Nutrient content of starter (0-28d), grower (28-63d) and finisher (63-72d) feeds were 19.5, 16.5 and 15 % crude protein and 3000 kcal kg<sup>-1</sup> metabolic energy, respectively. Corn-soybean based diets without a growth promoter, in mash form, and water were provided ad libitum. Access of birds to free-range area started at the first day grower period.

To determine weight gain, feed intake and feed efficiency, chicks and feed were weighed at placement and weekly throughout the study. At the end of the experiment, 16 birds representing the average body weight of the group (2 male and 2 female from each replicate) were weighted and slaughtered from each group. Growth performance, carcass yield, breast, thigh, wing and abdominal fat weights were determined. Mortalities were considered for FCR calculation. Data were analysed by ANOVA using the GLM procedure of SPSS 17. Significant differences among means of treatments were determined by Duncan's multiple range test with 5% probability.

### **Results**

Growth performance and carcass characteristics of slow growing broilers grazing on pasture covered chicory, white clover or purslane were presented in Table 1. There were no significant differences in body weight of slow growing broilers ( $P>0.05$ ).

However feed intake of control group was higher at day 42 of the experiment ( $P<0.05$ ). Moreover, feed conversion ratio was higher in control group at days 42 and 63 ( $P<0.05$ ). There were no differences in carcass yield, proportional weights of breast, thigh and wing ( $P>0.05$ ).

Table 1. Growth performance and carcass characteristics of slow growing broilers grazing on pasture covered chicory, white clover or purslane

	<i>Control</i>	<i>Chicory</i>	<i>White Clover</i>	<i>Purslane</i>	<i>SEM<sup>1</sup></i>	<i>P value</i>
<b>Body weight, g</b>						
0 d	39.27	39.42	39.72	39.35	0.20	0.710
28 d	761.25	752.85	760.35	754.40	5.84	0.955
42 d	1398.7	1411.7	1434.1	1426.8	7.35	0.723
63 d	2500.3	2415.1	2518.8	2493.7	25.41	0.529
72 d	2792.1	2784.9	2820.3	2789.0	23.34	0.960
<b>Feed intake, g</b>						
0-28 d	1336.6	1313.3	1334.4	1323.6	8.37	0.785
0-42 d	2936.2 <sup>a</sup>	2797.11 <sup>b</sup>	2846.3 <sup>b</sup>	2845.8 <sup>b</sup>	16.78	0.010
0-63 d	5901.7	5700.5	5828.9	5814.1	35.97	0.274
0-72 d	7481.9	7465.1	7558.2	7557.8	48.13	0.880
<b>Feed conversion ratio (g feed: g gain)</b>						
0-28 d	1.88	1.84	1.85	1.85	0.01	0.445
0-42 d	2.28 <sup>a</sup>	2.00 <sup>b</sup>	2.03 <sup>b</sup>	2.04 <sup>b</sup>	0.03	<0.000
0-63 d	2.53 <sup>a</sup>	2.41 <sup>b</sup>	2.38 <sup>b</sup>	2.40 <sup>b</sup>	0.02	0.048
0-72 d	2.70	2.66	2.66	2.72	0.02	0.683
<b>Carcass characteristics</b>						
CY	74.14	73.95	74.68	74.95	0.17	0.150
BC	29.86	28.83	29.71	29.76	0.23	0.395
TC	29.25	30.01	29.80	29.17	0.17	0.245
WC	11.53	11.61	11.36	11.42	0.07	0.671

CY: Carcass yield, %, BC: Breast, % of carcass, TC: Thigh, % of carcass, WC: Wing, % of carcass, <sup>a, b</sup> Values within a column that do not share the same superscript are different at P <0.05, SEM<sup>1</sup>: Standard error of the mean

## Conclusion

Based on the data, it can be concluded that chicory, white clover or purslane have almost the same effects on growth performance. Access to free-range area improved feed efficiency. It is worth to investigate more potentials of the plants for the free-range systems.

## Acknowledgments

This project was funded by ESOĞÜ BAP (Eskişehir Osmangazi University, Scientific Research Projects Commission)-2015900

## References

CASTELLINI C., MUGNAI C., DAL BOSCO A. (2002) Meat quality of three chicken genotypes reared according to the organic system. Italian Journal of Food Science 4: (14) 401-412.

- CASTELLINI C., BERRI C., LE BIHAN-DUVAL E., MARTINO G. (2008) Qualitative attributes and consumer perception of organic and free-range poultry meat, *World's Poultry Science Journal* 64: 500-512.
- GRASHORN, M.A. (2006) Aspects of Nutrition and Management of Meat Quality, XVIIth European Symposium on the Quality of Poultry Meat Doorwerth, The Netherlands, 23-26 May 2005.
- HORSTED K., HAMMERSHØJ M., HERMANSEN J.E. (2006) Short-term effects on productivity and egg quality in nutrient-restricted versus non-restricted organic layers with access to different forage crops. *Acta Agriculturae Scandinavica Section A* 56: 42-54.
- LEWIS, P.D., PERRY G.C., FARMER R.L., PATTERSON R.L.S. (1997) Responses of two genotypes of chicken to diets and stocking densities typical of UK and Label Rouge production systems: I. Performance, behaviour and carcass composition. *Meat Science* 18: 121.
- QUENTIN M., BOUVAREL I., BERRI C., LE BIHAN-DUVAL E., BAEZA, E., JEGO Y., PICARD M. (2003) Growth, Carcass Composition and Meat Quality Response to Dietary Concentrations in Fast, Medium and Slow Growing Commercial Broilers. *Animal Research* 52: 65-77.

# **POSTER PRESENTATIONS**

## **SESSION-2**

### **NUTRITION I**

## The Effect of Feeding of Poultry on Intestinal Health

Soner Uysal<sup>a</sup>, Emre Yilmaz<sup>a</sup>, Mehmet Gül<sup>a</sup>

<sup>a</sup>Ataturk University, Faculty of Veterinary, Animal Feeding and Nutritional Diseases  
Department

### Abstract

After the ban on the use of antibiotics in animal feeding, scientists have carried out many studies on feed additives that can be used instead of antibiotics. Various feed additives (organic acids, enzymes, probiotics, prebiotics) developed for promote growth. The antimicrobial properties of organic acids are exploited. Considering the short occurrence of poultry digestive system and the lack of digestive enzymes, it is absolutely necessary to add enzymes to the feeds. Probiotics prevent pathogenic microorganisms from invading the intestinal epithelium. Prebiotics are used to benefit from feed and improve yield performance, improve product quality, protect intestinal health and strengthen immunity.

**Keywords:** immunity, nutrition, organic acid, poultry, probiotic

### Introduction

#### *Digestive System in Poultry*

Nutrients need to be absorbed from the intestinal mucosa and transferred to the circulatory system in order to be used in metabolic events in the organism. Therefore, nutrients ingested by feed are converted into a form that can be evaluated by the organism in the digestive system by mechanical, chemical and enzymatic digestion (Celik and Acikgoz, 2006). Egg yolk begins to pull into the abdominal cavity towards the end of the hatching period and meets a large portion of the young's energy and protein needs until feed intake begins (Noy and Sklan, 1999). The digestive systems of poultry are anatomically formed in the embryonic period and after morphological and physiological changes that occur with effect of the nutrient after post hatching and the are also activated by the increase of small intestinal development and enzyme secretion (Celik and Acikgoz, 2006).

The digestive system of the poultry begins with the beak and mouth cavity, ends with the urogenital pathway and with the cloaca. Organs in this system are respectively rank as beak, mount, esophagus, craw, proventriculus, gizzard, small intestine (duodenum, jejunum, ileum), cecum, large intestine and cloaca. The liver and pancreas are also involved in the digestive system (Kutlu et al, 2015).

Poultry different animals according to their anatomical structure and feeding habits than other farm animals. In other words, animals with higher metabolic rates and energy needs. These features require that rations are richer in energy and the feed content is more dense (Ozdogan and Sari, 2001).

The intestinal health of poultry is also influenced by the physical form of the feed. The physical forms of the feeds affect the morphological and physiological properties of the intestinal epithelium. Fine-ground feeds can increase the mortality rates associated with necrotic enteritis compared to rough-ground feeds. The use of whole wheat (uncrushed) in broiler rations has been found to contribute to intestinal health by providing the development of the gastrointestinal tract, especially the gizzard (Efil,2014).

### ***Immune System in Poultry***

Immunity is generally defined as all general and specific defense mechanisms of the body against foreign substrates (microorganism, toxin, toxoid, protein, polysaccharide, complex structure molecules, etc.) that enter the body or exogenously and to do away with the relevant substance. Immunity is generally divided into two subgroups: natural and acquired immunity. The largest immune system of poultry is the intestines. When the growth rate of poultry and the rate of growth and development of pathogenic microorganisms are compared, it is seen that the rate of growth of poultry do not catch up to the growth rate of pathogenic microorganisms (Ergun and Sehu, 2013).

### ***Intestinal Flora of Poultry***

In poultry, the digestive system microflora is a complex ecosystem of many bacterial species. Naturally, there are more than 400 types of microorganisms in the digestive system microflora. The natural intestinal flora is composed of anaerobic bacteria producing lactic acid (Lactobacillus), anaerobes Bacteroides and Fusobacterium species, and 10% E. coli, Enterococcus, Clostridium, Staphylococcus, Blastomyces, Pseudomonas and Proteus species. Intestinal microflora in poultry affects performance, health and product quality (Kirkpinar and Acikgoz, 2003).

### **Feed Additives Used to Protect Intestinal Health in Poultry**

#### ***Use of Organic Acids***

Among the most important organic acids used are butyric, formic, fumaric, probionic, cetic, sorbic, malic, citric acids and salts. The main uses of organic acids include prevention of mycotoxin production in feedstuffs and raw materials, protection of animals against mycotoxicity, increase in storage period of feedstuffs and raw materials, prevention of aerobic degradation in

silages, increase of aerobic stability in silages, increase of antibacterial effects in animals and ensure growth in animals.

Organic acids help the immune system with its antimicrobial properties, allowing poultry to benefit more from protein and energy in feed (Roth et al., 2017). Organic acids also reduce the incidence of subclinical infections and can be used safely in animal feeding (Dibner and Buttin,2002). In addition to accelerating growth, organic acids are an alternative to antibiotics with antimicrobial properties (Liu et al., 2017). Another feature of the organic acid also showed protective effects in animal products. Contaminated poultry products with *Salmonella* bacteria are both a major hazard for human health and shorten the shelf life of products by causing deterioration in poultry products. Organic acids have long been used as preservatives in foods. The use of organic acids due to bacterial effects reduces the risk of food spoilage and extends the shelf life of the products (Axmann et al., 2017).

#### ***Use of Enzymes***

The poultry digestive system is not as developed as the ruminant digestive system, then it is absolutely necessary to add the exogenous enzyme to the rations to increase the yield. In a study, showed positive effects on feed conversion ratio with the addition of enzyme to poultry ration (Shahir et al., 2016). As is known, plant-derived phosphorus can not be used directly by poultry. This is mainly due to the lack of phytase enzyme in the poultry. With the addition of such elements to the ration, the animals will benefit more from the feed components, and the systems that have important functions in the body, such as the immunity system, will indirectly be supported.

#### ***Use of Prebiotics and Probiotics***

Commercial probiotic preparations most commonly used in poultry rations include live bacteria, fungi, yeast and yeast cultures and various enzymes. *Lactobacillus spp.*, *Bifidobacteria spp.* and *Streptococcus spp.* are the major microorganisms commonly used in the production of probiotics (Sarica,1999).

Intestinal diseases are a major problem in the poultry industry. Intestinal diseases can lead to loss of yield, to increase mortality rate and to contamination of microorganism to poultry products which used in human consumption. Probiotics are defined as live microorganisms that are beneficial to host health when given in sufficient quantities by the WHO. Probiotics' mechanisms of pathogenicity prevention; stimulation of the immune system, competition with pathogens for available nutrients and direct antimicrobial inhibitor secretion or competing with pathogens for intestinal epithelial adhesion receptors. Probiotics prevent pathogenic

microorganisms be invading to the intestinal epithelium (Pourakbari et al., 2016).

Prebiotics are generally defined as feedstuffs that are not digested by the host and are composed of oligosaccharides that have a positive effect on host health by stimulating the growth and activity of intestinal microflora bacteria. Prebiotics in poultry are widely used to improve feed consumption, FCR, yield performance, product quality, to protect intestinal health and to strengthen immunity. The general mechanism of action of prebiotics; They act as energy sources for probiotic bacteria such as *Bifidobacteria* and *Lactobacillus* and thus provide microbial balance of the digestive system (Ustundag and Ozdogan., 2017).

### Conclusion

The ban on the use of antibiotics due to the various adverse effects of their has increased the use of organic acids, enzymes, probiotics and prebiotics as feed additives. The immunomodulatory properties of feed additives are known. The use of poultry feed additives and the promotion of immune systems will result in healthier products.

### References

- AXMANN, S., KOLAR, V., ADLER, A. and STRNAD, I. (2017) Efficiency of organic acid preparations for the elimination of naturally occurring Salmonella in feed material. *Food Add Cont: Part A*, 34(11): 1915-1924.
- CELİK, L. and ACİKGOZ, Z. (2006) Kanatlı hayvanlarda sindirim sisteminin gelişimi ve besleme ile sindirim sisteminin gelişimi arasındaki ilişki. *Hayv Urt*, 47(2): 38-47.
- CETİN, M. (2012). Hayvan Beslemede Antibiyotik ve Antiparaziterlere Alternatif Olarak Bitkisel Ekstraktlar ve Pelinotu'nun (*Artemisia Absinthium*) Kullanılması. *KSIU Dog Bil Derg*, 15(4): 58-63.
- DIBNER, J. J. and BUTTIN, P. (2002) Use of organic acids as a model to study the impact of gut microflora on nutrition and metabolism. *J Appl Poult Res*, 11(4): 453-463.
- ERGÜN, A. and SEHU, A. (2013) Dengesiz beslenmenin immun sistem üzerine etkileri. *Tav Aras Derg*: 45-50.
- EFİL, M.M. (2014) Kanatlı Hayvanlarda Bağırsak Sağlığı ve Beslenme Arasındaki İlişki. *J Fac Vet Med*,: 33.
- KIRKPINAR, F. And ACİKGOZ, Z. (2003) Kanatlı hayvanlarda nisasta tabiyatında olmayan polisakkaritlerin sindirim sistemi mikroflorası üzerine etkileri. *Hayv Urt*, 44(2): 20-28.
- KUTLU, H.R. (2015). Farklı seviyelerde ekspander mısır içeren rasyonların broylerde performans ve karkas özelliklerine etkisi. *Kant Hay Bes Ders Notu*: 3-8.

- LIU, Y., YANG, X., XIN, H., CHEN, S., YANG, C., DUAN, Y. and YANG, X. (2017) Effects of a protected inclusion of organic acids and essential oils as antibiotic growth promoter alternative on growth performance, intestinal morphology and gut microflora in broilers. *Anim Sci J*, 88(9):1414-1424.
- NOY, Y. and SKLAN, D. (1999) Energy utilization in newly hatched chicks. *Poult Sci*, 78(12): 1750-6.
- OZDOGAN, M. and SARI, M. (2001). Kanatlı rasyonlarına yağ katkısı. *Hayv Urt*, 42(1): 28-34.
- POURAKBARI, M., SEIDAVI, A., ASADPOUR, L. and MARTÍNEZ, A. (2016) Probiotic level effects on growth performance, carcass traits, blood parameters, cecal microbiota, and immune response of broilers. *Anai Aca Bras Ciê*, 88(2): 1011-1021.
- ROTH, N., MAYRHOFER, S., GIERUS, M., WEINGUT, C., SCHWARZ, C., DOUPOVEC, B. and DOMIG, K. J. (2017) Effect of an organic acids based feed additive and enrofloxacin on the prevalence of antibiotic-resistant *E. coli* in cecum of broilers. *Poult Sci*, 96(11): 4053-4060.
- SARICA, S., (1999). Kanatlı hayvan beslemede probiyotik kullanımı. *Hayv Urt*, 39(40): 105-112.
- SHAHIR, M. H., RAHIMI, R., TAHERI, H. R., HEIDARINIYA, A., BARADARAN, N. and ASADI KERMANI, Z. (2016) Effect of protein source and protease addition on performance, blood metabolites and nutrient digestibility of turkeys fed on low-protein diets from 28 to 55 d post hatch. *Bri Poult Sci*, 57(3), 390-396.
- USTUNDAG, A.O. AND OZDOGAN, M., (2017) Kanatlı Beslemede Alterbiyotik Kullanımı: Probiyotikler, Prebiyotikler, Organik Asitler ve Bakteriyosinler. *Tr Kli J Vet Sci-Pharm Tox-Special Top*, 3(3), 225-240.

## The Determination of Consumers' Perception, Attitude and Behavior about the Influence of Nutrition on Chicken Meat Quality

Kerem Karasu<sup>a</sup>, Ergin Öztürk<sup>b</sup>

<sup>a</sup>Ondokuz Mayıs University, Science Institute, Department of Animal Science, 55139-Samsun, Turkey, <sup>b</sup> Ondokuz Mayıs University Agricultural Faculty, Department of Animal Science, 55139-Samsun, Turkey

### Abstract

A questionnaire study was conducted with the aim of determining the perception, attitudes and behaviors of consumers on the effects of feeding on the quality of chicken meat. The face to face interviews were made with 384 interviewers in the provincial centers of Istanbul in 2017. The most important criteria reported by consumers during purchasing of chicken meat are brand, packaging and color characteristics. Percent seventy of consumers reported that they did not know how the chicks they bought were fed and 75% reported that they do not know the contents of mixed feeds consumed by broilers. Also, 77% of the consumers did not think that broiler chickens were healthy. It was reported by 87.2% of the consumers that hormones was being used in broiler diets and 91.9% reported that they believe that antibiotics were used as an accelerator to grow. It has been observed that the consumers who participated in the survey in Istanbul have a very high perception of the nutrition of the broiler chickens and the product quality. These perceptions, which do not overlap with the realities of the industry and which may create a negative pressure on chicken meat consumption and production in the long run, need to be corrected with appropriate methods.

**Key Words:** *Chicken Meat, Broiler, Animal Nutrition, Antibiotic, Hormone, Consumer*

### Piliç Eti Kalitesinin Beslemeden Etkilenmesi Hakkında Tüketicilerin Algı, Tutum Ve Davranışlarının Belirlenmesi

#### Özet

Piliç eti kalitesi üzerine beslemenin etkileri hakkında İstanbul ilindeki tüketicilerin algı, tutum ve davranışlarının ölçülmesi amacı ile bir anket çalışması düzenlenmiştir. Araştırma İstanbul ili merkez ilçelerinde, 2017 yılı içerisinde, 384 anketör ile yüz yüze görüşme şeklinde gerçekleştirilmiştir. Araştırma sonuçlarına göre, tüketiciler piliç eti satın alırken sırası ile marka, ambalaj ve renk özelliklerini tercihte ön plana aldıklarını belirtmişlerdir.

Tüketicilerin % 70'i satın aldıkları piliçlerin nasıl beslendiğini bilmediklerini, %75'i ise piliçlerin tükettiği karma yemlerinin içeriğini bilmediklerini bildirmişlerdir. Ayrıca tüketicilerin %77'si etlik piliçlerin sağlıklı beslendiklerini düşünmediklerini ifade etmişlerdir. Tüketicilerin % 87'si ise etlik piliçlerin beslenmesinde hormon kullanıldığını düşündüklerini bildirirken, %91,9'u ise büyümeyi hızlandırıcı olarak antibiyotik kullanıldığını düşündüklerini ifade etmişlerdir. Araştırma sonuçları, İstanbul ilinde ankete katılan tüketicilerin etlik piliçlerin beslenmesi ve ürün kalitesi konusunda çok yüksek bir oranda yanlış algı içerisinde oldukları gözlenmiştir. Sektör gerçekleri ile örtüşmeyen ve uzun vadede piliç eti tüketimi ve üretimi üzerine olumsuz bir baskı oluşturabilecek olan bu algıların uygun yöntemlerle düzeltilmesine ihtiyaç duyulmaktadır.

***Anahtar kelimeler:** Piliç eti, etlik piliç, tüketici, hayvan besleme, antibiyotik, hormon, tüketici*

### **Introduction**

Production and consumption of poultry meat shows a rapid increase both in the world and in our country. In Turkey, the consumption of chicken meat per capita increased from 8.5 kg in 2001 to 21.8 kg in 2016. Within the same period, chicken meat production increased from 592,567 tons to 1,951,000 tons. Despite the rapid development in the sector, the per capita white meat consumption level in our country is below the world average. In recent years, one of the most important factors affecting the development of the poultry industry is the make lots of news, the use of products obtained from genetically modified plants (transgenic and GMO) as feedstuffs in feeding animal, in relation to the use of hormones and antibiotics in poultry nutritions, It lacks scientific grounds and makes news far from the reality.

Due to the development of communication speed, the change of perception models that develop in the society cause the perception of food to change more rapidly. Especially the disclosure of social media, written or visual media by non-specialists causes information pollution in society (Topçu et al., 2015). In this study, it was aimed to determine the sector effects by measuring the perception, attitudes and behaviors of GM feeds, hormones and antibiotics usage and product quality in mixed feeds with the content of the feeds used in the feeding of the broiler chickens of consumers in İstanbul province.

### **Materials and Methods**

The research was conducted with face to face interviews with 384 people who were randomly selected from different education and income levels among adult people aged 18 and over living in 39 provinces of İstanbul. It is also consistent with the study by Gegez (2007) that the main mass reported

is  $\geq 10,000,000$  and  $n = 384$  in 95% confidence interval studies. In the analysis of the data obtained, descriptive analysis and chi-square tests were used. All statistical calculations was performed in the SPSS 21.0 V, statistical package program.

### Results and Discussion

According to the results of the research, consumers prefer the meat, brand, packaging and all / part features, in order to buy, respectively. Dokuzlu et al. (2013) emphasized that brand was one of the most important factor in general for households in the consumption of poultry meat. Karakaya et al. (2014) conducted a research in the province of Bingöl, 89% of consumers stated that they choose well-known brands for buying chicken meat. Our research in this direction is similar to the findings of both studies.

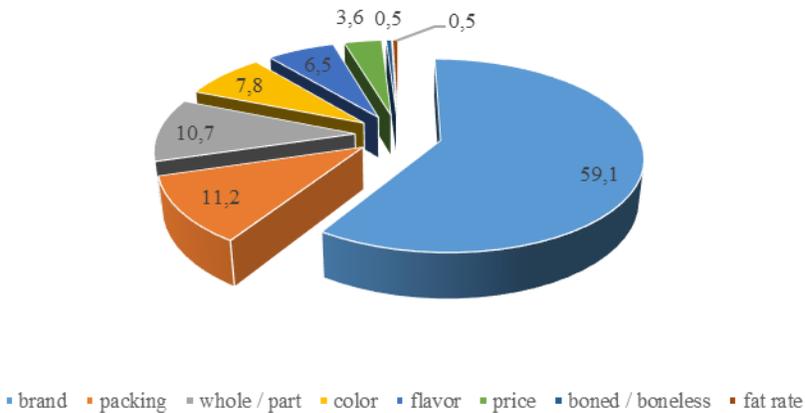


Figure 1. Considerations about the characteristics that the consumers pay attention when buying chicken meat

Seventy percent of consumers explained they did not know how the chicks they bought were fed, 75% reported that they do not know the contents of mixed feeds consumed by broilers. Also, 77% of the consumers did not think that broiler chickens were healthy. Eighty seven of the consumers reported that they think used hormones in the feeding of broiler chickens and 91.9% stated that they think that antibiotics were used as an accelerator to grow.

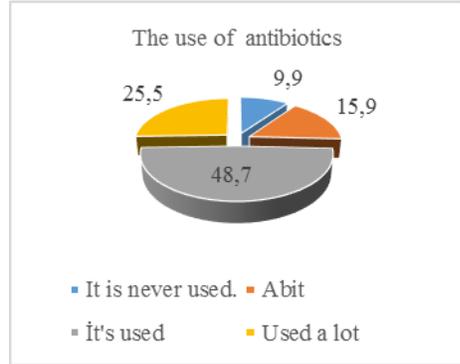
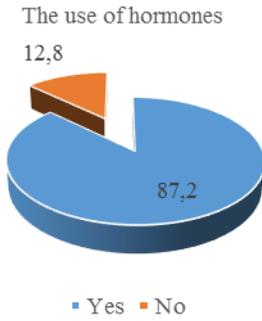


Figure 2. Consumers' thoughts on the use of hormones and antibiotics in broilers feed

In a study conducted by Bekar (2013) in the province of Muğla, the percentage of those who are often or very worried about the presence of hormones and antibiotics in poultry was determined as 71.7%. Yang et al. (2017) reported that 57% of consumers thought that hormones were used in the production of chicken meat in a study conducted in the United States. The results of these two studies are parallel to our research results and it clearly shows that consumers do not have enough information about the mixed feeds and contents used in chicken meat production and they are prejudiced about chicken meat production.

### Conclusion

Findings from the research show that a large majority of consumers have misinformed about mixed feed contents used in feeding of broilers. Considering that the use of antibiotics and hormones has been banned in European countries and our country since 2006, it is understood that the vast majority of consumers do not know sector facts. For decades, misinformation sources and consumer perception of chicken meat as an unhealthy, risky and hormone food (Dokuzlu et al., 2013) it is anticipated that this situation will create a negative pressure on chicken meat consumption if not corrected by appropriate methods. Istanbul, with its social and economic structure, is the most representative city of Turkey. Therefore, it is also thought that results obtained from this study to better represent Turkey in guiding due to the broiler sector will play an important role.

### References

BEKAR, A., (2013). Tüketicilerin Gıda Güvenliğine Yönelik Tutumları. *YYÜ Tarım Bilimleri Dergisi*, 23(2): 90–101.

- DOKUZLU, S., BARIŞ, O., HECER, C., GÜLDAŞ, M., (2013). Türkiye’de Tavuk Eti Tüketim Alışkanlıkları ve Marka Tercihleri. U. Ü. Ziraat Fakültesi Dergisi, 27(2): 83-92.
- Gegez, E. (2010). Pazarlama Araştırmaları Kitabı, 3. Baskı, Beta Basım Yayım Dağıtım A.Ş., İstanbul.
- KARAYAKA, E., İNCİ, H., (2014). Bingöl İli Merkez İlçesi Hane Halkının Kanatlı Eti Tüketim Tercihleri. Uludağ Üniversitesi Ziraat Fakültesi Dergisi, 28(1): 53-64.
- TOPÇU, Y., UZUNDUMLU, S., A., BARAN, D.,( 2015). Tüketicilerin Tavuk Eti Tüketimi ile İlgili Tutum ve Davranışlarını Etkileyen Faktörlerin Analizi. Türk Tarım-Gıda Bilim ve Teknoloji Dergisi, 3(5): 242-247.
- TÜİK, 2016. Türkiye İstatistik Kurumu, <https://biruni.tuik.gov.tr/medas/?kn=80&locale=tr>, 13 Ocak 2018.
- YANG, R., RAPER, K.C., LUSK, J.L., (2017). The Impact of Hormone Use Perception on Consumer Meat Preference. Southern Agricultural Economics Association Annual Meeting Conference Paper/Presentation, <http://purl.umn.edu/252772>, 13 Ocak 2018.

## Expander Technology in Mixed Feed Production

Emre Ekici, Yavuz Gürbüz

University of Kahramanmaraş Sutcu Imam, Faculty of Agriculture, Department of Animal Science Campus of Avsar, Kahramanmaraş-TURKEY

### Abstract

The expander application affects the nutritional value of the feed. The most important approach in the expander process has been to increase the amount of feed energy by gelatinizing starch. However, it is known that the gelatinization of starch is not always beneficial, depends on the feedstuff to be treated and on the animal species. The most important reason for this is known as overheating can reduce the utility of certain nutrients. For example, the amino acid of lysine may react with reducing sugars and lose its ultimate character of Maillard formation. For this, attention should be paid to the application of the exciter system in the production of feed for different animal varieties. One of the most important benefits of the expander application is that it can provide feed hygiene. Thanks to the heat and pressure created during the expander process, pathogenic microorganisms, which are particularly problematic in the poultry sector, and most importantly, it is possible to struggle with salmonella. In addition, with the expander process, it is possible to reduce and eliminate the harmful effects of weeds in the feedstuffs. However, the expander process can improve the physical properties and quality of the feed, while positively affecting the feed. This process improves pellet quality and pellet production capacity by improving pre-conditioning of feedstuffs. With this technology, it is possible to add more liquids such as mixed food, molasses, and oil. Therefore, expander technology is used in the production of poultry and pet animal feeds, especially because of the advantages it has achieved. Recently it is thought to contribute to the application of the technology applied in the feed factories. This review will focus on information about expander technology and animal feeding effects.

**Key words:** *Feed technology, mixed feed, expander technology, animal feed*

### Karma Yem Üretiminde Ekspander Teknolojisi Özet

Ekspander uygulaması, yemlerin besleyici değerini etkilemektedir. Ekspander işleminde en önemli yaklaşım nişastanın jelatinleştirilerek yemin enerji miktarını artırmak olmuştur. Bununla birlikte, nişastanın jelatinleşmesi

her zaman faydalı olmadığı, işleme tabi tutulacak yem hammaddesine ve hayvan türlerine bağlı olarak değiştiği bilinmektedir. Bunun en önemli sebebi, aşırı ısı işlemin bazı besin maddelerini faydalılığını azaltabileceği olarak bilinmektedir. Örneğin lizin amino asitinin indirgeyici şekerlerle reaksiyona girmesi ve Maillard oluşumu sonucu özelliğini kaybedebilmektedir. Bunun için farklı hayvan çeşitleri için yem üretiminde ekspander sisteminin uygulamasına dikkat etmek gerekir. Ekspander uygulamasının en önemli kazanımlarından biride, yem hijyenini sağlayabiliyor olmasıdır. Ekspander işlemi esnasında oluşan ısı ve basınç sayesinde, özellikle kanatlı sektöründe problem olan patojen mikroorganizmalar ve bunlardan en önemlisi salmonella ile mücadelede mümkün olabilmektedir. Ayrıca ekspander işlemi ile, yem hammaddelerinde bulunan yabancı otlardaki zararlı maddelerin etkinliğinin azaltılması ve yok edilmesi sağlanabilmektedir. Bununla birlikte, ekspander işlemi beslemeyi olumlu etkilemekle beraber, yemin fiziksel özelliklerini ve kalitesini iyileştirebilmektedir. Söz konusu olan bu işlem, yemlerin buhar ile ön şartlandırılması iyileştirerek pelet kalitesini ve pelet üretim kapasitesini geliştirmektedir. Bu teknoloji ile, karma yeme, melas ve yağ gibi sıvı maddelerin daha fazla ilavesi mümkün olabilmektedir. Bundan dolayı ekspander teknolojisi özellikle sağlamış olduğu avantajlardan dolayı kanatlı ve pet hayvan yemlerinin üretiminde kullanılmaktadır. Son zamanlarda yem fabrikalarında uygulanan teknolojinin uygulanmasına katkıda bulunulacağı düşünülmektedir. Bu derlemede, ekspander teknolojisi ve hayvan beslemede etkileri ile ilgili bilgiler üzerinde durulacaktır.

**Anahtar Kelimeler:** *Yem teknolojisi, Karma yem, Ekspander teknolojisi, hayvan besleme*

## **Effects of Usage of Thyme And Black Cumin Oil on Performance, Histomorphological Parameters and Cecum Volatile Fatty Acids in Broilers.**

**Özlem Durna Aydın, Gültekin Yıldız**

<sup>a</sup>Kafkas Unversty Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Disease

<sup>b</sup>Ankara Unversty Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Disease

### **Abstract**

This research was carried out to investigate the effect of thyme oil and black cumin oil, which are added broiler rations at certain ratios, on performance impact (body weight, body weight gain, feed intake, feed conversion rate-FCR, mortality and European Production Efficiency Factor-EPEF), carcass yield, organ weights, histomorphologic parameters of jejunum and ileum, and cecum short chain fatty acid (SCFA) concentrations

In the study, 216 male chicks (Ross 308) were randomly divided into 4 groups each consisting of 54 chickens and each subgroup is randomly divided into 9 subgroups consisting of 6 chicks. The chicks were fed with corn, soya bean and full-fat soybean based rations for 42 days. The basis of the research rations is corn, soya bean and full-fat soybean. While the control group was fed with basic ration, the experimental groups were fed respectively with 250 mg / kg of thyme extract, 100 mg / kg of black seed extract, 250 mg / kg of thyme extract and 100 mg / kg of black seed extract added to the basic ration. All experimental group rations were formulated to meet the nutrient requirements recommended by NRC (1994) or to some extent.

On day 42 of the study, 1 chick (9 total from each group) from each subgroup was killed to small intestine histomorphology and SCFA concentration. At the end of the experiment, no statistically significant difference was found between the groups in terms of body weight, body weight gain, feed intake, feed conversion rate- FCR, fecal moisture and fecal ammonia levels, mortality and European Production Efficiency Factor-EPEF. No deaths were seen in the BT group for any period. In addition, no significant difference was observed between groups in terms of various carcass parameters, internal organ weights, fecal moisture and ammonia level.

At the end of the study, there was no statistically significant difference between the control and experimental groups (T, B, BT) as the villus height, crypt depth and villus height: crypt depth at the jejunum. At the end of the experiment, there was no statistically significant difference between the

control and experimental groups (T, B, BT ) as the villus height and villus height:crypt depth but the difference between the groups in terms of crypt depth was found to be statistically significant at the ileum. Ileum crypt depth in the control and experimental groups (T, B, BT) were found respectively 99,61; 108, 66; 122, 72; 114,50  $\mu\text{m}$ .

At the end of the study, acetic acid, propionic acid, isobutyric acid, butyric acid, isovaleric acid, valeric acid, isocaproic acid, caproic acid, total SCFA and BCFA values in the secum of control and experimental groups (T, B, BT) were found to be 70.74, 64, 69; 63,45; 60,41  $\mu\text{mol} / \text{g}$ . The difference between the groups was not statistically significant for all parameters.

The combined use of 250 mg / kg thyme extract, 100 mg / kg black cumin extract, 250 mg / kg thyme extract and 100 mg / kg black cumin extract added to the rations in the study showed many positive effects when all the parameters were evaluated. In particular the synergistic effect caused by the combined use of the two oils, has resulted in considerable healing effects on mortality and intestine health.

**Key Words:** *Intestinal Histomorphology, Broiler, Black Cumin, Thyme, Short Chain Fatty Acid*

## The Effect of Dietary Conjugated linoleic acid (CLA) on the Fatty Acid Composition and Cholesterol Content of Eggs in Turkeys

R. Aydın<sup>a</sup>, A.K. Özüğür<sup>b</sup>

<sup>a</sup>Department of Animal Nutrition and Nutritional Diseases, Balıkesir University, Balıkesir Turkey 10100.

<sup>b</sup>Adnan Menderes University, Cine Vocational School, Cine-Aydın, Turkey

### Abstract

The aim of the present study was to investigate effects of CLA on egg fatty acid composition and cholesterol content in turkeys. Laying hens (6/group) were fed a diet supplemented with 30g/kg vegetableoil (control), 25g/kg vegetableoil plus 5g/kg CLA or 20g/kg vegetableoil plus 10g/kg CLA for 49 days. Eggs were collected for yolk fatty acid and cholesterol analysis at the final week. Egg weights and egg production were also evaluated. CLA increased the ratio of C16:0/C16:1(n-7) and C18:0/C18:1(n-9) in egg yolk. Yolk total CLA increased as the levels of dietary CLA increased. The level of cholesterol of the eggs from the groups did not differ. Egg production was decreased when CLA was included at the level of 10g/kg in the diet compared to control. This study showed that dietary CLA significantly influenced egg fatty acid composition, but not the cholesterol content of egg yolk in turkeys.

**Keywords:** *CLA; Egg Fatty Acid Composition; Yolk Cholesterol; Egg Production; Turkey*

## Usage Possibilities of Mealworms (*Tenebriomolitor*) in Poultry Diets

Kübra Melis Sabuncuoğlu<sup>a</sup>, Firdevs Korkmaz<sup>a</sup>, Doğan Nariç<sup>b</sup>, Hasan Ersin<sup>a</sup> Şamlı

Department of Animal Science, Faculty of Agriculture, Namık Kemal University, Tekirdağ, 59100, Turkey

Department of Genetics, Faculty of Veterinary Medicine, Namık Kemal University, Tekirdağ, 59100, Turkey

### Abstract

Due to the increasing world population, the increase in the production of animal products has become compulsory. With the increase in production, it is important that feeds are obtained in a sustainable way. This is increasingly important for alternative feed sources that can be used to meet the nutritional needs of poultry. In this case, the alternative feed sources that can be used to meet the nutrient needs of poultry is becoming increasingly important. In this context, the role of insects naturally found in the food chain of poultry is the subject of this study. In this review, information on the use of mealworm (*Tenebriomolitor*) as an alternative to protein-containing feedstuffs in poultry feeds has been given.

**Keywords:** *Alternative protein source, Mealworm (Tenebriomolitor), Insect*

### Un Kurdunun (*Tenebriomolitor*) Kanatlı Yemlerinde Kullanım Olanakları

#### Özet

Artan dünya nüfusu hayvansal ürünlerin de üretiminin artışı zorunlu hale getirmiştir. Üretimin artışı ile birlikte yemlerin sürdürülebilir bir şekilde elde edilmesi önem taşımaktadır. Bu durum kanatlı hayvanların besin madde ihtiyaçlarını karşılamak için kullanılacak alternatif yem kaynaklarının önemini giderek artırmaktadır. Bu bağlamda kanatlı hayvanların besin zincirinde doğal olarak bulunan böceklerin rolü bu çalışmanın konusunu oluşturmaktadır. Bu derlemede protein içeren hammaddelere alternatif olarak kullanılan un kurtlarının (*Tenebriomolitor*) kanatlı yemlerinde kullanım olanakları hakkında bilgiler verilmiştir.

**Anahtar kelimeler:** *Alternatif protein kaynağı, Un kurdu (Tenebriomolitor), Böcek*

## **Introduction**

Due to industrial and technological developments, changing environment, increasing energy consumption and waste material affect the global life negatively. Global food demand is rising in so far as population growth in the world (Elorduy et al., 2002). Broiler and layer productions are the cheapest source of animal protein. But the energy and protein levels of these birds' feeds are quite high. For this reason, feed is expensive and at the same time it is produced with limited resources. The main sources used in poultry rations to meet protein need are soybean and sunflower. In addition to these, protein additives such as meat meal, bone meal, fish meal are also used as animal protein additives (Işık ve Kırkpınar, 2017). There are two fundamental problems for soybean, such as genetic concerns and the inability to meet demand for production (Muros et al., 2013). Sunflower production is already very small. Fish production is at risk even in terms of human consumption (FAO, 2012; Thevenot et al., 2017). The decrease in fishmeal production also increases feed costs. The use of meat and bone meal in poultry rations is prohibited in some countries. As a result of these adverse events, it is increasing day by day to work on the use of some insects as alternative protein sources (Azagoh et al., 2014). In this study, studies on the usage possibilities of mealworms (*Tenebriomolitor*) in poultry diets, which are considered to be alternatives to the raw materials used as protein sources, are summarized.

## **Insects as a Food Source**

Protein and fat content was found to be higher in many insect species, which are not a problem in terms of food safety, as compared with the nutrient content, soybean meal and fish meal (Veldkamp et al., 2012). In addition, insects provide ecological benefits due to low carbon and gas emissions (Thevenot et al., 2017). Edible insects traditionally consumed in some countries in the world play a nurturing role due to their high fat, protein and mineral content. These nutrient contents vary according to the species (Elorduy et al., 2002). It is known that edible insects with a crude protein content of 63-68% and a crude oil content of 29-31% on a dry matter basis are also high in protein quality (Zielińska et al., 2015).

## **Morphology and Life Cycle of Mealworm**

Small white bean-shaped eggs have a length of about 2 mm and a width of 0.9 mm. Larval is dark yellow and has two antennae. It has a large head in the pupa period and has a white-cream structure with a pointed tail. The darker adult beetles are divided into three parts, the head, the chest and the abdomen. They have six legs, two antennae and compound eyes in their body. Adult mealworms have an average length of 12-25 mm and their color

is dark brown (Johnson, 2013). The life cycle of mealworm is realized in four stages; the egg period 7 to 14 days, larval period 30 to 90 days, pupa period 10 to 20 days, and adult period 5 to 10 days (Johnson, 2013). Mealworms are usually fed with wheat, oats, and flour as well as carrots, cabbage, and apples. Mealworms prefer hot and humid places as production conditions, the number of eggs increases due to temperature and moisture.

**Nutrient Content of Mealworm**

In a study carried out by Işık and Kırkpınar (2017), it was reported that the content of protein, fat content, raw ash, and moisture were 18.7%, 13.4%, 0.9%, and 61.9% in dry matter, respectively. In a similar study, it was determined that the content of protein in mealworm was 20.19%. Studies conducted by Azagoh et al. (2016), Zielińska et al. (2015) and Muros et al. (2014) show that the protein content of mealworm is between 47.2-65.6% and the fat content is between 24.1-43.3%. The percentages of amino acids in protein content obtained from mealworm and their comparison with soybean and fish meal are given in Table 1 (Işık ve Kırkpınar, 2017). As can be understood from Table 1, mealworm has a balanced amino acid profile and shows similarities with fish flour and soybean.

**Table 1. Amino acid profiles of mealworm larval, fish flour and soybean bagasse**

Amino asitler %	Mealworm	Fish flour	Soybean bagasse
Alanine	<b>7.3</b>	6.1	<b>4.3</b>
Aspartic acid	<b>7.5</b>	8.7	<b>11.4</b>
Arginin	<b>4.8</b>	5.8	<b>7.3</b>
Cystine	<b>0.8</b>	0.8	<b>1.6</b>
glycine	<b>4.9</b>	5.9	<b>4.2</b>
Glutamic acid	<b>11.3</b>	12.6	<b>17.9</b>
Hystidine	<b>3.4</b>	2.2	<b>2.7</b>
Isoleucine	<b>4.6</b>	4.3	<b>4.6</b>
Leucine	<b>8.6</b>	7.0	<b>7.7</b>
Methionin	1.5	2.8	<b>1.4</b>
Phenylalanine	<b>4.0</b>	3.8	<b>5.1</b>
Proline	6.8	3.8	5.0
Serine	7.0	4.0	4.6
Threonin	4.0	4.1	3.8
Triptophan	0.6	1.1	1.4
Tyrosine	7.4	2.9	3.5

## Conclusion

The search for an alternative protein source is a major challenge worldwide and mealworm is an important option to use as a substitute protein source due to its high protein content and high quality amino acids contents. However, the rearing of mealworm has been little known and is being carried out on a small scale. Establishment of production enterprises, provision of feeds and qualified human needs to do this job.

## Kaynaklar

- AZAGOH, C., DUCEPT, F., GARCIA, R., RAKOTOZAFY, L., CUVELIER, M.-E., KELLER, S. LEWANDOWSKI, R. and MEZDOUR, S. (2016) Extraction and physicochemical characterization of *Tenebriomolitor* proteins. *Food Research International*, 88:24–31 .
- ELORDUY, J.M., GONZÁLEZ, E.A., HERNÁNDEZ, A.R. and PINO, J.M. (2014) Use of *tenebriomolitor* (Coleoptera: Tenebrionidae) to recycle organic wastes and as feed for broiler chickens. *Journal of Economic Entomology*, 95(1):214-220.
- FAO, (2012). Report of the Sixth Session of the Sub-Committee on Aquaculture. FAO, Cape Town, South Africa. <http://www.fao.org/docrep/016/i2765t/i2765t.pdf>.
- IŞIK, Ö. and KIRKPINAR, F. (2017) Etlik piliçlerin beslenmesinde böceklerin kullanılması. *Türk Tarım – Gıda Bilim ve Teknoloji Dergisi*, 5 (7): 750-756, 2017.
- JOHNSON, M. (2013) Meal worm biology. Trinity University Press.
- MUROS, M.J.S., FERNANDO, G., BARROSO, F. and AGUGLIARO, F.M. (2014) Insect meal as renewable source of food for animal feeding: a review. *Journal of Cleaner Production*, 65:16-27.
- THEVENOT, A., RIVERA, J.L., WILFART, A., MAILLARD, F., HASSOUNA, M., SENGA-KIESSE, T., LE FEON, S. and AUBIN, J. (2018) Meal worm meal for animal feed: Environmental assessment and sensitivity analysis to guide future prospects. *Journal of Cleaner Production* 170:1260-1267.
- VELDKAMP, T., van DUINKERKEN, G., van HUIS, A., LAKEMOND, C.M.M., OTTEVANGER, E., BOSCH, G. and van BOEKEL, M.A.J.S. (2012). Insects as a sustainable feeding redient in pig and poultry diets - a feasibility study. Report 638 - Wageningen Livestock Research.
- ZIELIŃSKA, E., BARANIAK, B., KARAS, M., RYBCZYŃSKA, K. and JAKUBCZYK, A. (2015) Selected species of edible insects as a source of nutrient composition. *Food Research International* 77:460–466

## Factors Affecting Egg Quality Due to Egg Chicken Feeding

Yavuz Gürbüz

University of Kahramanmaraş Sutcu Imam, Faculty of Agriculture, Department of Animal Science Campus of Avsar, Kahramanmaraş-TURKEY

### Abstract

Egg quality; it is a special concept that defines egg shell, flow, wrap and nutrient content. Quality definitions for these properties should be measurable. Between the constituents of egg quality and the contents of the feed; there is often a linear relationship, such as that between the nutrient content of the egg and the nutrient content of the feed. It is necessary to study the content of the feed in order to be able to cope with problems such as aggravation in eggs, increased frequency of broken eggs, and to produce eggs more suitable for consumer tendencies (eg low-cholesterol egg yolk).

There are various standards of egg quality for egg quality. These standards are explained by looking at egg shell (outside shell quality) and egg inside (inside shell quality). In some of these standards, more subjective egg quality qualities are based on more quantitative egg quality measurements. Often, the egg shell and its internal quality standards are based on flours; shell cleanliness, sound when the shell is struck, hardness of the shell, shape, albumin visibility, absence of foreign materials on the album, shape and integrity of the egg wrap. All of these evaluations are required in the classification of eggs. It is important to remember that the chicks must have very good care and feeding conditions from the layer entrance to the carcass and oviposition period.

The raw feedstuff and feed additives used in egg hens have a significant impact on the internal and external quality of eggs. For example, the use of cotton seeds in the race can cause the egg yolk to get a brownish tone in animals. The internal quality of the egg is related to the functional, aesthetic and microbial contamination factors of albumin (white) and egg yolk. It is important for the consumers who use eggs in pastry and cooking that egg quality is good. As a result, it is important for egg producers and consumers to know and apply nutritional factors that affect egg shell and internal quality. In this review, nutritional factors affecting egg internal and external quality will be given.

**Keyword:** *Laying Hens, Egg Quality, Laying Hen Feeding*

# POSTER PRESENTATIONS

## SESSION-3

### HEALTH

## Influence of Different Population Sizes of Poultry Red Mite (*Dermanyssus gallinae*) on Hematological Values in Japanese Quail Chicks

Hakan Erdem<sup>a</sup>, Coşkun Konyalı<sup>b</sup>, Hande Işıl Akbağ<sup>a</sup>,  
Baver Coşkun<sup>a</sup>, Türker Savaş<sup>a</sup>

<sup>a</sup>Çanakkale Onsekiz Mart Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü, Çanakkale

<sup>b</sup>Çanakkale Onsekiz Mart Üniversitesi, Lapseki Meslek Yüksekokulu, Lapseki/Çanakkale

### Abstract

*Dermanyssus gallinae* is an ectoparasite that is caused anemia, irritation and decreased productivity. This study was conducted under same conditions in two experiments, except of infestation density. In each experiment, 80 quail chicks were used at one week old. Traps are placed in the cages for the mites colonization. Food and water are offered *ad-libitum* and lighting program was practiced 16L:8D. Blood samples were taken at the end of the experiments. In first experiment, hemoglobin values are 9.6 g/dl and 7.7 g/dl and eosinophile values are 5.8% and 18.5% in control and infested groups, respectively ( $P \leq 0.05$ ). In the second experiment, hemoglobin and erythrocyte values are 5.5 g/dl,  $1.8 \times 10^6 / \text{mm}^3$  for infested group and 11.3 g/dl,  $3.8 \times 10^6 / \text{mm}^3$  for control group, respectively ( $P = 0.0001$ ).

**Key words:** Anemia, *Dermanyssus gallinae*, Hematology, Infestation, Mite

### Kanathı Kırmızı Akarının (*Dermanyssus gallinae*) Farklı Popülasyon Büyüklüklerinin Japon Bildircını Palazlarında Bazı Hematolojik Değerlere Etkisi

#### Özet

*Dermanyssus gallinae* kanathılarda anemi, irritasyon ve verim kayıplarına neden olan bir dış parazittir. Bu çalışma enfestasyon yoğunluğu hariç aynı koşullarda düzenlenmiş iki deneme ile yürütülmüştür. Denemelerde 1 haftalık yaşta 80 Japon Bildircını palazı kullanılmıştır. Akarların yuvalanabilmesi için kafeslere trapezler yerleştirilmiştir. Palazlara *adlibitum* yem ve su sağlanmış, 16A:8K aydınlatma programı uygulanmıştır. Denemelerin sonunda kan örnekleri alınıp hematolojik değerler tespit edilmiştir. İlk denemede kontrol ve enfeste grupta sırasıyla hemoglobin miktarı 9,6 g/dl ve 7,7 g/dl, eozinofil oranı %5,8 ve %18,5'dir ( $P \leq 0,05$ ). İkinci denemede hemoglobin ve eritrosit değerleri sırasıyla enfeste grup için 5,5 g/dl,  $1,8 \times 10^6 / \text{mm}^3$ , kontrol grubu için 11,3 g/dl,  $3,8 \times 10^6 / \text{mm}^3$ 'dir ( $P = 0,0001$ ).

**Anahtar kelimeler:** Akar, Anemi, *Dermanyssus gallinae*, Enfestasyon, Hematoloji

### **Introduction**

*Dermanyssus gallinae* (De Geer, 1778) is an ectoparasite of poultry. According to Mul and Koenraadt (2009) the life cycle of the mite is completed in seven days as egg, larva, protonymph, deutonymph and adult, respectively. During the day, it is usually hidden in cracks, hole and roost in the coop. Although it is usually on the host to feed at nights, according to Kilpinen (2005), daytime can also be seen on the host. Chauve (1998) showed that blood-sucking parasite cause anemia, decrease or stop egg production of birds. According to Nordenfors and Chirico (2001), deaths can be seen in severe infestation. Although the birds are parasitic, it can also cause infestation in mammals. Akdemir *et al.* (2009) and Abdigoudarzi *et al.* (2014) showed that it can even see in human. In this study, effects of mite population density on hematological parameters were investigated.

### **Materials and Methods**

The study was conducted under same conditions in two experiments, except of infestation density. In each experiment, mite infested and non-infested 40 chicks were used at one week old. Food and water are offered *ad-libitum* and lighting program was practiced 16 L: 8 D. Traps were placed in the cages for nesting of mites and to determine the number of mites at the end of the experiment. During each experiment, live weight and feed consumption were observed. Blood samples were taken at the end of the experiments and erythrocyte, leucocyte, hemoglobin, hematocrit and leukocytes type values were determined. At the end of the experiment, the mites on traps were photographed and transferred to digital for counting.

### **Results and Discussion**

In the first experiment, mite number on the traps ranged from 0 to 2090 and total mite numbers 10276 were determined. However; in the second experiment, mite number on the traps ranged from 2000 to 22268 and total mite numbers 102035 were determined. Kaoud and El-Dahshan (2010) were defined from the traps of the broiler house, the traps with 250-5000 mites are low, the traps with 5000-8000 mites are medium and the traps with mite between 8000-15000 are severe infestations. Accordingly, the level of first experiment infestation is low and the level of second experiment infestation can be defined as severe.

In the first experiment, control and infested group live weight at the end of the experiment is 249.2g and 242.3g, respectively ( $P \geq 0.05$ ). In the second experiment, control and infested group live weight at the end of the experiment is 231.8g and 205.0g, respectively ( $P \leq 0.05$ ). No significant

difference was observed between the groups in the feed conversion rate for each experiment.

In the first experiment, hemoglobin and eosinophile values are differed significantly between control and infested group. Hemoglobin values are 9.6 g/dl and 7.7 g/dl for control and infested group ( $P \leq 0.05$ ), respectively and eosinophile values are 5.8% and 18.5% for control and infested group, respectively ( $P \leq 0.05$ ). In the second experiment, hemoglobin, erythrocyte, hematocrit and eosinophile values are 5.5 g/dl,  $1.8 \times 10^6 / \text{mm}^3$ , 29.4%, 8.3% for infested group and 11.3 g/dl,  $3.8 \times 10^6 / \text{mm}^3$ , 43.5%, 2.7% for control group, respectively. All differences between the groups are significant ( $P = 0.0001$ ). Lymphocyte rate are 77.7% for control group and 69.2% for infested group ( $P = 0.0145$ ). Blood values of healthy animals reported by Nirmaland and Robinson (1971) are similar to blood values of healthy animals in this study. In the first experiment, the difference of hemoglobin value indicated anemia even if is low. In the second experiment, hematocrit, erythrocyte and hemoglobin values that are below normal values are clearly indicated anemia in the infested group. As is known, leukocytes are cells of the immune system that recognize and neutralize antigens entering the organism. According to Nutman (2007) and Simon *et. al.* (2010), many allergic reactions, infectious diseases and parasitic infestation are caused an increase in the rate of eosinophils.

In the first experiment, the difference of mortality rate between the groups was not significant ( $P > 0.05$ ). In the second experiment, high mortality rate was observed in the infested group ( $P \leq 0.05$ ).

## Conclusion

Low-intensity infestation is affected hemoglobin and eosinophil; in addition, severe effects on hematocrit, erythrocyte and lymphocyte values are seen in severe infestation. In the first experiment, no significant differences in live weight and mortality rate are indicates that quails can tolerate low-intensity infestation. However, increasing of the severity of the infestation can have detrimental effects on the birds.

## References

- MUL, M. F. and KOENRAADT, C. J. M. (2009). Preventing introduction and spread of *Dermanyssus gallinae* in poultry facilities using the haccp method. *Exp. Appl. Acarol*, 48: 167–181.
- KILPINEN, O. (2005) How to obtain a blood meal without being eaten by a host: the case of poultry red mite, *Dermanyssus gallinae*. *Physiological Entomology* 30: 232–240.
- CHAUVE, C.(1998) The poultry red mite *Dermanyssus gallinae* (De Geer, 1778): current situatio nand future prospects for control. *Veterinary Parasitology*, 79: 239–245.

- NORDENFORS, H. and CHIRICO, J. (2001) Evaluation of a sampling trap for *Dermanyssus gallinae* (Acari: *Dermanyssidae*). *J. Econ. Entomol.* 94(6): 1617-1621 (2001).
- AKDEMIR, C., GÜLCAN, E. and TANRITANIR, P. (2009) Case report: *Dermanyssus gallinae* in a patient with pruritus and skin lesions. *Türkiye Parazitoloji Dergisi*, 33(3): 242 - 244, 2009.
- ABDIGOUDARZI, M., MIRAFZALI, M. S., BELGHEISZADEH, H. (2014) Human infestation with *Dermanyssus gallinae* (Acari: *Dermanyssidae*) in a family referred with pruritus and skin lesions. *J Arthropod-Borne Dis*, 8(1): 119-123.
- KAUD, H. A. and EL-DAHSHAN, A. R. (2010) Effect of red mite (*Dermanyssus gallinae*) infestation on the performance and immune profile in vaccinated broiler breeder flocks. *Journal of American Science* 6(8):72-79.
- NIRMALAN, G. P. and ROBINSON, G. A. (1971) Hematology of Japanese quail treated with exogenous stilbestrol dipropionate and testosterone propionate. *Poultry Science*, 51: 920-925.
- NUTMAN, T. B. (2007) Evaluation and differential diagnosis of marked, persistent eosinophilia. *Immunol Allergy Clin North Am*, 27(3): 529-549.
- SIMON D., WARDLAW A., ROTHENBERG M. E. (2010) Organ-specific eosinophilic disorders of the skin, lung and gastrointestinal tract. *J Allergy Clin Immunol*, 126(1): 3-13.

## Isolation *Escherichia coli* O157:H7 Bacteriophages from Different Water Sources and Wastewaters

Tuba Sakin, Zeliha Yildirim

Niğde Ömer Halisdemir University, Faculty of Engineering, Food Engineering Department

### Abstract

The objectives of this study were to isolate bacteriophages infecting *Escherichia coli* O157:H7 and then purify and determine their host range. For this purpose, 52 water samples from different environment were collected and screened for bacteriophages. Bacteriophages were detected 17 out of 52 wastewater samples and 21 *E. coli* O157:H7 phages were isolated and purified. Host range results showed that isolated phages were generally infective against *E. coli* O157:H7. Furthermore, 8 out of 21 *E. coli* O157:H7 phages were also infective against some *E. coli* strains and 5 phages were virulent against some *Salmonella enterica* serovars.

**Key words:** Bacteriophage, *Escherichia coli* O157:H7, Wastewater, Isolation

## Farkli Su Kaynaklari ve Atik Sulardan *Escherichia coli* O157:H7 Bakteriyofajlarinin İzolasyonu

### Özet

Bu çalışmanın amacı *Escherichia coli* O157:H7'yi enfekte eden bakteriyofajları izole etmek, saflaştırmak ve etki ettikleri konuk hücre aralığını belirlemektir. Bu amaçla farklı ortamlardan 52 örnek temin edilmiştir ve bakteriyofaj taraması yapılmıştır. Taranan 52 örnekten 17 tanesinde bakteriyofaj tespit edilmiş ve bu örneklerden 21 tane *E. coli* O157:H7 fajı izole edilip saflaştırılmıştır. Konuk hücre aralığı sonuçları izole edilen fajların genellikle *Escherichia coli* O157:H7 üzerine etkili olduğunu göstermiştir. Ayrıca, 21 *E. coli* O157:H7 fajından 8 tanesinin diğer *E. coli* suşlarına ve 5 tanesinin bazı *Salmonella enterica* serovarlarına karşı etkili olduğu bulunmuştur.

**Anahtar Kelimeler:** Bakteriyofaj, *Escherichia coli* O157:H7, Atık su, İzolasyon

## Introduction

*E. coli* O157:H7 is an important food-borne pathogen causing bloody diarrhea and hemolytic uremic syndrome which results in kidney failure (Bell, 2002). It is a durable microorganism that can survive in low pH and refrigerator conditions. Bacteriophages or phages are viruses that only infect bacteria and multiply within the host bacterial cell.

## Materials and Methods

51 water samples collected from rivers, ponds, pool waters of slaughterhouses, wastewaters of slaughterhouse and food processing and 1 raw milk sample were collected and screened for bacteriophages. Serial dilutions were prepared from the samples for which phage activity was determined and double layer agar plate method was used to observe the formation of lytic phage plaques. Lytic bacteriophages were purified by the single plate method and phage stocks were stored at -80°C (Adams, 1959). Bacteriophages that were stocked at -80°C were used to determine host range (Stenholm et al., 2008).

## Results

Bacteriophages were not detected 28 out of the 52 samples and only lysogenic phages were determined in 7 out of 52 samples. Lytic phages were determined in remaining 17 samples and 21 phages were isolated and purified by using the single plate method. Phages titer of the purified samples were changed among  $17.0 \times 10^3$ - $10.2 \times 10^7$  pfu/ml. Host range results showed that isolated phages were generally effective on *E. coli* O157:H7, and also it was found that 8 out of 21 phages were infective against some *E. coli* strains and 5 phages were infective against some *Salmonella enterica* serovars besides *E. coli* O157:H7.

## Conclusion

The isolated *E. coli* O157:H7 phages can be used as biocontrol agents to prevent *E. coli* infection in poultry.

## References

- ADAMS, M.H. (1959) Bacteriophages " *Interscience Publishers, Inc.* New York.
- BELL, C. (2002) Approach to the control of entero-haemorrhagic *Escherichia coli* (EHEC). *International Journal of Food Microbiology* 78: 197– 216.
- STENHOLM, A.R., INGER, D. and MATHIAS, M. (2008) Isolation and characterization of bacteriophages in infecting the fish pathogen *Flavobacterium psychrophilum*. *Applied and Environmental Microbiology* 74: 4070-4078.

## Effects of Energized Oxygen in Drinking Water to Laying Hens Feces Microorganism Count

Özlem Sahan Yapıcıer<sup>a</sup>, Mustafa Saatci<sup>b</sup>, Sibel Yaman<sup>c</sup>, Orçun Sav<sup>c</sup>

<sup>a</sup>Mehmet Akif Ersoy University, Faculty of Veterinary Medicine, Department of Microbiology, Burdur, Turkey, 15030

<sup>b</sup>Mehmet Akif Ersoy University, Faculty of Veterinary Medicine, Department of Animal Science, Burdur, Turkey, 15030

<sup>c</sup>Mehmet Akif Ersoy University, The Health Sciences Institute, Department of Microbiology, Burdur, Turkey, 15030

### Abstract

This study was conducted to identify the effects of energized oxygen and show possible differences of total bacterial/fungal and *Escherichia coli* count in layers feces. Energized gas device was set up to farm's water and generated gas has been hosed into the drinking water tank. Cloacal swabs and conveyor samples was collected in three runs; first was before setting up energized O<sub>2</sub> gas as a control, second one was after one week and the last one was two weeks later. The total bacteria counts for control and energized groups in cloacal swabs and conveyor samples were reduced 7.33 to 3.11, 10.21 to 7.69 log<sub>10</sub>cfu/g respectively. *E. coli* count was 3.65 to 1.16 in cloacal swab; 5.91 to 3.97 log<sub>10</sub>cfu/g in conveyor samples. Thus, it was concluded that energized oxygen gas was decrease total bacteri and *E. coli* count in layer hens feces.

**Key Words** : Microorganisms count, Energized oxygen, Layers

## Enerjilendirilmiş Oksijenli İçme Suyunun Yumurtacı Tavukların Dışısındaki Mikroorganizma Sayımına Etkisi

### Özet

Bu çalışmada enerjilendirilmiş oksijenin etkilerini tanımlamak ve yumurtacı tavukların dışısındaki toplam bakteri/ mantar ve *Escherichia coli* sayısını belirlenmiştir. Enerjilendirilmiş gaz cihazı çiftliğin su sistemine bağlandı ve gaz içme suyu tankına verildi. Kloakal svaplar ve konveyör örnekleri, enerjilendirilmiş O<sub>2</sub> gazından önce kontrol olarak, bağlandıktan 1 hafta sonra ve son olarak da iki hafta sonunda olmak üzere üç kez toplandı. Çalışmada kontrol ve enerjilendirilmiş gruptaki kloakal svap ve konveyör örneklerinin toplam bakteri sayısı sırasıyla 7.33'dan 3.11'e, 10.21'den 7.69 log<sub>10</sub> cfu/g geriledi. Kloakal svaptaki *E. coli* sayısı 3.65'den 1.16'a; konveyör örneklerinde 5.91'den 3.97 log<sub>10</sub>cfu/g azaldığı tespit edildi. Böylelikle

enerjilendirilmiş oksijen gazının yumurtacı tavukların dışındaki toplam bakteri ve *E. coli* sayısında azalmaya sebep olduğu sonucuna varıldı.

**Anahtar Kelimeler:** Enerjilendirilmiş oksijen, Mikroorganizma sayımı, Yumurtacı tavuk

### **Introduction**

Water consumption in poultry production is influenced by various factors such as animal species, activity, water quality, water temperature, environmental temperature, feed consumption and diet (Lardy et al., 2008). Water is used for two purposes, including maintenance, and drinking water. In poultry 55-77% of their bodies are composed of water, depending on age, sex and species. On the other hand eggs contain 65% on average. (Eleroğlu and Sarıca, 2004; Jafari et al., 2006; Baylan et al., 2007). Water is also transporting of nutrients, digestion, absorption, regulation of body temperature, and excretion of body wastes (Jafari et al., 2006).

Different water sources may be used in the rural area for animal consumption, such as springs, shallow wells, deep and artesian wells, lakes and creeks. The control of the microbiological quality of the water was started with the knowledge of water microbiological characteristics (Amaral, 2004). Water is presumed safe if it has a zero microbial population, provided that mineral content is at safe levels and undesired contaminants are not present. However, presence of microbes in water is not always correlated with a disease in flocks unless it increases above a certain infectious level. Disinfection is the main part of an effective biosecurity program in poultry operations to prevent entry of disease agents and foodborne pathogens in birds (Doreo et al. 2010; Newell et al. 2011) Ideal disinfectants used as a drinking water sanitizer should create disinfectant residuals throughout the distribution system and should inactivate microbes, control biofilms or neutralize undesired contaminants. In poultry industry, sodium hypochlorite, chlorine gas and calcium hypochlorite (Watkins, 2008) was used for drinking water sanitation as disinfectants/oxidizers. New generated and named, as “energized oxygen (O<sub>2</sub>)” is a product that can be introduced to the broiler sector in order to deal with the problems related to disinfection, water hygiene and water quality. The “energized oxygen” generator produced gas has been defined with special features, which is indicating the differences from ozone (O<sub>3</sub>) (IBU, 2012; Profoks, 2017; TPMDA, 2012).

The objective of this study was to evaluate the use of the energized oxygen in hens drinking water to reduced *Escherichia coli*, total aerobic bacteria and total fungi/yeast concentration in feces.

## Material and Methods

### *Ethics Statement*

The owners of the farms were aware that the samples were being collected for this study and gave their permission for doing so.

### **Farm**

Total of 8500, 29-wk-old laying hens at equally (n:8) were housed in cages (60 x 60 cm) of farm building (25 x10 m) that were used in this study. Energized O<sub>2</sub> (1.6g/sec) was diffused to water supply in the farm. Hens were fed and water *ad libitum*.

### **Sampling**

Cloacal swabs, conveyor and egg samples were collected with random sampling from laying hens in the farm. Cloacal swabs and conveyor samples was conducted in four runs; first was before setting up energized O<sub>2</sub> gas as a control, one was after one week, second one was after two weeks (Table 1, Table 2, Table 3).

**1. Conveyor samples:** Fecal samples were collected from the ends of the conveyor belts across the house. Belts were run before or during sampling to accumulate feces on the scrapers. 25 x 2 g feces were collected from each belt. Total fecal sample collection was 200-300 g.

**2. Cloacal swabs:** Sterile swabs were placed cloaca and rectum of each live birds gently. Twenty five birds were sampled randomly and were pooled to obtain five swabs for analysis.

**4. Microbiological analysis:** 20 g of fecal samples were homogenized with 180 ml sterile saline solution from the conveyor belts. Five pooled swab samples from cloaca were put into a sterile falcon test tube (50 ml) with 45 mL sterile saline solution (0.85% NaCl). Each samples mixed in this solution tube was brought to volume (10 mL) with 0.9% sterile saline solution. Samples (0.1 mL) was serially diluted via 10-fold dilutions (from 10<sup>1</sup> to 10<sup>10</sup>). Violet Red Bile Lactose agar (VRBA), Plate Count agar (PCA) and Sabouraud Dextrose agar (SDA) supplemented with chloramphenicol (0.05 mg/ml) were used for the enumeration of total aerobic bacterial count, *E. coli*, and total fungal count, respectively. All PCA and VRBA plates were incubated at 37°C, aerobically, for 24-48h, all SDA plates also were incubated at 25°C, aerobically, for 5-10 days and the number of colonies was counted.

After incubation, colonies formed on double inoculated media were counted and the average number of colonies on double medium was taken. All the data are expressed as CFUxlog10/g.

## Results and Discussion

Total microorganisms counts of the disinfectant groups are given in Table 1, 2, 3. Energized oxygen water resulted in significant reduction of total aerobic bacteria and *E. coli* in cloacal swabs and fecal content on conveyor

in comparison with control and second run. We couldn't achieved an effective results on total fungi/yeast count in our study.

Disinfecting water and water supplies and controlling microbiological issues related to water is taken as an important measure to minimize water borne diseases in poultry production. Especially in layers eggs contamination by microorganisms play a significant role in poultry production and public health.

Although various control measures had been adopted throughout the food production chain, the microbiological testing of eggs during production and processing remain an important role in preventing food-borne infection (Medici et al., 2003). High eggshell contamination is the positive correlation between the total airborne bacteria count in the housing system and the initial eggshell contamination (Protais et al., 2003).

**Table 1. Results of samples before energized O<sub>2</sub> gas was sprayed as controls**

Control	Total aerobic bacterial count (CFU/g)*	Total fungi/ yeast count(CFU/g)	Total E. coli count(CFU/g)
Cloacal swabs	7.33	0.69	3.65
Conveyor samples	10.21	1.89	5.91

\*CFU/g: Colony forming unit in per gram of samples (log<sub>10</sub>)

**Table 2. Results of one week after energized O<sub>2</sub> gas hosed**

Test 1	Total aerobic bacterial count (CFU/g)*	Total fungi/ yeast count(CFU/g)	Total E. coli count(CFU/g)
Cloacal swabs	7.21	3.84	2.81
Conveyor samples	8.99	1.8	4.43

\*CFU/g: Colony forming unit in per gram of samples (log<sub>10</sub>)

**Table 3. Results of two weeks after energized O<sub>2</sub> gas hosed**

Test 2	Total aerobic bacterial count (CFU/g)*	Total fungi/ yeast count(CFU/g)	Total E. coli count(CFU/g)
Cloacal swabs	3.11	1.60	1.16
Conveyor samples	7.69	3.99	3.97

\*CFU/g: Colony forming unit in per gram of samples (log<sub>10</sub>)

Several studies have also reported that drinking water acidification and disinfection is implementation in the poultry industry used for improving performance (Cornelison et al., 2005) and effort to reducing microbial contamination (Philipsen, 2006). For this situation addition of organic acid to the drinking water helps to reduce the level of pathogens in the water and the crop/proventriculus, to regulate gut microflora, to increase the digestion of feed and to improve growth performance (Philipsen, 2006). Açıkgöz et al. (2011) used formic acid to the drinking water but did not determine significant decrease total organism and *E. coli* counts. Chaveerach et al. (2004) reduced *Enterobacteriaceae* in the acidified drinking water compared

with the normal drinking water. It is common that disinfection by chlorination, iodination, ultraviolet light and ozone applications (Wagenet et al., 1995). The physicochemical properties of ozone, its relatively high solubility in water and a high redox potential which destroys the structure of microorganisms, have enabled its commercial application in the 1880s for deodorisation of industrial waste and disinfection of drinking water (Koppenol, 1982). Furthermore, due to the fact that ozone is unstable in water, in which some ozone-resistant compounds occur, including pesticides and chlorinated solvents, only partial oxidation may take place (Hoigne, 1998). Although similar effects with O<sub>3</sub>, energized O<sub>2</sub> is stable in water and friendly with animal and human health (Profoks, 2017).

Energized O<sub>2</sub> usage of drinking water with layers is the first study in Turkey. Energized oxygen can bring new and applicable facilities to the layer chicken system in terms of water hygiene and animal health.

### Conclusion

It is possible to hypothesize that total aerobic bacteria and *E.coli* was affected by energized O<sub>2</sub> but it does not influence particular microorganisms especially fungi. Further researches about this situation is needed. It should be underlined that energized O<sub>2</sub> effects in further investigations are required to confirm and increase our knowledge on the intestinal tract microorganisms of layers.

### References

- AÇIKGÖZ, Z., BAYRAKTA, H. and ALTAN, Ö. (2011) Effects of formic acid administration in the drinking water on performance, intestinal microflora and carcass contamination in male broilers under high ambient temperature. *Asian-Aust. J. Anim. Sci.* 24:96-102.
- AMARAL, L.A. (2004) Drinking water as a risk factor to poultry health. *Rev. Bras. Ciênc. Avícola* 6:191-199.
- BAYLAN, M., CANOĞULLARI, S., AYAŞAN, T. (2007) Kanatlı üretiminde içme suyu kalitesi. 5. Ulusal Zootekni Bilim Kongresi, Yüzüncü Yıl Üniversitesi, 05-08 Eylül, Van.
- CHAVEERACH, P., KEUZENKAMP, D., LIPMAN L. and VAN KNAPEN, F. (2004) Effect of organic acids in drinking water for young broilers on *Campylobacter* infection, volatile fatty acid production, gut microflora and histological cell changes. *Poult. Sci.* 83:330-334.
- DOREA, F.C., BERGHAUS, R., HOFACRE, C. and COLE, D.J. (2010) Survey of biosecurity protocols and practices adopted by growers on commercial poultry farms in GEORGIA, USA. *Avian Dis.* 54: 1007-1015.
- ELEROĞLU, H. and SARICA, M. (2004) Kanatlı üretiminde içme suyu kalitesi. 4. Ulusal Zootekni Bilim Kong. s. 318-324, Isparta.

- IBU. 2012. Abant İzzet Baysal University, Analyse Report of Environmental Engineering Department 12.09.2012, Bolu, Turkey.
- JAFARI, R.A., FAZLARA, A. and GOVAHI, M. (2006) An investigation into Salmonella and faecal coliform contamination of drinking water in broiler farms in Iran. *Int. J. Poult. Sci.* 5:491- 493.
- HOIGNE, J. (1998) Chemistry of aqueous ozone and transformation of pollutants by ozonation and advanced oxidation processes. The Handbook of Environmental Chemistry, Springer, Verlag, Berlin.
- KOPPENOL W.H. (1982) The reduction potential of the couple  $O_3/O_3^-$ . *FEMS Lett.*, 140, 169-172.
- LARDY, G., STOLTENHOW, C. and JOHNSON, R. (2008) Livestock and Water. North Dakota State University, Fargo, North Dakota.
- MEDICI, D.D., CROCI, L., DELIBATO, E., DI PASQUALE, S., FILETICI, E. and TOTI, L. (2003) Evaluation of DNA extraction methods for use in combination with SYBR green I real-time PCR to detect salmonella enterica serotype enteritidis in poultry. *Appl. Environ. Microbiol.* 69:3456-3461.
- NEWELL, D.G., ELVERS, K., DOPFER, D., HANSSON, I., JONES, P., JAMES, S., GITTINS, J., STERN, N.J., DAVIES, R. and CONNERTON, I. (2011) Biosecurity-based interventions and strategies to reduce *Campylobacter* spp. on poultry farms. *Appl. Environ. Microbiol.* 77: 8605-8614.
- PHILIPSEN I. (2006) Acidifying drinking water supports performance. *World Poult.* 22:20-21.
- PROFOKS, (2017) Professional oxygen systems. Omrak Plaza, Ankara, Turkey. [www.Profoks.com](http://www.Profoks.com).
- PROTAIS, J., QUEGUINER, S., BOSCHER, E., PIQUET, J-C., NAGARD, B. and SALVAT, G. (2003) Effect of housing system on the Products, Ploufragan, France, 142-149.
- TPMDA, (2016) Information report from T. C. Ministry of Health, Turkey Pharmaceuticals and Medical Devices Agency 16.08.2016, Ankara, Turkey.
- WATKINS, S. (2008) Water: Identifying and correcting challenges. University of Arkansas Cooperative Extension Service, Fayetteville. *Avian Advice* 10:10-15.
- WAGENET, L., MANCL, K. and Sailus, M. (1995) In Home Water Treatment, NREAS-48, Northeast Regional Agricultural Engineering Service, Ithaca, NY 14853.

## Prevalence of *Dermanyssus gallinae* and Relation with Henhouse Conditions of Backyards in Çanakkale Province in Turkey

Coşkun Konyalı<sup>a</sup>, Hakan Erdem<sup>b</sup>, Türker Savaş<sup>b</sup>

<sup>a</sup>Lapseki Vocational School, Canakkale Onsekiz Mart University, Canakkale, Turkey

<sup>b</sup>Department of Animal Science, Faculty of Agriculture, Canakkale Onsekiz Mart University, Canakkale, Turkey

### Abstract

Investigations were carried out between on 25 August-30 September in 10 districts and 124 villages of Çanakkale. Visited districts and villages into the region were divided into 5 different locations according to the geographical structure and analysis was performed with reference these locations. It was detected that infestation rate of red mite was 72.39% in Çanakkale province. The highest infestation rate was detected in where is located in higher parts of region. Infestation rate was significantly affected factors observed which presence of perch, location, air conditioning, height and roof materials of coops ( $P<0.05$ ). In conclusion, these results showing that geographic and coop conditions should be considered as a point of control of red mite.

**Keywords:** Coop, Ectoparasite, Infestation, Prevalence, Red mite

### Türkiye’de Çanakkale’ye Bağlı Köylerdeki Kümeslerde Kanath Kırmızı Akarı’nın Prevalansı ve Kümes Koşulları ile İlişkisi

#### Özet

Çalışma, 25 Ağustos-30 Eylül tarihleri arasında Çanakkale’ye bağlı 10 ilçe ve 124 köyde gerçekleştirilmiştir. Ziyaret edilen ilçe ve köyler, bölgenin coğrafik yapısına göre 5 farklı lokasyona ayrılarak analizler gerçekleştirilmiştir. Elde edilen bulgulara göre Çanakkale geneline ait akar prevalansının %72.39 olduğu tespit edilmiştir. Lokasyonlar bazında en yüksek prevalansın bölgenin dağlık-yüksek kesimine ait olduğu görülmektedir. Lokasyon, kümes içi havalandırma durumu, tünek varlığı, kümes yüksekliği ve çatı materyalinin akar prevalansı üzerinde istatistiksel olarak önemli etkisinin olduğu tespit edilmiştir ( $P<0.05$ ). İyi havalandırılan, tünek bulunan ve yüksekliği 0.60 m’den yüksek olan kümeslerde prevalansın daha yüksek olduğu görülmüştür. Sonuç olarak *D.gallinae* ile mücadelede bölgenin lokasyonu ve kümese bağlı faktörlerin de ele alınması gerektiği görülmektedir.

**Anahtar kelimeler:** *Dış parazit, Enfestasyon, Kırmızı akar, Kümes, Prevalans*

## **Introduction**

Poultry red mite, *Dermanyssus gallinae* (De Geer, 1778) is hematophagous ectoparasite. It is an obligatory parasite of domestic and wild birds. *Dermanyssus gallinae* is mainly affecting laying hens and other hands previous studies have shown that turkey, pigeon and other pet and wild birds infested by red mite (McGarry and Trees 1991; Circella et al., 2011; Escobar et al., 2014). *Dermanyssus gallinae* is the most important parasite affecting poultry production (Fletcher and Axtell 1991; Maurer and Baumgärtner 1992). Studies on prevalence of red mite are mostly originated from Europe. The review of Sparagano et al. (2009) showed that infestation rates can reach 80–90% of poultry birds as observed in the United Kingdom (UK), Italy, Serbia, Morocco, Japan, Montenegro, and The Netherlands. Except of report of Gıcık (1999) on wild pigeons, there is no any study on red mite prevalence rates in Turkey. In this context, the aims of this investigation were to determine red mite prevalence and expose conditions of backyards chicken houses in Çanakkale province in Turkey and to expose conditions of henhouses.

## **Material and Methods**

This study was conducted between on 25 August-30 September in 10 districts and 124 villages of Canakkale. Types of houses examined were mostly layer hens and small backyards. Totally 124 villages were visited and 355 houses were examined the presence of red mite. As well as mite presence, it was recorded some housing conditions examined. Visited districts and villages into the region were divided into 5 different locations according to the geographical structure and analysis was performed with reference these locations. 'Location 1' includes coastlines of Lapseki, Gelibolu, Eceabat and Center districts. Villages of Biga district situated in north-east of Canakkale was named 'Location 2'. The parts of high altitude of region (Çan, Yenice and a part of Bayramiç districts) were 'Location 3'. Ezine and a part of Bayramiç districts situated on lowland parts were named 'Location 4'. 'Location 5' includes villages of Ayvacık district is elongated in the south of Canakkale and coastline of Aegean Sea. All statistical analyses were performed using SAS Program. Prevalence was determined by henhouses in location surveyed. Prevalence rates were analyzed by locations and overall of Canakkale province. The effects of discussed factors were analyzed using GEE procedure based on binomial distribution. Model was included factors that henhouses conditions (Table 1), regional location of village (5 levels), and applied treatment to control of parasite (Yes-No). The

odds ratio was calculated using estimates obtained from analysis GEE procedure.

**Results and Discussion**

Infestation rate of red mite was 72.39% in overall of Çanakkale province (Fig. 1). According to location prevalence, highest infestation rate was detected in Location 3 (81.25%) where is located in higher parts of region. Lowest prevalence was detected in Location 5 and approximately red mite was detected at 1 of each 2 henhouses in this location (48.57%). Infestation rates can reach 50–90% of poultry birds as observed in the United Kingdom (UK), France, Italy, Serbia, Morocco, Japan, Montenegro, and The Netherlands depending on the breeding systems (Sparagano et al., 2009). Cencek (2003) was reported that prevalence was varied at levels 100% in Poland.

Table 1. Regression coefficients (*b*), standard errors (SE), odds ratios ( $\Psi$ ) and *P*- values of factors discussed on red mite prevalence

<b>Factors</b>	<b>Levels</b>	<b><i>b</i></b>	<b>SE</b>	<b><math>\Psi</math></b>	<b><i>P</i></b>
Location	1	1.16	0.65	3.19 <sup>a</sup>	0.0207
	2	-0.16	0.74	0.85 <sup>b</sup>	
	3	1.68	0.68	5.37 <sup>c</sup>	
	4	1.02	0.65	2.77 <sup>bc</sup>	
	5	0.00	0.00	1.00 <sup>b</sup>	
Air Conditioning	Good	2.50	0.58	12.18	<0.0001
	Bad	0.00	0.00	1.00	
Window	Yes	-0.14	0.56	0.87	0.8039
	No	0.00	0.00	1.00	
Floor	Wet	-1.36	0.88	0.26	0.1070
	Dry	0.00	0.00	1.00	
Perch	Existing	1.57	0.69	4.83	0.0013
	No	0.00	0.00	1.00	
Height	Short	0.60	0.56	1.82 <sup>a</sup>	0.0058
	Medium	1.64	0.57	5.14 <sup>b</sup>	
	High	0.00	0.00	1.00 <sup>a</sup>	
Roof Materials	Asbestos	1.12	0.56	3.06 <sup>b</sup>	0.0212
	Tile	1.30	0.48	3.68 <sup>b</sup>	
	Wood	1.47	0.89	4.31 <sup>b</sup>	
	Galvanize	0.00	0.00	1.00 <sup>a</sup>	
Treatment	Yes	0.68	0.48	1.97	0.1584
	No	0.00	0.00	1.00	

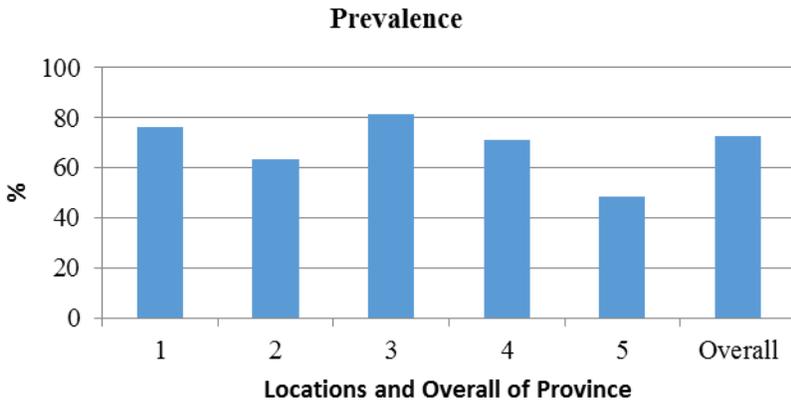


Figure 1. Prevalence by Location and Overall of Çanakkale

Effect of location is statistically significant on prevalence ( $P=0.0207$ ; Table 1). Infestation rate were 5.37 times higher in Location 3 compared with Location 5. Obtained results showed that highest infestation rates of regions high altitude are marked to environmental conditions of these locations were more convenient for *Dermanyssus gallinae*. Because temperature was relatively lower in high altitudes compared with other locations throughout the season of this study. Additionally, the most specific characteristics of these locations were have been humid or hemi-humid location during summer. Tucci et al., (2008) reported that high mortality at 35 °C that this temperature had adverse effects on development of *D. gallinae*, and that in field conditions *D. gallinae* populations may decrease or even disappear due to the negative impact of high temperature on development. In this context, difference between locations and 'having higher prevalence of Location 3' may be caused from this reason. Also air conditioning of henhouses was found to be statistically significant on prevalence and henhouses having better air conditions were 12.18 times higher infestation rate ( $P<0.0001$ ). There is no significant effect of window existing on mite prevalence ( $P=0.8039$ ). Dry floor in the henhouses have much possibility by high prevalence levels comparing with wet floor but this difference is no important statistically ( $P=0.1070$ ). Henhouses having perches were showed 4.83 times more prevalence levels ( $P=0.0013$ ). House height was statistically significant on prevalence and houses were the short from 0.6 m. had less infestation. Roofing material was significantly affected on prevalence of red mite ( $P=0.0212$ ). Least infestation rate was detected in galvanized roofing materials. There is no significant effect of treatment on the mite prevalence ( $P=0.1584$ ). Roofing material was significantly affected on prevalence of red mite. Least infestation rate was detected in galvanized roofing materials.

During this study was observed that houses roofing with galvanized materials were more hot and sweltering conditions. Due to this effect, probably houses roofing with galvanized materials would had been less prevalence. Henhouses having perches were showed higher prevalence levels ( $P=0.0013$ ). Perches are adequate places for hiding and nesting for mites and so mites may have longer survival in these houses. Although the perches are the equipment that birds need, the perches are a good hiding and aggregation place for mites. House height was statistically significant on prevalence and houses were the short from 0.6 m. had less infestation. This may be caused from environmental conditions (e.g. temperature, air conditioning). Because it was seen that the high henhouses had better ventilation conditions. Additionally, it was observed that hens haven't been quietly appeared in these henhouses in summer. The prevalence was not statistically affected by the parasitic treatment ( $P=0.1584$ ). It was detected that parasitic treatment was practiced inaccurately and this leads to ineffective treatments of mite-struggling. It is also known that mites may develop resistance to chemicals used for control (Sparagano et al., 2014).

### Conclusion

This study being first report on prevalence of *Dermanyssus gallinae* in backyards in Turkey was showed that red mite is serious problem. In general, it was seen that infestation rate raises with coop conditions improved. Prevalence was higher in better and well-ventilated henhouses. Furthermore, prevalence may have varied by location and the parameters discussed are closely related by henhouses conditions. It should be noted these results are valid for period studied and this study should be spread over the entire year. Knowledge relation of henhouse conditions and survival during specific abiotic conditions provides useful information for the understanding of their population dynamics.

### References

- CENCEK, T., (2003). Prevalence of *Dermanyssus gallinae* in Poultry Farms in Silesia Region in Poland. Bull. Vet. Inst. Pulawy, 47:465–469.
- CIRCELLA, E., PUGLIESE, N., TODISCO, G., CAFIERO, M.A., SPARAGANO, O.A.E., CAMARDA, A., (2011). Chlamydia psittaci Infection in Canaries Heavily Infested by *Dermanyssus gallinae*. Exp. Appl. Acarol., 55 (4): 329-38.
- ESCOBAR, C.M.A., PÉREZ-LARA, E., GARCÍALÓPEZ, J.C., ARROYO-LEDEZMA, J., SÁNCHEZ-BERNAL, E.I., (2014). Parasitic Mites in Backyard Turkeys In Oaxaca's Coast, Mexico. Tropical and Subtropical Agroecosystems, 12: 675 - 679.
- GİCİK, Y., (1999). Ankara ve çevresinde yaban güvercinlerde ektoparazitler. Kafkas Üni. Vet. Fak. Derg. (1999), 5(1):71-74.

- FLETCHER, M.G., AXTELL, R.C., (1991). Susceptibility of northern fowl mite, *Ornithonyssus sylviarum* (Acarina: Macronyssidae), and chicken mite, *Dermanyssus gallinae* (Acarina: Dermanyssidae) to selected acaricides. *Exp Appl Acarol* 13:137–142. doi:10.1007/BF01193664.
- MAURER, V., BAUMGÄRTNER, J., (1992). Temperature Influence on Life Table Statistics of The Chicken Mite *Dermanyssus gallinae* (Acari: Dermanyssidae). *Exp. Appl. Acarol.*,15: 27:40.
- MCGARRY, J., TREES, A., (1991). Trap Perches to Assess The Activity of Pyrethrins Against The Poultry Red Mite *Dermanyssus gallinae* In Cage Birds. *Exp Appl Acarol* 12:1–7.
- SPARAGANO, O., PAVLICEVIC, A., MURANO, T., CAMARDA, A., SAHIBI, H., KILPINEN, O., MUL, M., VAN EMOUS, R., BOUQUIN, S., HOEL, K., CAFIERO, M.A., (2009). Prevalence And Key Figures For The Poultry Red Mite *Dermanyssus gallinae* Infections In Poultry Farm Systems. *Exp. Appl. Acarol.* 48:3–10.
- SPARAGANO, O.A.E., GEORGE, D.R., HARRINGTON, D.W.J., GIANGASPERO, A., (2014). Significance and Control of the Poultry Red Mite, *Dermanyssus gallinae*. *Annu. Rev. Entomol.* 59:447–66.
- TUCCI, E.C., PRADO, A.P., ARAUJO, R.P., (2008). Development of *Dermanyssus gallinae* (Acari: Dermanyssidae) at Different Temperatures. *Vet. Parasitol.*, 155:127–32.

## Serological Study of H5, H7 and H9 Avian Influenza Viruses in Native Geese and Ducks of Rural Areas Around Neor Lake in Ardabil Province, Northwestern Iran

Aidin Azizpour<sup>a</sup>, Saeed Seifi<sup>b</sup>

<sup>a</sup>Meshginshahr Faculty of Agriculture, University of mohaghegh Ardabili, Ardabil, Iran

<sup>b</sup>Faculty of Veterinary Medicine, Amol University of Special Modern Technologies, Amol, Iran

### Abstract

Influenza viruses belong to the Orthomyxoviridae family which has been divided into three types C, B and A. Type A is considered to be the most pathogenic in humans, birds and some mammals. Type A influenza virus serotypes are determined on the basis of hemagglutinin (HA) and neuraminidase (NA) glycoprotein. Under subtypes H5N1, H7N1 and H9N2, they cause severe and mild diseases in birds, respectively. Wild and waterfowls with no clinical signs of avian influenza virus can transmit it to other birds. Given that Neor Lake, which is located in southeastern Ardebil, is a habitat for migratory birds and waterfowl, there is a possibility of contact between these birds and the native poultry of the region. The purpose of this research was to study the serology of Avian Influenza viruses in domestic geese and ducks of rural areas around Neor Lake in Ardabil province during 2017. Therefore, 65 unvaccinated birds (43 ducks and 22 geese) were randomly selected, blood samples collected from their wing veins and sent to serological laboratory. The serum was tested for H5N1, H7N1 and H9N2 avian influenza viruses by HI. The results of this study showed that serum samples were negative against H5N1, H7N1 avian influenza viruses, but 9 samples (13.8%) were positive for H9N2 avian influenza virus. According to HI test, the prevalence rate of H9N2 Influenza Virus was not high in domestic ducks and geese. However, direct or indirect contact with industrial poultry farms can spread the virus.

**Key words:** *Avian influenza virus, Domestic ducks and geese, Neor Lake*

## Physical Control Deficiencies *Dermanyssus gallinae*, and How to Overcome Them

Pavlicevic, A.<sup>a</sup>, Ratajac R.<sup>b</sup>, Milica Dotlic<sup>a</sup>, Igor S.<sup>b</sup>, Pavlovic I.<sup>c</sup>

<sup>a</sup>AVES MIT" DOO, Subotica-Bajmok, 24210 Bajmok, Cluster "Dermanyssus gallinae", Serbia

<sup>b</sup>Scientific Veterinary Institute „Novi Sad“, Novi Sad, Serbia

<sup>c</sup>Scientific Veterinary Institute of Serbia, Belgrade, Serbia

### Abstract

The main deficiencies of the *D. gallinae* control formulation SiO<sub>2</sub> are the following: formulation efficiency discrepancies, difficult application, applicator complexity, delayed lethal effect and the possibility of mite eggs, removal from surfaces, a small lethal capacity per surface unit, great impact of dirt and low penetrative intensity, behavioral adaptation, negative impact of humidity, freezing of liquid forms, repellency effect and others. Some improvement suggestions are the following: choice of formulation according to established efficiency, expert application and programmed, combined use in an empty facility, with mandatory rest period. Expected results: high level of suppression, and in an optimal procedure extermination of *D. gallinae* from production facilities. The second generation of inert substances P 547/17 has significantly improved characteristics.

### Introduction

In the physical control of red poultry mite (*Dermanyssus gallinae*) temperature, light and inert substances can be used (Sparagano, 2014). Of the three, most commonly used are inert substances based on SiO<sub>2</sub>. SiO<sub>2</sub> formulations have provided an alternative in *D. gallinae* control (Kilpinen and Steenberg, 2009), but have also demonstrated their disadvantages. Even with toxicological problems (Pavlicevic et al, 2017a) and resistance development (Marangi et al, 2009; Abbas et al, 2014; Pavlicevic et al, 2016), synthetic chemical compounds with neurotoxic impact have so far prevailed as the dominant way of controlling *D. gallinae* (Sparagano et al.2014; Pavlicevic et al, 2017b,c).

### Aim

Defining the deficiencies of inert substances in laboratory and clinical environment and offering improvement suggestions.

### Materials and Methods

Laboratory examinations were conducted with *D. gallinae* adult laboratory specimens which were fed females, with the Petri dish method and tin boxes. The examinations included two one-minute direct and full exposure periods,

and one one-hour subsequent exposure period. The clinical examinations were conducted with expert and controlled application of chosen formulations and monthly monitoring, which relied predominantly on visual checks and early detection method (Pavlicevic et al., 2017b) in the period from 2012 till the end of 2017.

**Results**

Table 1. Results for laboratory examinations of f SiO<sub>2</sub> formulations (powder and liquid form) and P 547/17 efficiency on *D. gallinae*

No	Formul., other	Exp. 1 (min./hr)	Day of results, efficiency (%)				
			1.	2.	3.	4.	5.
1	Natural DE	min.	5	12	11	13	34
		hr.	14	30	25	46	52
2	Natural DE	min.	12	25	79	98	-
		hr.	33	46	89	98	-
3	Natural DE	min.	17	72	82	86	89
		hr.	0	84	94	94	
4	Natural DE	min.	92	100	-	-	-
		hr.	99	100	-	-	-
5	Powder formula	min.	1	15	45	83	92
		hr.	1	15	43	82	88
6	Powder formula	min.	2	31	75	91	92
		hr.	1	22	59	69	88
7	Liquid formula (no.6)	min.	0	9	18	41	64
		hr.	0	0	3	0	-
8	Liquid formula	min.	13	35	37	-	-
		hr.	14	45	55	59	71
9	Liquid formula	min.	85	91	-	-	-
		hr.	37	78	88	97	100
11	Liquid formula	min.	71	88	90	-	-
		hr.	41	88	90	-	-
12	Residual effect 60 days (no.11)	hr.	38	73	80	-	-
13	P 547/17	min.	100	-	-	-	-
		hr.	100	-	-	-	-
14	P 547/17 Residual effect 60 days (no.13)	hr.	100	-	-	-	-

Table 2. Clinical efficiency of SiO<sub>2</sub> formulations (powder, liquid form and combined application) and P 547/17 to *D. gallinae*

No	Facility capacity	Means	Suppression duration (months)	Results (-/+) (months)
1	19000	DE (no.2)	5	Vis.
2	40000	DE (no.2)	4	Vis.
3	18000***	DE (no.2)	6	Vis.
4	14000	Liquid, (no.9)	6	Vis.
5	35000	Liquid, (no.9)	7	Vis.
6	42000***	Liquid, (no.9)	10	Vis.
7	70000*	Liquid, (no.9)	2	Vis.
8	22000	Comb., no (2+9)	5	Vis.
9	2500 ***	Comb., no (2+9)	12	12 (-)
10	45000 ***	Comb., no (4+9)	12	10 (-)
11	25000 ***	Comb., no (4+9)	12	12 (-)
12	6 x 25000 ***	Comb., no (4+9)	12	12 (-)
13	25000	P 547/17 (15 %)	Pending	од 7. (+)
14	2000 ***	P 547/17 (15 %)	Pending	6 (-)
15	4500 ***	P 547/17 (15 %)	Pending	6 (-)
16	28000	P 547/17 (17, 19 %)	3,5	Vis.

Key:\* no facility rest period, populated half dried \*\*\* with facility rest period and ambient conditions for *D.gallinae* activity (-) negative result for early detection method for *D. gallinae* (+) *D. Gallinae* presence detected, Vis. Visual examination

## Discussion

### SiO<sub>2</sub> formulation deficiencies:

- Laboratory examinations distinguish between the different efficiency of formulations (Kilpinen and Steenberg, 2009; Maurer at all, 2009; Schulz, 2014; Pavlicevic et. al, 2017a), that is those formulations the use of which is not and those those the use of which is justified. This suggests that the incorrect (accidental) choice of formulation (compound) can make the control inefficient.
- Lethal effect is slow, and in that time gravid females can lay eggs. This time period differs according to the formulation and can severely diminish the control effectiveness.
- The application requires expert training and suitable equipment for powder and liquid suspensions respectively. It is necessary that they can withstand material abrasion.
- The powder form can be successfully applied to the cage and equipment by electrostatic attraction. However, powder formulations cannot technically be applied to all the important areas of the cage and equipment. Liquid suspensions have better application possibilities, but their use is irrational and technically impossible for certain surfaces.
- Powder form is easy to remove, as well as liquid while it is still wet. After the liquid form dries, its persistency depends on the formulation.
- Their effect is strictly through contact. In places where they are not applied or have been removed the possibility of *D. gallinae* survival exists.

- They have a good residual effect, however greatly condition by circumstances. Especially if an inadequate amount is used in a populated facility.
- A small lethal effect by surface unit means insufficient efficiency with populated facilities. Especially combined with great infestation, unclean surfaces, layer removal and laying eggs and lethally exposed gravid females.
- Behavioral adaptation (Ebeling, 1971) is a very pronounced mechanism, by which *D. gallinae* can successfully adapt to SiO<sub>2</sub> formulations' deficiencies.
- The repelling effect further diminishes efficiency and stimulates *D. gallinae* adaptation.
- Freezing temperatures damage a layer of the liquid suspension applied in an empty facility and reduces its efficiency.
- The humidity of the environment has a great impact on the efficiency of the SiO<sub>2</sub> formulation (Kilpinen and Steenberg, 2009).
- Impurities prevent contact and the effect of the formulation. Beside the production process, the mite themselves create impurities and block the effect of the surfaces. Distribution in an unclean environment is not sufficient.

An optimal application can be done through programmed, combined application of selected formulations (Pavlicevic et al, 2017b, c) in an empty facility with mandatory rest period. Places conditioned by distribution and of particular importance are necessarily covered with the liquid form. The full environment coverage is then made with the powder form. Clinical results confirm the potential of high suppression levels, even extinction in the case of optimal program control. After SiO<sub>2</sub>, the second generation of inert substances are P 547/17 emulsions. Toxicologically inert compounds are highly efficient for *D. gallinae*. They do not require a special kind of applicator, machine application is also possible alongside great efficiency and better distribution. The length and efficiency of the residual effect is more intense than any which has been noted so far, but only on nonabsorbent surfaces, such as cages and equipment. Absorbent surfaces, such as concrete floor require the use of other inert formulations, so that the effect would be complete. The results of clinical examinations and practical application both depend on a number of factors. The limits of this report do not allow for a detailed analysis of all of them, but rather it serves to point to the most important information.

### **Conclusion**

Examination results suggest that with the approval of appropriate suggestions for inert substance application improvement, the formulations' deficiencies are minimized and their quality highlighted, and therefore a perspective in rational *D. gallinae* control is provided.

## References

- ABBAS, R.Z., COLWELL, D.D., IQBAL, Z. and KHAN, A. (2014) - Acaricidal drug resistance in poultry red mite (*Dermanyssus gallinae*) and approaches to its management. *Worl.Poul.Sci. J.* 70:113-124.
- MARANGI, M., CAFIERO, M.A., CAPELLI, G., CAMARDA, A., SPARAGANO, O.A.E. and GIANGASPERO, A. (2009) Evaluation of the poultry red mite, *Dermanyssus gallinae* (Acari: Dermanyssidae) susceptibility to some acaricides in field populations from Italy. *Exp. Apply Acarol*, 48:11-18.
- MAURER, V., PERLER, E. and HECKENDORN, F. (2009) In vitro efficacies of oils, silicas and plant preparations against the poultry red mite *Dermanyssus gallinae*. *Exp. Apply Acarol*. 48:31–41.
- P 547/17 - Potvrda o prijemu patenta. Naziv: "Smeša koja sadrži parafinsko ulje kao insekticidno i akaricidno jedinjenje". Podnosilac: "Pullos" d.o.o., Novi Beograd "Silikoni"d.o.o., Barič. Punomoćnik: advokat Gordana Popović. Pronalazač: spec.vet.med. Aleksandar Pavličević i dipl.ing. Predrag Kovačević. Elp- 2017/0342.
- PAVLIČEVIĆ, A., PAVLOVIĆ, I., STAJKOVIĆ, N. and BRATISLAV, P. (2016) Evidence for Resistance to Carbaryl in Poultry Red Mites from the Republic of Serbia and Montenegro. *ANIMAL SCI. BIOTECHNOL.* 49:222-225.
- PAVLIČEVIĆ, A., JONGUNG YOON, VASIĆ, A. and PAVLOVIĆ, I., (2017a) -¿Cómo evitar casos como la contaminación de huevos con fipronil? *Albéitar* (Esp) 212:51-53.
- PAVLIČEVIĆ, A., VASIĆ, A., PAVLOVIĆ, I. and JONGUNG YOON (2017b) Detección temprana del ácaro rojo. *Albéitar* (Esp) 205:24-26
- PAVLICEVIC, A., YOON, J. and PAVLOVIC, I. (2017c) Control of red poultry mite (*Dermanyssus gallinae*) by mechanical effect: the choice of current improvements of formulations, application and concept. 3 rd COST Conference 20, 21 September 2017. Oeiras, Portugal. Abstract book.
- SCHULZ J. (2014) - Maßnahmen zur Bekämpfung der Roten Vogelmilbe (*Dermanyssus gallinae*) in der ökologischen Legehennenhaltung. Inaugural-Dissertation zur Erlangung des Grades eines Doktors der Veterinärmedizin an der Freien Universität Berlin. Berlin 2014 Journal-Nr.: 3702
- SPARAGANO, O.A.E., GEORGE D.R., HARRINGTON, D.W.J. and GIANGASPERO, A. (2014) Signifiacion and Control of the Poultry Red Mite, *Dermanyssus gallinae*. *Ann.Rev.Entomol.* 59: 447-66.

## SibMOS Pro as An Alternative to Fodder Antibiotics

Berezin S.S.<sup>a</sup>, Kozlova Ju.N.<sup>b</sup>, Davidova N.V.<sup>c</sup>, Afonyushkin V.N.<sup>b,c</sup>

<sup>a</sup>LTD SIBAF

<sup>b</sup>Institute of Chemical Biology and Fundamental Medicine Siberian Branch of the Russian Academy of Sciences

<sup>c</sup> Siberian Federal Scientific Centre of Agro-BioTechnologies of the RAS (Russian Federation, Novosibirsk)

### Abstract

LTD SIBAF Company has developed the innovative fodder additive “SibMos-pro” that combines the properties of a probiotic, a prebiotic and a mycosorbent. The main component of the “SibMos-pro” is mannan-oligosaccharide (MOS). *Paramecium caudatum* were used as a model for toxicological testing of feed. It was shown that addition “SibMos-pro” to toxic feed at the dose of 1 kg / ton didn't change the motility of *P. caudatum*, whereas the death of all infusorians was detected in control feed sample without using the “SibMos-pro”. Thus it was shown that feed concentrate “SibMos-pro” significantly reduces feed toxicity.

**Key words:** *mannan-oligosaccharide, mycotoxin, Paramecium caudatum, zearalenone, mycosorbent*

### Introduction

Poultry farming is one of the branches of animal husbandry that provides high-quality and valuable meat for human consumption. To stimulate a body weight's increase in chickens, poultry farmers successfully use a variety of drugs that improve feed intake and digestibility, increase body weight gain, reduce the incidence and waste of poultry. However the main condition for achieving high results in poultry farming is proper feeding. Birds, consuming low-quality feed, are often exposed to mycotoxicosis, dysbiosis etc. As a result body weight gain and safety of broilers are reduced. This problem became especially urgent at the present time, when most countries refused to use fodder antibiotics. Significant help in this situation have new regulators of intestinal biosynthesis.

LTD SIBAF Company has developed the innovative fodder additive “SibMos-pro” that combines the properties of a probiotic, a prebiotic and a mycosorbent. This fodder additive is widely used in the territory of the Russian Federation.

The main component of the “SibMos-pro” is mannan-oligosaccharide (MOS). MOS are a glucomannoprotein complex derived by enzymatic hydrolysis of the inner cell wall of the *Saccharomyces cerevisiae* yeast.

MOS are well known for their high ability to bind a wide range of mycotoxins (Shetty P.H., Jespersen L., 2006), such as aflatoxin B1, ochratoxin A, T-2 toxin, zearalenone, fumonisin B1, deoxynivalenol etc., but at the same time MOS do not adsorb vitamins, microelements and amino acids. Mycotoxins are adsorbed with MOS both in the feed and in gastrointestinal tract.

### Materials and Methods

To investigate the adsorption of mycotoxin zearalenone with the “SibMos-pro” we added 400ppb of zearalenone to 1 ml 10% suspension of “SibMos-pro”. After 30 min of incubation the sample was centrifuged and concentration of zearalenone in the supernatant was estimated using ELISA. We wasn't be able to detect any zearalenone in the supernatant (concentration of zearalenone was below the detection threshold), which means that most of zearalenone was bound with “SibMos-pro”. Paramecium caudatum were used as a model for toxicological testing of feed. They quickly react to toxic substances by changing their motility and increasing mortality.

### Results and Discussion

It was shown that addition “SibMos-pro” to toxic feed at the dose of 1 kg / ton didn't change the motility of *P. caudatum*, whereas the death of all infusorians was detected in control feed sample without using the “SibMos-pro”. Thus it was shown that feed concentrate “SibMos-pro” significantly reduces feed toxicity.

Besides the adsorption properties, MOS serve as an alternative attachment field for various pathogenic bacteria, including gram negative. MOS in the "SibMOS-pro" bind bacterial receptors and remain on bacterial surfaces. Such bonds aren't destroyed with digestive enzymes, so pathogenic bacteria with blocked receptors cannot attach to the epithelial cell's surfaces and, consequently, pathogens are removed from the digestive tract. Moreover MOS alter the characterization of gut microbiota and enhance gut morphology by increasing absorptive surface area and improving microvilli structure (Dimitroglou et al, 2009).

Other important of the “SibMos-pro” is the complex of rod-shaped spore-forming aerobic bacteria *B. subtilis* and *B. licheniformis*. These microorganisms are widely studied, safe for humans and animals, resistant in the digestive tract and stable under storage. It was shown that *B. subtilis* and *B. licheniformis* produce more than 45 antimicrobial molecules (Stein T., 2005), therefore these bacterial strains have an antagonistic activity to the wide range of microorganisms, such as *Staphylococcus aureus*, *Escherichia coli*, *Clostridium spp.*, *Pseudomonas aeruginosa*, *Proteus vulgaris* etc. Moreover *B. subtilis* and *B. licheniformis* stimulate the growth of lacto- and

bifidobacteria in gastrointestinal tract, stimulate specific and non-specific immunity and synthesize more than 20 digestive enzymes.

Numerous studies of the "SibMOS-pro" in Russian poultry farms have shown that fodder additive "SibMOS-pro" improved broiler performance through all growth periods and safety of the broiler population, while the control group obtained lower growth rates. The European Broiler Index (EBI) was increased by 2,4% in comparison with the control group; feed conversion rate (FCR) is decreased.

### **Conclusion and References**

Thus "SibMOS-pro" is an effective tool for raising productivity and profits in the livestock and poultry farming.

## Hepafon - Complex Hepatoprotector

Berezin S.S.<sup>a</sup>, Zinchenko E.<sup>a</sup>, Kozlova Ju.N.<sup>b</sup>, Afonyushkin V.N.<sup>b,c</sup>

<sup>a</sup>LTD SIBAF

<sup>b</sup>Institute of Chemical Biology and Fundamental Medicine Siberian Branch of the Russian Academy of Sciences

<sup>c</sup>Siberian Federal Scientific Centre of Agro-BioTechnologies of the RAS (Russian Federation, Novosibirsk)

### Abstract

The hepatitis of various etiologies is an important factor limiting both the safety and productivity of poultry.

**Key words:** *Adenoviral infections, Biochemical monitoring of hepatitis, Hepatitis, Hepatoprotectors, Mycotoxins*

### Introduction

The hepatitis of various etiologies is an important factor limiting both the safety and productivity of poultry. In case of accidental feeding of poultry feed with high content of mycotoxins, it is not possible to introduce mycosorbents to have produced batches of feed and the only option is to introduce of hepatoprotectors. The prevention of liver damage caused by mycotoxins and a number of viruses, should include a precise localization in time periods of application for protections of liver, with clarification of the methods of biochemistry or pathology monitoring.

### Materials and Methods

Analysis of liver disease were are carried out on poultry in Siberia: Kemerovo Region, Krasnoyarsk Territory, the Altai Territory. Diagnosis of inclusion body hepatitis of chickens and hepatosplenomegaly performed using histological techniques. For the diagnosis of reovirus infection using enzyme-linked immunosorbent assay (ELISA). The testing of "Gepafon" production SIBAF was carried out on poultry in Siberia farms.

### Results and Discussion

Modern hepatoprotectors should combine a number of functions - detoxification, minimizing damages, stimulation of liver regeneration, and stimulation of energy metabolism and metabolic processes. Unlike the medical drug the hepatoprotector for chicken should to be cheap due to the use of the minimum required spectrum components. Hepatitis, infections caused by adenovirus, are widespread in the poultry industry. At the biochemical monitoring of hepatitis from the 10th day to 25th day),

increased activity of the enzyme ALT during adenoviral infections in the blood serum is evidence of hepatitis spread dynamics in the herd and thus to allows determine the terms of application of hepatic protectors. In case of accidental feeding of poultry feed with high content of mycotoxins, it is not possible to introduce mycosorbents to have produced batches of feed and the only option is to introduce of hepatoprotectors. Hepatoprotectors "Gepafon" from the company SIBAF is a combination of nutrients in synergistic combination which provides a comprehensive correction of unfavorable metabolic processes that occur in hepatites and hepatosises. The components of the drug is intensify gluconeogenesis and liver regeneration processes, prevent accumulation of free radicals and deliver methyl and -SH groups for inactivation of a number of toxins. The totality of ingredients of hepatoprotectors can be used to increase resistance to intoxications (mycotoxins xenobiotics), hepatites.

### **Conclusion and References**

In the conditions of industrial poultry farming, prevention of liver damage caused by mycotoxins and a number of viruses, should include a precise localization in time periods of application for protections of liver (with clarification of the methods of biochemistry or pathology monitoring), providing antioxidant protection, transport, reduction of copper, activation energy metabolism, providing substrates to inactivate the toxins.

## Effects of Dietary Glutamine and Quercetin on Performance and Jejunum Histomorphology of Broilers

Pinar Sacakli<sup>a</sup>, Ahmet Ceylan<sup>b</sup>, Ali Calik<sup>a</sup>

Ankara University Faculty of Veterinary Medicine, <sup>a</sup>Department of Animal Nutrition and Nutritional Disease, <sup>b</sup>Histology and Embriology, 06110 Ankara- Turkey

### Abstract

This study evaluated the effect of dietary glutamine and/or quercetin on performance and jejunum histomorphology of broiler chicks. A total of 320 Ross 308 male broiler chicks were used in the experiment. Birds were randomly distributed 4 treatment groups with 10 replicates each of 8. Experimental diets were supplemented with 0% (C) 1% glutamine (G), 0.05% quercetin (Q) and 1% glutamine + 0.05% quercetin (GQ), respectively. Body weight gain of the birds in C group was lower ( $P<0.01$ ) than those of the birds in G, Q and GQ groups. Feed conversion ratios were improved ( $P<0.001$ ) by dietary glutamine and/or quercetin compared to C group, and found as 1.452, 1.332, 1.338 ve 1.349 in C, G, Q and GQ groups, respectively. At 21 day of age, while glutamine was not affect villus height, quercetin alone or in combination with glutamine increased jejunum villus height. There were no differences in villus height/crypt depth ratio, tunica muscularis thickness among the groups.

**Key Words:** *Broiler, Glutamine, Jejunum histomorphology, Quercetine*

### Introduction

In the poultry industry where the intensive farming is carried out, the passive immunity and healthy intestinal microflora of the chicks does not develop because of preventing the contact with the broodstock. In addition, numerous stress factors, such as transport, delaying of feed intake and temperature fluctuations, negatively affect the development of intestinal microflora. It has been demonstrated that amino acid and antioxidant additives to be added to broiler rations may be beneficial in forming a protective barrier against pathogenic microorganisms by increasing mucin secretion, protecting tissues against free radicals by removing reactive oxygen species from the body, and protecting cells from harmful effects of oxidative stress (Bartel and Batal 2007; Chen et al., 1990). However, the addition of amino acid and antioxidant additives to the rations; positively affects intestinal histomorphology and integrity and may improve the overall health condition and performance of the poultry. Glutamine is no essential but has been classified as a functional amino acid. Quercetin a very strong antioxidant belonging to the flavonol class of flavonoids. However, it is clarified by in

vitro and in vivo (especially in mice and humans) studies that both compounds have positive effects on antibacterial, antioxidant, immunomodulator and intestinal development, there are not enough studies on these compounds especially on birds. In this study, we tried to determine the effects of dietary supplementation of glutamine and quercetin on performance and intestinal histomorphology in broiler chickens challenged with lipopolysaccharide (LPS) at 21 days of age.

### **Materials and Methods**

All experimental procedures were approved by the Animal Ethics Committee of Ankara University (2015-10-129). A total of 320 Ross x Ross 308 broiler chicks were obtained from a commercial hatchery (Beypiliç, Bolu, Turkey). Four treatment groups were randomly assigned to 10 replicate pens of 8 birds each. The experimental diets were based on corn soybean meal in Control without supplementation and in 3 treatments with Glutamine (1%) Quercetin (0.05) and Glutamine (1%) +Quercetin (0.05%) supplementations. All diets were formulated to meet or exceed NRC (1994) nutrient recommendations for broilers. Diets for all groups were isocaloric and isonitrogenic. Water and the mash form experimental diets were provided ad libitum throughout the experimental period. Chicks were either injected intraperitoneally with Sallmonella Typhimirium LPS (250µg /kg of BW; Sigma, St. Louis, MO) or saline with a 0,5x16mm sterile needle (25G). Broiler performance responses, body weight gain (BWG), feed intake (FI, g), and feed conversion ratio (FCR, feed intake/weight gain) were determined per week during the 3 weeks experimental period. All chicks were individually weighed and feed intake (FI) was calculated on a pen basis and feed conversion ratio (FCR) were calculated by dividing FI:BWG. At 21 d of age, after 4 hours LPS or saline injection two birds (one LPS injected, one saline injected) from each replicate were euthanized by exsanguination and the intestinal tract was immediately removed. Tissue samples were obtained from the jejunum for histomorphologic analysis. Fragments of approximately 5 cm in length were obtained from jejunum (from the distal portion of the duodenal loop to Meckel's diverticulum)Villus height, crypt depth, villus height: crypt depth ratio villus width and tunica muscularis thickness (Sacakli et al., 2015) and Goblet cells (Calik and Ergun, 2015) were determined. Data were analysed using the ANOVA procedure of the SPSS software, version 14.01 (SPSS Inc., Chicago, IL). Significant differences among treatment groups were tested by Tukey multiple range tests. Statistical differences were considered significant at  $P \leq 0.05$ .

**Results**

Effect of glutamine and/or quercetin supplementation on BW, BWG, FI and FCR to broiler chick diets were given Table 1. There was no significant difference in BW among the groups at 7 and 14 days. On the 21st day of the experiment, BW of the chicks in control group was significantly ( $P < 0.01$ ) lower than those of the chicks in other experimental groups. The same situation was observed in terms of BWG.

**Table 1.** Effect of glutamin and/or quercetin supplementation on broiler performance at 21days of age.

	Treatments				Statistics	
	C	G	Q	G+Q	SEM	P-value
	0-21 d					
BW, g						
0	40.19	40.19	40.17	40.19	0.025	0.984
7	143.05	149.45	146.10	145.39	1.068	0.206
14	372.58	388.22	373.67	373.83	3.166	0.250
21	727.96 <sup>b</sup>	771.44 <sup>a</sup>	771.13 <sup>a</sup>	756.14 <sup>a</sup>	4.671	0.001
BWG, g						
0-7	102.86	109.25	105.93	105.19	1.075	0.212
0-14	332.39	348.02	333.50	333.64	3.171	0.252
0-21	687.77 <sup>b</sup>	731.25 <sup>a</sup>	730.96 <sup>a</sup>	715.94 <sup>a</sup>	4.680	0.001
FI, g						
7	125.20	124.37	120.50	122.22	1.676	0.766
14	315.61	310.17	308.59	308.54	2.975	0.561
21	557.85	539.65	548.46	535.57	5.86	0.561
FCR						
0-7	1.218	1.139	1.141	1.168	0.017	0.335
0-14	1.377	1.300	1.360	1.351	0.011	0.086
0-21	1.452 <sup>a</sup>	1.332 <sup>b</sup>	1.338 <sup>b</sup>	1.349 <sup>b</sup>	0.011	0.000

<sup>1</sup>Data represent mean values of 10 replicates per treatment. <sup>2</sup>C-Control: birds fed a basal diet, G: birds fed a basal diet + 1 % glutamine supplementation, Q: birds fed a basal diet + 0,5 % quercetin supplementation, G+Q: birds fed a basal diet + 1 % glutamine + 0,5 % quercetin supplementation.

Feed conversion ratio in C, G, Q and G+Q groups were found as 1.452, 1.332, 1.338 ve 1.349 and the difference between control and other treatment groups was statistically ( $P < 0.001$ ) important. The villus height, crypt depth, villus width, villus height: crypt depth ratio and tunica muscularis thickness are given in Table 2 on the 21st day of the experiment. Contrary to expectations, glutamine had no effect on the height of the jejunal villus height and it was found to be similar to the control group. However, the use

of quercetin alone or in combination with glutamine has significantly increased the villus height. The lowest crypt depth was obtained from the chicks fed with quercetin and significantly lower than those of the chicks fed with glutamine, similar to the chicks fed with control and glutamine + quercetin diets. There were no difference among the groups in term of villus height: crypt depth ratio and tunica muscularis thickness. While there was no effect of LPS injection on jejunal villus height, crypt depth ( $P<0.01$ ) villus height: crypt depth ratio ( $P<0.05$ ) and tunica muscularis thickness ( $P<0.01$ ) were affected. Villus height: crypt depth ratio was increased while other parameters were decreased by LPS injection in the quercetin group. There was an interaction between nutrition and stress in all histomorphologic parameters examined in the experiment.

Table 2. Effect of glutamine and or quercetin on intestinal histomorphology of broiler at 21 days of age

		Villus height, $\mu\text{m}$	Crypt depth, $\mu\text{m}$	Villus width, $\mu\text{m}$	Villus height: Crypt depth	Tunica muscularis thickness
Diet	Challenge					
C	FTS	949,1 <sup>ab</sup>	153,3 <sup>a</sup>	163,5 <sup>bc</sup>	6,19 <sup>b</sup>	135,5 <sup>ab</sup>
C	LPS	875,4 <sup>b</sup>	146,2 <sup>ab</sup>	146,2 <sup>c</sup>	6,07 <sup>b</sup>	113,8 <sup>ab</sup>
G	FTS	859,6 <sup>b</sup>	168,6 <sup>a</sup>	176,5 <sup>ab</sup>	5,24 <sup>b</sup>	139,6 <sup>a</sup>
G	LPS	975,8 <sup>ab</sup>	154,1 <sup>a</sup>	167,0 <sup>abc</sup>	6,36 <sup>b</sup>	125,5 <sup>ab</sup>
Q	FTS	1061,7 <sup>a</sup>	157,9 <sup>a</sup>	191,1 <sup>a</sup>	6,74 <sup>b</sup>	120,7 <sup>ab</sup>
Q	LPS	1028,6 <sup>a</sup>	125,9 <sup>b</sup>	154,6 <sup>bc</sup>	8,82 <sup>a</sup>	102,8 <sup>b</sup>
GQ	FTS	978,2 <sup>ab</sup>	153,3 <sup>a</sup>	158,5 <sup>bc</sup>	6,44 <sup>b</sup>	134,1 <sup>ab</sup>
GQ	LPS	1058,1 <sup>a</sup>	158,6 <sup>a</sup>	165,3 <sup>bc</sup>	6,71 <sup>b</sup>	123,1 <sup>ab</sup>
SEM		12,26	2,26	3,08	0,19	2,63
Main Effect						
C		912,2 <sup>b</sup>	149,7 <sup>ab</sup>	154,9 <sup>b</sup>	6,13	124,6
G		917,7 <sup>b</sup>	161,3 <sup>a</sup>	173,3 <sup>a</sup>	5,80	132,6
Q		1045,2 <sup>a</sup>	141,9 <sup>b</sup>	172,8 <sup>a</sup>	7,78	111,7
GQ		1018,2 <sup>a</sup>	156,0 <sup>ab</sup>	161,9 <sup>ab</sup>	6,58	128,6
	FTS	962,1	158,3	172,4	6,15	132,5
	LPS	984,5	146,2	159,0	6,99	116,3
P-value						
Diet		<0,001	0,005	0,002	<0,001	0,079
Challenge		0,251	0,003	0,001	0,011	0,008
Diet x Challenge		0,002	0,010	0,002	0,086	0,926

## Conclusions

When this study evaluated from the point of view of performance, from the first 21 days, the BWG and FCR were positively affected by the addition of glutamine and quercetin compared with control group. LPS challenge on day 21 of the experiment stressed on animals and performance parameters were adversely affected. Chicks fed with glutamine less affected from this stress condition. In other words, glutamine mitigated the adverse effects of stress from LPS challenge.

The authors thank Beypilic A.S, for providing chicks used in the experiment.

## References

- BARTELL, S.M. and BATAL, A.B. (2007) The effect of supplemental glutamine on growth performance, development of the gastrointestinal tract, and humoral immune response of broilers. *Poultry Science* 86: 1940-1947.
- CHEN, Y., ZHENG, R., ZHONGJIAN, J., JIA, Z. and JU, Y. (1990) Flavonoids as superoxide scavengers and antioxidants. *Free Radicals Biology and Medicine* 9:19-21.
- CALIK, A. and ERGUN, A. (2015) Effect of lactulose supplementation on growth performance, intestinal histomorphology, cecal microbial population, and short-chain fatty acid composition of broiler chickens. *Poultry Science* 94:2173-2182.
- NRC. (1994) Nutrient Requirements of Poultry. 9th ed. National Academies Press, Washington, DC.
- SACAKLI, P., CALIK, A., BAYRAKTAROGLU, A.G., ERGUN, A., SAHAN, O. and OZAYDIN, S. (2015) Effect of clinoptilolite and/or phytase on broiler growth performance, carcass characteristics, intestinal histomorphology and tibia calcium and phosphorus levels. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*. 21:729-737.

## The Use of Immunomodulator in Drinking Water for Broiler Chicks

Ovseychik E.A., Lukashenko V.S., Andrianova E.N.

All-Russian Research and Technological Institute of Poultry, Sergiev Posad, Russia

### Abstract

The development of new multi-purpose immunostimulators improving livability, stress resistance, and productivity is an actual task for modern poultry production. The effects of immunomodulating preparation Polyferon on the productive performance of broilers were studied. Supplementation of drinking water with Polyferon improved live bodyweight by 2.7-6.8% and decreased mortality by 2.9% in compare to unsupplemented control. Feed conversion ratio in treatments with Polyferon doses 0.005-0.01 g/bird/day was better by 3.9-4.4% in compare to control. In Polyferon treatments average weights of eviscerated carcass were higher by 3.0-8.4%, eviscerated carcass yields by 0.2-1.1% in compare to control.

**Key words:** *Broilers, Live bodyweight, Mortality, Feed conversion ratio, Eviscerated carcass yield.*

### Introduction

Large-scale commercial poultry production implies high flock concentration on the restricted areas to achieve higher economic efficiency of the production, and application of innovative technologies of management and nutrition to achieve maximal productivity with minimal cost expenses. Health and welfare of poultry at large farms require reasonable veterinary programs including vaccination etc. Certain managemental and/or nutritional factors can promote immunodeficient conditions affecting vaccination efficiency and immune status in poultry (Belyaeva, 2010; Dmitrieva, 2013). To improve livability, stress resistance, and productivity in poultry immunomodulating preparations are widely used which can improve the functionality of the immune system when applied in prophylactic or therapeutic doses (Kuzmin et al., 2009; Fisinin and Surai, 2013). However, immunomodulators developed to date cannot effectively address the complex of the aforementioned problems. The search and development of new multi-purpose immunostimulators is therefore an actual task for modern poultry production (Sanin et al., 2012).

## Materials and Methods

The study on the efficiency of immunomodulator Polyferon was performed on 5 treatments of cage-housed Cobb-500 broilers from 1 to 37 days of age (35 birds per treatment). Active substances of Polyferon are affinity purified human antibodies to gamma-interferon and insulin; main inactive ingredient is lactose monohydrate; gamma-interferon antibodies stimulate humoral and cell immunity while insulin antibodies activate cell metabolism and improve metabolism of the carbohydrates.

Drinking water for control treatment 1 was not supplemented; water for treatments 2-5 was supplemented with Polyferon to achieve daily consumptions 0.025; 0.005; 0.0075 and 0.010 g/bird. All treatments were fed the same diets according to breeder's recommendations for this cross. Live bodyweight (BW), mortality, feed conversion ratio (FCR), weight and yield (% to BW) of eviscerated carcass were recorded.

## Results and Discussion

Mail results of the trial are presented in Table 1. The preparation improved mortality levels: in treatments 3, 4, and 5 mortality was 0% vs. 2.9% in control. In treatment 2 mortality was at the same level as in control (2.9%) due to cases of catarrhal enteritis and had no relation to the application of the immunomodulator. Zero mortality levels with the increasing doses of the preparation evidence its safety for birds.

Table 1. Productivity parameters in broilers (n=35)

Parameters	Treatments				
	1(c)	2	3	4	5
Avg. live BW at 37 days of age, g	2151	2210	2283*	2295*	2297*
Avg. daily weight gains, g/bird/day	57.0	58.6	60.5	60.8	60.9
Mortality, %	2.9	2.9	0	0	0
FCR	1.81	1.80	1.74	1.74	1.73
Eviscerated carcass weight, g	1551	1598	1667	1678	1681
Eviscerated carcass yield, %	72.1	72.3	73.0	73.1	73.2

\* - the difference with control treatment 1 is significant, P<0.05.

Average live BW at 37 days of age in all Polyferon treatments was higher in compare to control: in treatment 3 by 132 g (or 6.1%, P<0.05), in treatment 4 by 144 g (or 6.7%, P<0.05), in treatment 5 by 146 g (or 6.8%, P<0.05); the increase in BW in treatment 2 (59 g) was insignificant. Average daily weight gains in all Polyferon treatments were also higher compared to control. The preparation also influenced FCR in broilers. In treatments 3-5 FCR was lower by 3.9-4.4% in compare to control; there was no difference in FCR between control and treatment 2 with the lowest Polyferon dosage.

Average weights of eviscerated carcass in Polyferon treatments were higher by 3.0-8.4% in compare to control; the respective average eviscerated carcass yields were higher by 0.2-1.1%.

### Conclusions

Application of immunomodulator Polyferon with drinking water was found to improve final bodyweights in broilers by 2.7-6.8% and mortality by 2.9% in compare to unsupplemented control. Feed conversion ratio in treatments with Polyferon doses 0.005-0.01 g/bird/day was better by 3.9-4.4% in compare to control. In Polyferon treatments average weights of eviscerated carcass were higher by 3.0-8.4%, eviscerated carcass yields by 0.2-1.1% in compare to control.

### References

- BELYAEVA, S.N. (2010) Stress and immunodeficiency states prevention in commercial poultry by biocorrector timogen. *Poultry & Chicken Products* (Russia)1:45-48.
- DMITRIEVA, M.E. (2013) Features of vaccine prevention immunosuppression diseases of birds in industrial poultry breeding. *Farm Animals* (Russia) 3-4:81-83.
- KUZMIN, G., SKOGOREVA A., PRIBYTKOVA K., and POPOVA O. (2009) The influence of Miramistin and Phosprenil on the immune function in chicken challenged with AIV and NDV. *Ptitsevodstvo* (Russia) 5:35-36.
- FISININ, V., and SURAI P. (2013) Immunomodulation in modern poultry and animal farming: From theory to practice. *Ptitsevodstvo* (Russia) 5:4-10.
- SANIN, A.V., VIDENINA A.A., NAROVLYANSKY A.N., and PRONIN A.V. (2012) On usage of immunomodulators in poultry industry. *Poultry & Chicken Products* (Russia) 1:45-48.

## Point Prevalence of Gastro-Intestinal Parasites and Zoonotic Risk Associated with Captive Birds of Gujranwala and Jhang District (Punjab, Pakistan)

Muhammad Zeeshan Akram, Hassan Jalal, Usman Siddiq, Arslan Ahmed, Muhammad Arif, Ateeqa Aslam, Sadaf Qadir

University of Veterinary and Animal Sciences Lahore, Pakistan  
Corresponding author: Muhammad Zeeshan Akram (zeeshanakram219@gmail.com)

### Abstract

A survey was conducted to investigate the point prevalence of gastro-intestinal (GIT) parasites in captive birds from Gujranwala and Jhang districts (Punjab-Pakistan). Randomly, 114(n=114) apparently healthy birds were selected for copro-diagnostic techniques for detection of the GIT parasites. Dominantly, the captive birds were found infected with mixed-type GIT parasites. Protozoa, nematodes, cestodes and trematodes contributed 69.35, 35.48, 6.45 and 1.61% respectively in overall prevalence (54.38%). Predominant species were *Eimeria* spp. (67.74%) in following order of *Ascaridia* spp. (33.87), *Capillaria* spp. (11.29%), *Hymenolepsis* (6.45%). Zoonotic potential protozoa including *Cryptosporidium* spp. (9.67%), *Entamoeba* spp. (8.06%) and *Balantidium* spp. (6.45%) were also observed. However, none of zoonotic significant nematodes, cestodes and trematodes was found. Adults of *Ascaridia galli* were also recovered in the postmortem of peacock. In the light of these findings, routinely hygienic practices and prophylactic measures are recommended to prevent GIT parasitic infections in the captive birds.

**Key words:** Zoonosis, Captive birds, GIT Parasites, Gujranwala, Jhang

### Introduction

Birds have a supreme place being exceptionally valued by humans (Bibi & Ali, 2013). Out of 30,000 species of captive birds in all over the world (Parsani et al. 2003), 786 species are reported in Pakistan ([https://en.wikipedia.org/wiki/List\\_of\\_birds\\_of\\_Pakistan](https://en.wikipedia.org/wiki/List_of_birds_of_Pakistan)). In Pakistan, captive birds are rear for gaming and fancy purposes and important for emotionally and economically perspective. In recent years, due to dramatic increase in human population and subsequently, shortage of accommodation places, encourage people to adapt captive birds as pets. Further, increasing awareness of zoonotic issues associated with dogs and cats might be another reason enhancing replacement of these animals with captive birds. However, these birds under captivity are facing many troubles including parasitic infections. Parasites of gastro-intestinal tract (GIT) including protozoa,

nematodes, cestodes and trematodes are incriminated for robbing the nutrients, minerals and vitamins and causing serious conditions like enteritis (Khan et al. 2010), immunosuppression (Shahawy et al. 2015), low performance, stunt growth, poor reproductive efficiency and sometime deaths (Otegbade & Morenikeji, 2014; Krone & Cooper, 2002). In Pakistan as far as it could be ascertained, any study focused on parasites of GIT especially with reference of zoonitically potential parasites of captive birds has not been executed. The caregivers of the community are susceptible to zoonotic parasites by direct or indirect contact and improper handling. In this backdrop, this study was carried out to find point prevalence of GIT parasites mainly focused on zoonitically important parasites of captive birds in Gujranwala and Jhang districts (Punjab-Pakistan).

## **Materials and Methods**

### ***Sampling***

A total of 114 (n=114) fresh faecal droopings were collected at early morning from pet shops, houses and aviaries in sterile pre-labeled plastic vials. All the samples were picked through sterile plastic spatula to avoid cross contamination. Samples were transported to Parasitology Laboratory, Department of Pathobiology, College of Veterinary and Animal Sciences (CVAS), Jhang (Pakistan) for examination. The samples were examined under microscope within 24 hours post-collection. Simultaneously, the collected samples were also subjected to macroscopic examination for their odour, color, consistency, presence of blood and mucus and tapeworm proglottids.

### ***Parasitological Procedures***

All the samples were processed through direct wet mount preparation (Khan et al., 2010; Shahawy et al., 2015) and centrifugal floatation techniques (Shahawy et al., 2015) in the laboratory of Parasitology, Department of Pathobiology, CVAS, Jhang (Punjab-Pakistan). Briefly, in direct wet mount method, a small amount of faecal sample was placed on clean, grease-free slide. The sample was mixed with a few drops of water with the help of tooth pick. A cover slip was placed on smear and examined under microscope. While using centrifugal floatation method, one gram of faeces was mixed with few ml (15-20ml) of water. Then mixture was filtered through sieve (size). The filtered material was mixed with saturated sugar solution at ratio of 1:3. The contents were centrifuged at 1500 rpm for 5minutes. After spinning, the small amount of superficial contents was transferred on clean and dry glass slides. The slides were subjected to examination under microscope for parasitic ova.

**Results**

Total sixty two (n=62) out of 114 samples were found positive with single or mixed parasitic infection of protozoa, nematodes, cestodes and trematodes. Over all prevalence was 54.38%, whereas, relative prevalence of protozoa, nematodes, cestodes and trematodes was 69.35, 35.48, 6.45 and 1.61 %, respectively (Table-1). Among the noticed parasites, predominant species were *Eimeria* 67.74%(42/62) in following order of *Ascaridia* sp.33.87% (21/62), *Capillaria* sp.11.29% (7/62), *Hymenolepis* 6.45% (4/62) and some unknown trematodes 1.61% (1/62) (Fig-1). Zoonitically important protozoa including *Cryptosporidium* spp. 9.68% (6/62), *Entamoeba* spp. 8.06% (5/62) and *Balantidium* spp. 6.45% (4/62) were also observed. In necropsy findings of a peacock, adults *Ascaridia galli* were recovered.

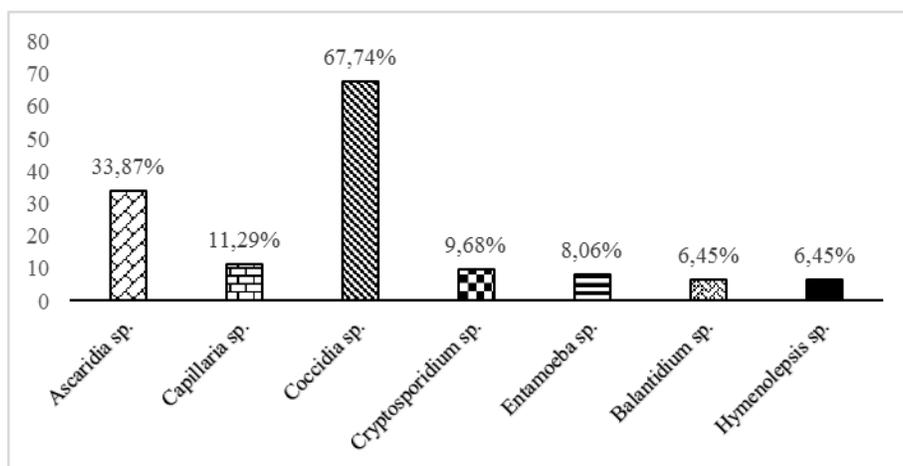


Fig. 1. Prevalence of different spp. In captive birds

Table 1. Number and percentage of gastro-intestinal parasites present in captive birds at Gujranwala & Jhang district (n=114)

Parasites	No. of positive samples	Relative prevalence (%)
Protozoa	43	69.35
Nematodes	22	35.48
Cestodes	4	6.45
Trematodes	1	1.61

**Conclusion and Recommendations**

Finding of this study pertaining to protozoa is important due to risk of zoonotic infection of professional workers e.g. veterinarians, lab personnel, and bird tradesmen. Based on the data found in this study, following points are recommended. There is dire need of time to check the faecal samples of captive birds through microscopic and macroscopic examination on routinely basis (fortnightly due to incubation period of protozoa is more or

less one week or two week) with effective treatment programs to control and prevent the birds from GIT parasites. Direct contact with these birds should be restricted to avoid potentially zoonotic agents.

**References:**

- BIBI, F. and ALI, Z., (2013) Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. *J. Anim. Plant Sci.* 23(2):469-474.
- PARSANI, H.R., MOMIN, R.R., SAHU, R.K. and PATEL, B.G. (2003) Prevalence of gastrointestinal parasites in captive birds at Kamla Nehru Zoological Garden, Kankaria Zoo, Ahmedabad, Gujarat. *Zoos' Print J.* 18(1), pp.987-992.
- KHAN, M.A., KHAN, M.S., SHAFEE, M. and KHAN, J.A. (2010) Prevalence and chemotherapy of helminthiasis in parrots at Lahore Zoo, Pakistan. *J. Anim. Plant Sci.* 20:189-192.
- EL-SHAHAWY, I.S. and ABOU ELENIEN, F. (2015) Enteric parasites of Egyptian captive birds: A general coprological survey with new records of the species. *Trop. Biomed.* 32(4):650-658.
- OTEGBADE, A.C. and MORENIKEJI, O.A. (2014) Gastrointestinal parasites of birds in zoological gardens in south-west Nigeria. *Trop. Biomed.* 31(1):54-62.
- KRONE, O. and COOPER, J.E. (2002) Parasitic diseases. *Birds of Prey: Health & Disease, Third Edition*, pp.105-120.

## Probiotic Effect of Tarhana on Caecal Microflora of Quails (*Coturnix coturnix Japonica*)

Isa Coskun<sup>a</sup>, Huseyin Cayan<sup>a</sup>, Kubra Sacihan<sup>a</sup>, Guray Erener<sup>b</sup>

<sup>a</sup> Ahi Evran University, Faculty of Agriculture, Department of Animal Science, 40100

<sup>b</sup> Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, 55000

### Abstract

The aim of this study was to determine the probiotic effect of tarhana on caecal microflora of quails. In this study, 20 caecum contents (10 caecal content for per treatment group) were analyzed. Quails consumed basal diet and basal diet supplemented with %0,5 tarhana. Treatment groups were 1) control, 2) dietary tarhana supplementation. Data collected from study analyzed with independent samples T test at SPSS statistical programme. At the end of study, it was determined that caecal coliforms and E Coli was decreased by supplementation tarhana statistically ( $P<0.05$ ). *Enterobacteriaceae* did not affected, but tended to decrease. Also Lactic acid bacteria (LAB) and Yeast population did not affected, but tended to increase. To conclude, it was determined that tarhana developed caecal microflora of quails and tarhana can use as probiyotic feed additives.

**Key words:** *Tarhana, Quail, Bacteria, Caecum*

## Tarhananın Bıldırcın Sekum Mikroflorası Üzerine Probiyotik Etkisi

### Özet

Bu çalışmanın amacı bıldırcın sekum mikroflorası üzerine tarhananın probiyotik etkisini belirlemektir. Çalışmada 20 bıldırcından alınan sekum içerikleri (10 sekum içeriği her muamele grubu için) analiz edilmiştir. Araştırmadaki muamele grupları 1) kontrol, 2) tarhana ilaveli grup. Tarhana bıldırcınların yemlerine %0.5katılarak 21 gün süreyle verilmiştir. Çalışmada elde veriler SPSS istatistik paket programında bağımsız örneklem T testine tabi tutulmuştur. Çalışmanın sonunda, tarhana ilaveli yem tüketen bıldırcınların sekum içeriklerinde koliform ve E Coli miktarları istatistiki olarak düşmüştür ( $P<0.05$ ). *Enterobacteriaceae* miktarı değişmemiş fakat düşüş eğilimi göstermiştir. Laktik asit bakteri (LAB) ve Maya miktarı da değişmemiştir fakat artış eğilimi göstermiştir. Sonuç olarak tarhananın bıldırcınların bağırsak mikroflorasını olumlu yönde etkilediği ve probiyotik yem katkısı olarak kullanılabileceği belirlenmiştir.

**Anahtar kelimeler:** *Tarhana, bıldırcın, bakteri, sekum.*

## Introduction

Tarhana is a traditional Turkish fermented cereal food and dates back ancient time (Ozdemir et al., 2007). Lactic acid bacteria (LAB) and yeast fermentations occur simultaneously during tarhana production (Bilgicli et al., 2006). It is produced by mixing wheat flour, yoghurt, yeast tomatoes, onions, green, and red pepper, salt, herbs, mint and thyme. Fermentation occurs until the 5 days (Ekici, 2005). Different ingredients such as milk, soybean, lentil, chickpea, corn flour, and egg can also be added (Ekici and Kadakal, 2005) to increase nutritional value. Organic acids produced in fermentation, low moisture content (6–10%) and low pH (3.3–5.0) provide a bacteriostatic effect on pathogenic microorganisms and so increase shelf life (Daglioglu, 2000). At the end of fermentation, it was determined that tarhana includes average  $8 \times 10^8$  *L. acidophilus* and  $6 \times 10^9$  *S. thermophilus*. In earlier studies, it was well documented that tarhana has symbiotic effect as a functional food (Gabrial et al., 2010). After the ban of antibiotic use in animal production, researchers focused on new probiotics food additive such as yeast fermented food additives (Yasar and Yegen, 2017), A Niger fermented food (Okrathok et al., 2017) instead of antibiotic growth promoter. Also tarhana is a fermentation product and it is good source of live *L. acidophilus* and *S. thermophilu*. But, there is no study on the effect of tarhana on animals caecum microflora. It is questioned that tarhana can used to increase gut health like probiotics or symbiotic in animals. Therefore the aim of this study was to investigate the effect of tarhana on on caecal lactic acid bacteria (LAB), Yeast, Enterobacteriaceae, E Coli and Coliform bacteria count of quail's caecum.

## Material and Methods

Tarhana was provided from local dairy product company in Kırşehir province. In this study, 2 dietary groups were made up 1) Control (Basal Diet), 2) Dietary supplementation of tarhana at 0.5 of diet. At the end of 21 days, 20 caecum contents from quails (10 caecum content for per treatment group) analyzed. Samples of the caecum contents were collected into sterile glass tubes in which they were kept on ice until subsequent inoculation into agars. MRS agar (MERCK, Darmstadt, Germany, 1.10660) was used for enumeration of lactic acid bacteria (LAB) at 37°C for a 3-d incubation period and malt extract agar (MERCK, Darmstadt, Germany, 1.05398) was used for enumeration of yeast at 30°C for a 3-d incubation period. VRBD (Violet Red Bile Dextrose) (MERCK, Darmstadt, Germany, 1.01406) agar was used for enumeration of *Enterobacteriaceae* at 37°C for an 18 – 20 h incubation period. 3M Petrifilm TM (3M Microbiology Products St. Paul MN 55114 USA) was used to determine *Escherichia coli* and *Coliform* count in caecal samples. The following manufacturer's instructions for incubation conditions

were used to determine the microbial counts of samples: *Escherichia coli*: at 32°C for 24 h; *Enterobacteriaceae*: at 35°C for 24 h. Bacterial colonies were counted by determining the average number of live bacteria per g caecal content. LAB, Yeast, *Enterobacteriaceae*, E. coli and Coliform bacteria counts of the samples were converted into logarithmic colony forming units (cfu g<sup>-1</sup>). The data were analysed using the independent samples T test procedure of SPSS software (SPSS 15).

Table1. The effect of tarhana on caecal microflora

	Control	Tarhana	P Value
LAB	6.21±0.29	7.09±0.30	0.58
Yeast	6.67±0.22	7.22±0.15	0.55
E Coli	6.82±0.28	6.53±0.10	0.05
Coliforms	7.17±0.45a	6.67±0.14b	0.01
Enterobacteriaceae	7.72±0.25	7.03±0.24	0.73

a-b - Means in a row with no common superscript letters differ significantly (P<0.05).

## Results and Discussion

The effect of tarhana on caecum LAB, yeast, *enterobacteriaceae*, E Coli and coliform bacteria count of quail's caecum were given in table 1. It was determined that caecal E Coli and Coliform Count decreased statistically (P<0.05). Although there were no difference among the groups *Enterobacteriaceae* population was tend to decrease and yeast count was tend to increase in quails consumed tarhana. The result of this study is the first record on the effect of tarhana on caecal microflora of quail chicks. The result of this study showed that dietary tarhana has promising probiotics feed additive. Because, dietary tarhana supplementation decreased pathogenic bacteria population and increased beneficial bacteria population in quail's caecum. Yasar and Yegen. (2017) reported that yeast fermented food additive improves growth performance of broilers. Bacteria in tarhana may protect their livability, because caecal microflora results indicates this conclusion. Also, Ozdemir et al. (2007) reported that tarhana can store with 6 month with any loss due to its low pH (3.5–5.0) and moisture content.

## Conclusions

To conclude, it was determined that tarhana developed gut microflora of quails and it can use as probiotic in chickens. Because tarhana increased beneficial bacteria population and decreased pathogenic bacteria population in caecum. But, further studies must be conducted the effect of tarhana on different bacteria development or under different stress factors in different animal species.

## References

- BILGIÇLI, N., ELGÜN, A. and TÜRKER, S. (2006). Effects of various phytase sources on phytic acid content, mineral extractability and protein digestability of tarhana. *Food Chem.*, 98: 329–337.
- DAGLIOGLU, O. (2000). Tarhana as a traditional turkish fermented cereal food, its recipe, production and composition. *Nahrung*, 44 (2), 85–88.
- EKINCI, R. (2005). The Effect of Fermentation and Drying on the Water-Soluble Vitamin Content of Tarhana, a Traditional Turkish Cereal Food. *Food Chem.*, 90: 127–132.
- EKINCI, R., KADAKAL, C. (2005). Determination of seven water-soluble vitamins in tarhana, a traditional turkish cereal food, by high-performance liquid chromatography. *Acta Chrom.*, 15: 289–297.
- GABRIAL, S.G., ZAGHLOUL, A.H., KHALAF-ALLAH, A.E.R., EL-SHIMI, N.M., MOHAMED, R.S. and GABRIAL, G.N. (2010). Synbiotic Tarhana as a functional food. *Journal of American Science*, 6(12), 847-857.
- OZDEMIR, S., GOCMEN, D. and YILDIRIM KUMRAL, A.A. (2007). Traditional Turkish fermented cereal food: Tarhana. *Food Reviews International*. 23(2): 107-121.
- OKRATHOK, S., PASRI, P., THONGKRATOK, R., MOLEE, W. and KHEMPAKA, S. (2017). Effects of cassava pulp fermented with *Aspergillus oryzae* as a feed ingredient substitution in laying hen diets. *The Journal of Applied Poultry Research*.
- YASAR, S. and YEGEN, M.K. (2017). Yeast fermented additive enhances broiler growth. *R. Bras. Zootec.* 46: 814-820.

# POSTER PRESENTATIONS

## SESSION-4

### NUTRITION II

## Changing Nutritional Composition of Pomegranate (*Punica granatum L.*) Seed by *Aspergillus niger* Solid State Fermentation to Making Suitable for Poultry Nutrition

Emrah Güngör, Aydın Altop, Güray Erener

Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun, Turkey

### Abstract

Nutritional changes in pomegranate (*Punica granatum L.*) seed by *Aspergillus niger* solid state fermentation were investigated in this study. Pomegranate seed was fermented by two different *A. niger* strains (ATCC 20345 and ATCC 9142). Crude protein, ether extract and ash were increased ( $P < 0.001$ ), nitrogen-free extract, crude fiber, neutral detergent fiber and acid detergent fiber were decreased ( $P < 0.001$ ) by fermentation in both strains. Hemicellulose was not changed ( $P > 0.05$ ) by ATCC 20345 but decreased ( $P < 0.01$ ) by ATCC 9142. This results showed that *A. niger* solid state fermentation can be used to improve nutritional composition of pomegranate seed in order to make a suitable feedstuff for poultry nutrition.

**Key words:** *Aspergillus niger*, pomegranate seed, poultry nutrition, *Punica granatum L.*, solid state fermentation

### Introduction

Utilization of agricultural residues has become having particular attention in recent years in order to reduce the dependence of poultry nutrition on the cereals that are used in human nutrition (Saki et al., 2014). Agricultural residues, which can be supplied at cheap prices, can reduce feed costs with using in poultry diets. In addition, environmental pollution caused by agricultural residues can also be lowered.

Pomegranate is one of the most ancient edible fruits (Manterys et al., 2016). Annual pomegranate production of Turkey reached 656.200 tons in 2016 (TUIK, 2016). Pomegranate seed has antioxidant effect on broiler chicks and laying hens (Saki et al., 2014, Ahmed et al., 2015). It can increase egg production (Saki et al., 2014) and improve egg yolk color (Kostogryns et al., 2017). Moreover, harmful effects of mycotoxins on broiler chicks can be eliminated with pomegranate feeding (Hussein, 2015).

Cellulose is one of the major factors affecting digestibility of feedstuffs (Graminha et al., 2008). Poultry is more sensitive to cellulose level of the diet than ruminants. Pomegranate seed contains 13.2% crude protein (CP), 35.3% crude fiber (CF) and 27.2% ether extract (EE) on dry weight basis

(El-Nemr et al., 1990). High CF content of pomegranate seed is thought to limit its use in poultry nutrition. Solid state fermentation can be used for nutritional enrichment of agricultural residues (Aro, 2008). *Aspergillus niger* is recommended for solid state fermentation because of growing ability in the low-water environment (Raimbault, 1998). It was aimed to improve nutritional composition of pomegranate seed and reduce its CF content by two different *A. niger* strains (ATCC 200345 and ATCC 9142) for making a feedstuff that can be used in poultry diets.

### Materials and Methods

Pomegranate seeds were obtained from a juice factory in Turkey. *A. niger* strains were ATCC 200345 and ATCC 9142. Pomegranate seeds were milled and sterilized with autoclave at 121°C for 15 min. The nutritional salt (glucose: urea:(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>:peptone:KH<sub>2</sub>PO<sub>4</sub>:MgSO<sub>4</sub>.7H<sub>2</sub>O=4:2:6:1:4:1) was added to support microbial development. *A. niger* was cultured in Potato-Dextrose-Agar (PDA) and inoculated at 10<sup>5</sup> spores/kg pomegranate seed. Afterwards, samples were incubated at 60 °C for 48 hours and dried at room temperature for 6 days till reaching %90 dry matter.

CP, EE, ash and CF were analyzed according to AOAC (2000) before and after fermentation. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) analyses were conducted as reported by Van Soest et al. (1991). Hemicellulose was calculated as NDF minus ADF. All of the experiments were carried out in triplicate. Differences between treatments were tested using ANOVA and Duncan's multiple range test (SPSS 21.0 Statistics). The level of statistical significance was declared at  $P \leq 0.05$ .

### Results and Discussion

Nutritional composition of pomegranate seed was changed by *A. niger* solid-state fermentation. CP, EE and ash were increased ( $P < 0.001$ ) by fermentation whereas nitrogen-free extract (NFE), CF, NDF and ADF decreased ( $P < 0.001$ ) in both groups (P1: fermented pomegranate seeds with ATCC 200345, P2: fermented pomegranate seeds with ATCC 9142). However, hemicellulose did not change ( $P > 0.05$ ) in P1 but decreased ( $P < 0.01$ ) in P2.

*A. niger* increased CP contents of pomegranate peel (Aguilar et al., 2008), shea nut (Dei et al., 2008), mango kernel (Kayode and Sani, 2008), palm kernel cake (Iluyemi et al., 2006, Lawal et al., 2010), sour cherry kernel (Güngör et al., 2017) and grape seed (Altop et al., 2017). In this study, crude protein of pomegranate seed was increased ( $P < 0.001$ ) by fermentation from 16.12% to 31.82% (P1) and 32.63% (P2). This increase may be due to enzymes and mycelia produced by *A. niger* (Raimbault, 1998).

EE increased ( $P<0001$ ) from 1.55% to 5.72% (P1) and 6.17% (P2). Similar findings have been obtained from the studies on shea nut (Dei et al., 2008), whereas there was no difference in ether extract in the studies on palm kernel (Iluyemi et al., 2006, Lawal et al., 2010), pomegranate peel (Aguilar et al., 2008) sour cherry kernel (Güngör et al., 2017), grape seed (Altop et al., 2017) and decrease in the studies on mango kernel (Kayode and Sani, 2008), sour cherry kernel (Güngör et al., 2017), grape seed (Altop et al., 2017).

Ash content was increased ( $P<0.001$ ) by solid state fermentation ( $P<0.001$ ) from 3.05% to 8.19 (P1) and %8.33 (P2). This result consistent with the studies on pomegranate peel (Aguilar et al., 2008), shea nut (Dei et al., 2008), mango kernel (Kayode and Sani, 2008), sour cherry kernel (Güngör et al., 2017) and grape seed (Altop et al., 2017).

*A. niger* prefers soluble carbohydrates to other nutrients for using as a carbon source (Papagianni, 2007). NFE content of pomegranate seed was decreased ( $P<0.001$ ) by fermentation from 41.12% to 28.65 (P1) and 26.49 (P2) in this study. This result is in line with the studies on pomegranate peel (Aguilar et al., 2008), shea nut (Dei et al., 2008), mango kernel (Kayode and Sani, 2008), sour cherry kernel (Güngör et al., 2017) and grape seed (Altop et al., 2017).

CF decreased ( $P<0.001$ ) from 38.16% to 25.62% (P1) and 26.39% (P2). NDF decreased ( $P<0.001$ ) from 51.38% to 41.32% (P1) and 37.77 (P2). ADF decreased ( $P<0.001$ ) from 37.66% to 28.87% (P1) and 27.04% (P2). Hemicellulose did not change ( $P>0.05$ ) in P1 (control:13.72%, P1:12.44%) while decreased ( $P<0.01$ ) in P2 from 13.72% to 10.73%. *A. niger* has been reported to produce cellulase in solid state fermentation (Xie et al., 2016). These decreases can be attributed to the production of cellulase that breaks down the structural carbohydrates.

## Conclusion and References

Nutritional composition of pomegranate seed was improved by *A. niger* solid state fermentation. CP, EE and ash were increased while NFE, CF, NDF and ADF were decreased ( $P<0.001$ ) by ATCC 20345 and ATCC9142 in solid state fermentation. Hemicellulose was not changed ( $P>0.05$ ) by ATCC 20345 but decreased ( $P<0.01$ ) by ATCC 9142. This results showed that *A. niger* solid state fermentation can be used to improve nutritional composition of pomegranate seed in order to make a suitable feedstuff for poultry nutrition. However, detailed fermentation studies and animal experiments are needed to recommend to use of fermented pomegranate seeds in poultry diets.

## References

- AGUILAR, C. N., AGUILERA-CARBO, A., ROBLEDO, A., VENTURA, J., BELMARES, R., MARTINEZ, D., RODRÍGUEZ-HERRERA, R. and CONTRERAS, J. (2008) Production of antioxidant nutraceuticals by solid-state cultures of pomegranate (*Punica granatum*) peel and creosote bush (*Larrea tridentata*) leaves. *Food Technology and Biotechnology* 46: 218-222.
- AHMED, S. T., ISLAM, M. M., BOSTAMI, A. R., MUN, H.-S., KIM, Y.-J. and YANG, C.-J. (2015) Meat composition, fatty acid profile and oxidative stability of meat from broilers supplemented with pomegranate (*Punica granatum* L.) by-products. *Food Chemistry* 188: 481-488.
- ALTOP, A., GÜNGÖR, E. and ERENER, G. (2017) *Aspergillus niger* may improve nutritional quality of grape seed and its usability in animal nutrition through solid state fermentation. Proceedings of the International Advanced Researches & Engineering Congress, Osmaniye, pp. 2399.
- AOAC (2000) Official Methods of Analysis of AOAC International (17. Edition), Journal, (ABD, AOAC International).
- ARO, S. (2008) Improvement in the nutritive quality of cassava and its by-products through microbial fermentation. *African Journal of Biotechnology* 7: 4789-4797.
- DEI, H., ROSE, S., MACKENZIE, A. and AMAROWICZ, R. (2008) Growth performance of broiler chickens fed diets containing shea nut (*Vitellaria paradoxa*, Gaertn.) meal fermented with *Aspergillus niger*. *Poultry Science* 87: 1773-1778.
- EL-NEMR, S., ISMAIL, I. and RAGAB, M. (1990) Chemical composition of juice and seeds of pomegranate fruit. *Molecular Nutrition & Food Research* 34: 601-606.
- GRAMINHA, E., GONÇALVES, A., PIROTA, R., BALSALOBRE, M., DA SILVA, R. and GOMES, E. (2008) Enzyme production by solid-state fermentation: Application to animal nutrition. *Animal Feed Science and Technology* 144: 1-22.
- GÜNGÖR, E., ALTOP, A., ÖZTÜRK, E. and ERENER, G. (2017) Nutritional changes of sour cherry (*Prunus cerasus*) kernel subjected to *Aspergillus niger* solid-state fermentation. *Journal of Tekirdag Agricultural Faculty*: 99-103.
- HUSSEIN, H. Z. (2015) Activity of pomegranate peels and clove powders in detoxification of aflatoxin B1 and ochratoxin A from contaminated poultry diet. *Journal of Plant Pathology & Microbiology* 6: 1-4.
- ILUYEMI, F., HANAFI, M., RADZIAH, O. and KAMARUDIN, M. (2006) Fungal solid state culture of palm kernel cake. *Bioresource Technology* 97: 477-482.
- KAYODE, R. and SANI, A. (2008) Physicochemical and proximate composition of mango (*Mangifera indica*) kernel cake fermented with mono-culture of fungal isolates obtained from naturally decomposed mango kernel. *Life Science Journal* 5: 55-63.
- KOSTOGRYS, R. B., FILIPIAK-FLORKIEWICZ, A., DEREN, K., DRAHUN, A., CZYŻYŃSKA-CIHOŃ, I., CIEŚLIK, E., SZYMCZYK, B. and FRANCZYK-ŻARÓW, M. (2017) Effect of dietary pomegranate seed oil on laying hen performance and physicochemical properties of eggs. *Food Chemistry* 221: 1096-1103.

- LAWAL, T., IYAYI, E., ADENIYI, B. and ADARAMOYE, O. (2010) Biodegradation of palm kernel cake with multienzyme complexes from fungi and its feeding value for broilers. *International Journal of Poultry Science* 9: 695-701.
- MANTERYS, A., FRANCZYK-ZAROW, M., CZYZYNSKA-CICHON, I., DRAHUN, A., KUS, E., SZYMCZYK, B. and KOSTOGRYS, R. (2016) Haematological parameters, serum lipid profile, liver function and fatty acid profile of broiler chickens fed on diets supplemented with pomegranate seed oil and linseed oil. *British Poultry Science* 57: 771-779.
- PAPAGIANNI, M. (2007) Advances in citric acid fermentation by *Aspergillus niger*: biochemical aspects, membrane transport and modeling. *Biotechnology Advances* 25: 244-263.
- RAIMBAULT, M. (1998) General and microbiological aspects of solid substrate fermentation. *Electronic Journal of Biotechnology* 1: 26-27.
- SAKI, A., RABET, M., ZAMANI, P. and YOUSEFI, A. (2014) The effects of different levels of pomegranate seed pulp with multi-rnzyme on performance, egg quality and serum antioxidant in laying hens. *Iranian Journal of Applied Animal Science* 4: 803-808.
- TUIK (2016). Turkish Statistical Institute. <http://www.turkstat.gov.tr/UstMenu.do?metod=temelist> (Accessed date:01.02.2018).
- VAN SOEST, P. V., ROBERTSON, J. and LEWIS, B. (1991) Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* 74: 3583-3597.
- XIE, P., HUANG, L., ZHANG, C. and ZHANG, Y.-L. (2016) Nutrient assessment of olive leaf residues processed by solid-state fermentation as an innovative feedstuff additive. *Journal of Applied Microbiology* 121: 28-40.

## ***Aspergillus niger* can Improve Nutritional Composition of Wheat Bran under Solid State Fermentation to Make a Protein Source for Poultry Diets**

Aydın Altop, Emrah Güngör, Güray Erener

Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun, Turkey

### **Abstract**

The effects of two different *Aspergillus niger* strains on nutritional composition of wheat bran are investigated in this study. Wheat bran was fermented with two different *A. niger* strains (ATCC 200345 and ATCC 52172). Crude protein and ash content increased ( $P<0.001$ ) while nitrogen-free extract, crude fiber, hemicellulose, neutral detergent fiber and acid detergent fiber decreased ( $P<0.01$ ) by both strains. Ether extract was not changed ( $P>0.05$ ) by ATCC 52172 but decreased ( $P<0.05$ ) by ATCC 200345. It can be said that *A. niger* can be used to improve nutritional composition of wheat bran to make a protein source for poultry diets.

**Key words:** *Aspergillus niger*, poultry nutrition, solid state fermentation, wheat bran

### **Introduction**

Feeding costs represent up to %70 of the total cost for poultry production. Protein sources have a large scale in feeding costs because of being more expensive than other feedstuffs and using large amounts in poultry diets. Therefore, it is necessary to find new cheap protein sources or to improve nutritional composition of known feedstuffs for making a protein source. Wheat bran contains 15.7% crude protein, 3% ether extract, 11% crude fiber, which is weak for crude protein content compared to oil cakes (NRC, 1994). Furthermore, wheat bran has some antinutritional factors such as phytic acid and non-starch polysaccharide that restrict using of wheat bran in poultry diets (Cavalcanti and Behnke, 2004). Improving nutritional composition and eliminating antinutritional factors of feedstuffs are possible with solid state fermentation (Zhang et al., 2006). *Aspergillus niger* is preferred fungus for solid state fermentation due to growing ability in the low-water environment (Raimbault, 1998). The effects of two different *A. niger* strains (ATCC 200345 and ATCC 52172) on the nutritional composition of wheat bran are investigated in this study.

## Materials and Methods

*A. niger* strains used in the study were ATCC 200345 and ATCC 52172. Wheat bran was milled to pass through a 2 mm sieve and sterilized with autoclave at 121°C for 15 min. The nutritional salt (glucose: urea:(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>:peptone:KH<sub>2</sub>PO<sub>4</sub>:MgSO<sub>4</sub>.7H<sub>2</sub>O=4:2:6:1:4:1) was added to encourage the growth of fungi. *A. niger* inoculated at 10<sup>5</sup> spores/kg wheat bran. Thereafter, samples were incubated at 60 °C for 48 hours and dried at room temperature for 6 days until reaching %90 dry matter.

Crude protein, ether extract, ash, crude fiber were analyzed according to AOAC (2000) before and after fermentation. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) analyses were conducted as reported by Van Soest et al. (1991). Hemicellulose was calculated as NDF minus ADF. All of the experiments were carried out in triplicate. Differences between treatments were tested with using ANOVA and Duncan's multiple range test (SPSS 21.0 Statistics). The level of statistical significance was declared at P≤0.05.

## Results and Discussion

*A. niger* improved nutritional composition of wheat bran under solid state fermentation. Crude protein and ash increased (P<0.001) while nitrogen-free extract (NFE), crude fiber, hemicellulose, neutral detergent fiber (NDF) and acid detergent fiber (ADF) decreased (P<0.01) in both groups (A1: fermented wheat bran with ATCC 200345, A2: fermented wheat bran with ATCC 52172). Ether extract did not change (P>0.05) in A2 and decreased (P<0.05) in A1.

Protein content in feedstuffs is one of the major factors that affect growth and yield of poultry. In this study, crude protein content of wheat bran increased (P<0.001) from 16.87% to 31.53% (A1) and 33.51% (A2). Similar results have been reported in the studies on palm kernel (Iluyemi et al., 2006), cottonseed meal (Zhang et al., 2006), mango kernel (Kayode and Sani, 2008), shea nut (Dei et al., 2008), *Ginkgo biloba* leaves (Zhang et al., 2013), rapeseed meal (Shi et al., 2015, Shi et al., 2016), olive leaves (Xie et al., 2016, Altop et al., 2017a), sour cherry kernel (Güngör et al., 2017) and grape seed (Altop et al., 2017b).

Güngör et al. (2017) reported that different *A. niger* strains changed ether extract content of substrate differently. Similarly, ether extract content of wheat bran was affected by the strains differently. Ether extract decreased (P<0.05) from 3.15% to 2.04% in A1 but did not change (P>0.05) in A2 (2.46%). It is reported that ether extract increased in shea nut (Dei et al., 2008), rapeseed meal (Shi et al., 2015) and olive leaves (Altop et al., 2017a), did not change in palm kernel (Iluyemi et al., 2006, Lawal et al., 2010), rapeseed meal (Shi et al., 2016), sour cherry kernel (Güngör et al., 2017),

grape seed (Altop et al., 2017b) and decreased in mango kernel (Kayode and Sani, 2008) and sour cherry kernel (Güngör et al., 2017).

Ash increased ( $P<0.001$ ) from 5.51% to 10.57% (A1) and 11.22% (A2). Similar findings have been obtained from the studies on palm kernel (Lawal et al., 2010) and rapeseed meal (Shi et al., 2016) studies.

Soluble carbohydrates are firstly preferred by fungi for using as a carbon source (Papagianni, 2007). This thesis is confirmed by the results of studies on mango kernel (Kayode and Sani, 2008), sour cherry kernel (Güngör et al., 2017) and grape seed (Altop et al., 2017b) in which NFE content decreased with fermentation. Similarly, NFE decreased ( $P<0.001$ ) from 63.53% to 46.87% (A1) and 43.01% (A2) in this study. However, it has been reported that NFE content was not changed in olive leaves (Altop et al., 2017a) by *A. niger* solid state fermentation.

Structural carbohydrates affect digestibility of feedstuffs for poultry because of hardly digested by monogastric animals. *A. niger* can produce cellulase that breaks down structural carbohydrates under solid state fermentation (Graminha et al., 2008). In this study, crude fiber decreased ( $P<0.01$ ) from 10.95% to 8.97% (A1) and 9.79% (A2), NDF decreased ( $P<0.001$ ) from 43.52% to 29.87% (A1) and 30.01% (A2), ADF decreased ( $P<0.001$ ) from 13.46% to 10.46% (A1) and 11.87% (A2), hemicellulose decreased ( $P<0.001$ ) from 30.06% to 19.41% (A1) and 18.14% (A2). These results are in line with the studies on palm kernel (Iluyemi et al., 2006, Lawal et al., 2010), shea nut (Dei et al., 2008), rapeseed meal (Shi et al., 2015, Shi et al., 2016), sour cherry kernel (Güngör et al., 2017), grape seed (Altop et al., 2017b) and olive leaves (Altop et al., 2017a). This result inconsistent with the studies on mango kernel (Kayode and Sani, 2008) and sour cherry kernel (Güngör et al., 2017).

## Conclusion

Nutritional composition of wheat bran was improved by *A. niger* solid state fermentation. Crude protein and ash content increased while nitrogen-free extract, crude fiber, hemicellulose, neutral detergent fiber and acid detergent fiber were decreased by both strains. Ether extract was not changed by ATCC 52172 but decreased by ATCC 200345. It can be said that *A. niger* can be used to improve the nutritional composition of wheat bran to make a protein source for poultry diets. Nevertheless, this result need to verify by further fermentation studies and animal experiments that investigate possible changes in antinutritional components of wheat bran through fermentation and effects of fermented wheat bran in poultry.

## References

- ALTOP, A., GÜNGÖR, E. and ERENER, G. (2017a) Effect of *Aspergillus niger* ATCC 52172 on main nutritional components, minerals, condensed tannin and phenolic compounds of olive leaves in solid-state fermentation Proceedings of the International Advanced Researches & Engineering Congress, Osmaniye, pp. 2400.
- ALTOP, A., GÜNGÖR, E. and ERENER, G. (2017b) *Aspergillus niger* may improve nutritional quality of grape seed and its usability in animal nutrition through solid state fermentation. Proceedings of the International Advanced Researches & Engineering Congress, Osmaniye, pp. 2399.
- AOAC (2000) Official Methods of Analysis of AOAC International (17. Edition), Journal, (ABD, AOAC International).
- CAVALCANTI, W. and BEHNKE, K. (2004) Effect of wheat bran phytase subjected to different conditioning temperatures on phosphorus utilization by broiler chicks based on body weight and toe ash measurements. *Int. J. Poultry Sci* 3: 215-219.
- DEI, H., ROSE, S., MACKENZIE, A. and AMAROWICZ, R. (2008) Growth performance of broiler chickens fed diets containing shea nut (*Vitellaria paradoxa*, Gaertn.) meal fermented with *Aspergillus niger*. *Poultry Science* 87: 1773-1778.
- GRAMINHA, E., GONÇALVES, A., PIROTA, R., BALSALOBRE, M., DA SILVA, R. and GOMES, E. (2008) Enzyme production by solid-state fermentation: Application to animal nutrition. *Animal Feed Science and Technology* 144: 1-22.
- GÜNGÖR, E., ALTOP, A., ÖZTÜRK, E. and ERENER, G. (2017) Nutritional changes of sour cherry (*Prunus cerasus*) kernel subjected to *Aspergillus niger* solid-state fermentation. *Journal of Tekirdag Agricultural Faculty*: 99-103.
- ILUYEMI, F., HANAFI, M., RADZIAH, O. and KAMARUDIN, M. (2006) Fungal solid state culture of palm kernel cake. *Bioresource Technology* 97: 477-482.
- KAYODE, R. and SANI, A. (2008) Physicochemical and proximate composition of mango (*Mangifera indica*) kernel cake fermented with mono-culture of fungal isolates obtained from naturally decomposed mango kernel. *Life Science Journal* 5: 55-63.
- LAWAL, T., IYAYI, E., ADENIYI, B. and ADARAMOYE, O. (2010) Biodegradation of palm kernel cake with multienzyme complexes from fungi and its feeding value for broilers. *International Journal of Poultry Science* 9: 695-701.
- NRC (1994) Nutrient requirements of poultry: ninth revised edition (Washington DC, The National Academies Press).
- PAPAGIANNI, M. (2007) Advances in citric acid fermentation by *Aspergillus niger*: biochemical aspects, membrane transport and modeling. *Biotechnology Advances* 25: 244-263.
- RAIMBAULT, M. (1998) General and microbiological aspects of solid substrate fermentation. *Electronic Journal of Biotechnology* 1: 26-27.

- SHI, C., HE, J., AU, J., YU, B., MAO, X., ZHENG, P., HUANG, Z. and CHEN, D. (2016) Physicochemical properties analysis and secretome of *Aspergillus niger* in fermented rapeseed meal. *PLoS one* 11: 1-16.
- SHI, C., HE, J., YU, J., YU, B., HUANG, Z., MAO, X., ZHENG, P. and CHEN, D. (2015) Solid state fermentation of rapeseed cake with *Aspergillus niger* for degrading glucosinolates and upgrading nutritional value. *Journal of Animal Science and Biotechnology* 6: 1-7.
- VAN SOEST, P. V., ROBERTSON, J. and LEWIS, B. (1991) Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* 74: 3583-3597.
- XIE, P., HUANG, L., ZHANG, C. and ZHANG, Y.-L. (2016) Nutrient assessment of olive leaf residues processed by solid-state fermentation as an innovative feedstuff additive. *Journal of Applied Microbiology* 121: 28-40.
- ZHANG, W.-J., XU, Z.-R., SUN, J.-Y. and YANG, X. (2006) Effect of selected fungi on the reduction of gossypol levels and nutritional value during solid substrate fermentation of cottonseed meal. *Journal of Zhejiang University-Science B* 7: 690-695.
- ZHANG, X., ZHAO, L., CAO, F., AHMAD, H., WANG, G. and WANG, T. (2013) Effects of feeding fermented *Ginkgo biloba* leaves on small intestinal morphology, absorption, and immunomodulation of early lipopolysaccharide-challenged chicks. *Poultry Science* 92: 119-130.

## Chickens Are Not Omnivore Any More

Hüseyin Çayan, İsa Coşkun, Ahmet Şahin

Ahi Evran Üniversitesi Ziraat Fakültesi Zootečni Bölümü, Kırşehir, 40100

### Abstract

Chickens are omnivores, this means they eat both vegetables and animal originated foods. In the wild, chickens eat grain, seeds, fruit, other vegetation, and insects, they often scratch at the soil to search for seeds and insects. Industrial poultry farming; it aims to present chickens the nutrition and feed components that are closest to their natural eating habits. For this reason, both vegetable and animal protein sources are available in poultry rations. But due to the risk on food and feed-borne animal diseases, animal by-products had been banned in European Countries. In this review, studies on animal by-products and effects on feed industry will be examined under the light of literature.

**Key words:** *Animal by-product, feeding, rendering, poultry.*

## Tavuklar Artık Omnivor Değil

### Özet

Tavuklar omnivor hayvanlardır. Bu hem bitkisel hemde hayvansal kökenli kaynaklarla beslendikleri anlamına gelmektedir. Doğal yaşamda tavuklar, tahıllar, tohumlar, yada diğer bitki örtüleriyle ve böceklerle beslenmektedirler. Aynı zamanda sıklıkla tohumları ve böcekleri bulabilmek için toprağı karıştırmaktadırlar. Endüstriyel tavukçuluk, tavuklara doğadaki beslenme alışkanlıklarına en yakın beslenme ve yem bileşenini sunmayı hedefler. Bu nedenle kanatlı yemlerinde hem bitkisel hem de hayvansal besin kaynakları bulundurulur. Fakat, gıda ve yem kaynaklı hayvan hastalıkları risklerinin artması nedeniyle, hayvansal yan ürünler Avrupa Ülkelerinde yasaklanmıştır. Bu derlemede, hayvansal yan ürünlerle ilgili yapılan çalışmalar ve yem sanayicileri açısından etkileri literatür ışığı altında incelenecektir.

**Anahtar kelimeler:** *Hayvansal yan ürünler, besleme, rendering, kanatlı.*

### Introduction

The word omnivore comes from the Latin words omni, meaning "everything or all" and vorare which means "to devour." Although some commercial egg

producers proclaim that their eggs are from "vegetarian fed" hens, chickens are actually omnivores. This means that they can eat a diet that contains both plants as well as animal proteins. And chickens are hardly alone in their dining preferences in the animal kingdom. Commercial chicken feeds blend a balanced mix of grains and seeds, often supplemented with bone meal or fish meal. Certainly not a vegetarian diet, although some organic feeds use insect larvae as the protein source instead of a animal by-product source.

### **Poultry Rendering**

The poultry rendering process handles the by-process of the poultry slaughter. The poultry by-products that are not intended for human consumption are transformed into valuable proteins, minerals and oils. Poultry is a general term used for the animals such as chicken, turkey, ducks, geese etc.. The poultry by-products consist of soft meat, feathers, blood, and deboning residue but can also consist of dead on arrival, deboning residue and farm waste (Anonymous, 2017).

### **Application of the Animal by-products**

None of the poultry by-products are thrown away! However, to use the poultry by-products in other processes they have to be treated first. Our systems transfer the poultry by-products into meat and bone meal, whole meal, feathers meal, blood meal and fats/tallow/oils. This process is called rendering. These meals can be sold to the pet food industry, feed industry etc. and the fats to the pharmaceutical industry, chemical industry, oil industry and many other. The way of processing determines the value of the end products (Anonymous, 2017).

The processing of the poultry by-products starts with raw material handling, followed by heat treatment to reduce the moisture content and to kill micro-organisms. Separation of the melted oil from the solids (protein) is achieved through draining and pressing. The solid fraction is then ground into a powder, such as whole meal, poultry meat meal, feather meal, blood meal and poultry oils. The oil can be clarified through decanting or settling.

### **Animal by-product and Regulation**

Animal by-products are entire animal bodies, parts of animals, products of animal origin or other products obtained from animals that are not fit or intended for human consumption. These of unsuitable animal by-products for human consumption is based on human beings before the first agricultural activities. As a result of industrialization and intensification of animal production, the evaluation of animal by-products has become increasingly important (Çınar, 2009). In slaughter houses, there maining tissues after the products being used as human food are obtained, can be processed and converted into valuable by-products that are not used for

human food. The products obtained in this way are meat-bone meal, meat meal, bone meal, chicken meal, blood meal, feather meal and fats. These animal by-products are important feedstuffs for poultry feeding because of its good nutritional content, economical and abundant quantity, animal needs (Lessons and Summers, 2005). Therefore, it has been used as protein source for many years and so on in many countries.

Food hygiene and human health are considered much more important. Consumer awareness has improved much more in terms of product health and quality. That has been why the intensive research and development activities on organic farming and animal welfare in the European Union (EU) countries have become predominant. Due to the risk on food and feed-borne animal diseases, animal by-products had been banned in European Countries. The European Union has taken a series of measures to increase food safety as a solution to the secrises that took place during this period when the consumer's influence on the market has been a great importance. The regulation of 999/2001; prohibits these of animal protein in the feeding of animals raised for food production. Based on the harmonization process with the EU, the regulation of Ministry of Food, Agriculture and Livestock published in the Official Gazette dated 24.12.2011 numbered 28152, "Animal By-Products Not Used for Human Consumption" has introduced new regulations that directly affecting broiler and egg sector. Prepared according to European Union standards and the EU harmonization process, this regulation sets a standard for poultry feed. As banned in ruminants, animal protein sources were banned in animal feeding operations on 1<sup>st</sup> January 2017 to prevent possible disease risks.

### **Conclusion**

Chickens are not omnivore any more with the recent regulation in European Countries and Turkey. We can ban it in legislation but how to intervene in the natural environment with or without considering ethical and behavioural issues.

### **References**

- ANONYMOUS, (2017). Poultry Rendering. <http://mavitecrendering.com/rendering-process/poultry-rendering/>. Accessed Date: 01.02.2018.
- ÇINAR, H. (2009). Avrupa Birliği'ne uyum sürecinde Türkiye'de tavuk unu kullanımına getirilecek yasaklamanın broyler entegrasyonları üzerinde ekonomik etki analizi, Ph. D. Thesis, University of Ankara.

## Determination of The Effect of Myrtle (*Myrtus Communis L.*) Oil on Small Intestinal Motility In Broiler

Tuba Blbl<sup>a</sup>, Vural zdemir<sup>b</sup>, Elmas Ulutař<sup>c</sup>, Aziz Blbl<sup>c</sup>

<sup>a</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, <sup>a</sup>Department of Animal Nutrition and Nutritional Diseases, Afyonkarahisar - TURKEY

<sup>b</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Physiology, Afyonkarahisar - TURKEY

<sup>c</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Physiology, Afyonkarahisar - TURKEY

### Abstract

This research was conducted to determine the effects of essential oil of myrtle on small intestine motility. The effects of essential oil of myrtle obtained by hydrodistillation method of Clevenger device, were determined in a concentration range of 0.1-1000 µg / ml on the duodenum, jejunum and ileum tissues obtained from broiler chickens. It was determined that 300 and 1000 µg/ml levels of myrtle essential oils inhibited spontaneous contractions of all three tissues completely, whereas no significant responses were observed in these tissues at other concentration levels.

In conclusion, the essential oil of myrtle was demonstrated to inhibit the contractions of small intestine as *in vitro*.

**Key words:** Broiler, essential oil, small intestine, Motility

### zet

Bu arařtırma mersin bitkisi esansiyel yaęının ince baęırsak kasılımları zerine etkisini belirlemek amacıyla yapılmıřtır. Clevenger cihazın hidrodistilasyon metodu ile elde edilen mersin bitkisi esansiyel yaęı; 0,1–1000 µg/ml deriřim aralıęında broyler tavuklardan elde edilmiř duodenum, jejenum ve ileum dokularına uygulanarak etkileri ve etkili dozları belirlenmiřtir.

Her ç dokuda da mersin ucucu yaęının 300 ve 1000 µg/ml dozlarının spontan kasılımları tamamen engelledięi, dięer deriřimlerin dokular zerinde belirgin bir yanıt oluřturmadıęı belirlendi.

Sonuç olarak mersin bitkisi uęucu yaęının ince baęırsak kasılımlarını engelledięi *in vitro* olarak gsterilmiřtir.

**Anahtar kelimeler:** Broyler, esansiyel yaę, ince baęırsak, motilite.

## Introduction

As an aromatic plant, *Myrtus communis* L. belongs to the Myrtaceae family. It is widely used in medicine and the pharmaceutical industry, because it contains volatile fatty acids (VFAs) and other compounds. Volatile fatty acids of *M. communis* L. include myrtenol, myrtenyl acetate, limonene, linalool,  $\alpha$ -pinene, 1,8-cineole,  $\beta$ -caryophyllenein, p-cymene, geraniol, nerol, phenylpropanoid and methyleugenol (Ozek 2000). It has been reported that derivatives of some myrtus extracts, such as beta-triketones, tannens, myricetin, gallic acid and ellagic acid, have antibacterial effects and the plant has strong antioxidant activity due to its galloyl derivatives (Romani et al., 2004). Also, it has antifungal (Sepeci et al. 2004), hypoglycaemic (Garg et al. 1988), anticonvulsant (Elisha et al. 1988), anticarcinogenic (Cassady et al. 1988), anti-inflammatory (Feisst et al., 2005) and antimutagenic (Hayder et al. 2008] effects. The poultry industry is under increasing pressure to produce high quality products for consumers. In particular, antioxidants have been widely used as food additives in poultry nutrition. However, there is a general rejection of synthetic food additives by consumers (Cassady et al. 1980, Biricik et al. 2012). However, the effect of aromatic compounds or essential oil addition on broiler diets on intestinal contractility is not clearly known.

The aim of this research was to investigate the effects of essential oil of myrtle on small intestine contractility.

## Materials and Methods

Samples of small intestines of ten broiler chickens were collected about 15 min after exsanguinations and transported on ice to the laboratory within 30 min. Samples then were placed in a dissecting Petri dish containing Krebs' solution (KS) (NaCl, 118 mmol/l; KCl, 4.7 mmol/l; CaCl<sub>2</sub>, 2.5 mmol/l; MgSO<sub>4</sub>, 1 mmol/l; KH<sub>2</sub>PO<sub>4</sub>, 1 mmol/l; glucose 11, mmol/l; NaHCO<sub>3</sub>, 25 mmol/l) in an atmosphere of 95% O<sub>2</sub> and 5% CO<sub>2</sub>. Five millimeter wide longitudinal smooth muscle strips were dissected from the middle portions of the excised samples and incised parallel to the long axis of the gut to obtain 5 × 2 mm strips. Longitudinal smooth muscle strips were isolated carefully and one edge of each tissue preparation was fixed by 2:0 silk ligatures to platinum ring electrodes. The opposite edge of the tissue was connected to a force-displacement transducer by 2:0 silk ligatures (model 10-A; MAY; Commat, Ankara, Turkey). Isolated strips were placed in a four chamber organ bath (IOBS 99 Isolated Tissue Bath Stand Set; Commat) filled with 20 ml KS (pH 7.4) in an atmosphere of 95% O<sub>2</sub> and 5% CO<sub>2</sub> at 39° C. The isometric smooth muscle activity of the intestine samples was monitored and recorded by computer using the force transducer and an acquisition system (model MP30 WSW with Biopac Student Lab, PRO Software, Biopac Systems; Commat).

### **Recording Isometric Duodenum, Jejunum and Ileum Contractility**

Small intestine samples in the organ baths were kept in KS for at least 1 h before the recordings to permit the tissues to adapt to the environment; the solution was refreshed at 15 min intervals. The appropriate resting tension for the muscle strips was determined by preliminary experiments. The strips were placed under progressive increments of tension. Optimal tension relationships for the strips were achieved with resting tensions of 1 g to stimulate maintenance of the physiological contractile activity of the tissue. Therefore, a resting tension of 1 g was applied to the tissues. After the 30 min baseline period, contractions of longitudinal strips for each portion of small intestine for each animal were recorded to determine normal spontaneous contractions. The muscle strips then were treated with 0.1, 0.3, 1.3, 10, 100, 300 and 1000 µg/ml myrtle essential oils.

### **Results and Discussion**

In recent years, essential oils in poultry feeding have been used as digestive regulators as well as many functions. The effects of essential oils on the digestive system include aroma enhancer in addition to enhancing the function of digestive enzymes. It has been shown that essential oils may be effective on digestion (Pradeep ve ark., 1991; Pradeep ve Geervani, 1994) or digestive enzymes (Bhat ve ark., 1984; Bhat ve Chandrasekhara, 1987; Sambaiah ve Srinivasan, 1991). However, the effects of essential oils on small intestinal contractility in poultry are unknown. In this study, it was determined that doses of the Myrtle essential oil apart from 300 and 1000 µg/ml did not produce a notable response on tissue and that normal (phsaic) contractions in tissue were prevented upon application of the signified concentrations. Also, it was detected that normal contractions resumed after washing Krebs' solution.

### **Conclusion**

In conclusion, it was demonstrated *in vitro* that the Myrtle essential oil inhibition contractions in the small intestine. In this regard, the fact that effects of high doses oil intestinal motility needs to be taken into consideration when adding the Myrtle essential oil to the broiler diets.

### **References**

- OZEK, T., DEMIRCI, B., BASER, K.H.C. (2000) Chemical composition of Turkish myrtle oil. *Journal of Essential Oil Research* 12, 541-544.
- ROMANI, A., COINU, R., CARTA, S., PINELLI, P.C., GALARDI, C., VINCIERI, F.F., FRANCONI, F. (2004) Evaluation of antioxidant effect of different extracts of *Myrtus communis* L. *Free Radical Research* 38, 97-103.

- SEPICI, A., GURBUZ, I., CEVIK, C., YESILADA, E. (2004) Hypoglycaemic effects of myrtle oil in normal and alloxan-diabetic rabbits. *Journal of Ethnopharmacology* 93, 311-318.
- GARG, S.C., DENGRE, S.L. (1988) Antifungal activity of the essential oil of *Myrtus-communis-var-microphylla*. *Herba Hungarica* 27, 123-126.
- ELISHA, E.E., MOUSSA, S.O., ABED, S.K. (1988) Effects of the leaves of *Myrtus communis* on the CNS I: The central depressant and anticonvulsant actions. *Journal of Biological Sciences* 19, 545-560.
- CASSADY, J.M. and SUFFNESS, M. (1980) Terpenoid antitumor agents. In: CASSADY, J.M., DOUROS, J.D. (Eds.), *Anticancer agents based on natural product models*, pp.201-269 (Academic Press).
- FEISST, C., FRANKE, L., APPENDINO, G., WERZ, O. (2005) Identification of molecular targets of the oligomeric nonprenylated acylphloroglucinols from *Myrtus communis* and their implication as anti-inflammatory compounds. *Journal of Pharmacology and Experimental Therapeutics* 315, 389-396.
- HAYDER, N., SKANDRANI, I., KILANI, S., BOUHLEL, I., ABDELWAHED, A., BEN, AMMAR, R., MAHMOUD, A., GHEDIRA, K., CHEKIR-GHEDIRA, L. (2008) Antimutagenic activity of *Myrtus communis* L., using *Salmonella* microsome assay. *South African journal of Botany* 74, 121-125.
- BIRICIK, H., YESILBAG, D., GEZEN, D.D., BULBUL, T. (2012). Effects of dietary myrtle oil (*Myrtus communis* L.) supplementation on growth performance, meat oxidative stability, meat quality and erythrocyte parameters in quails. *Revue de Medecine Veterinaire* 163, 131-138.
- PRADEEP, K.U., GEERVANI, P. (1994) Influence of spices on protein utilization of winged bean (*Psophocarpus tetragonolobus*) and horsegram (*Dolichos biflorus*). *Plant Foods for Human Nutrition* 46, 187-193.
- PRADEEP, K.U., GEERVANI, P., EGGUM, B.O. (1991) Influence of spices on utilization of sorghum and chickpea protein. *Plant Foods for Human Nutrition* 41, 269-276
- BHAT, B.G., SRINIVASAN, M.R., CHANDRASEKHARA, N. (1984) Influence of curcumin and capsaicin on the composition and secretion of bile in rats. *Journal of Food Science and Technolog* 21, 225-227.
- BHAT, B.G., CHANDRASEKHARA, N. (1987) Effect of black pepper and piperine on bile secretion and composition in rats. *Nahrung* 31: 913-916.
- SAMBALIAH, K., SRINIVASAN, K. (1991) Secretion and composition of bile in rats fed diets containing spices. *Journal of Food Science and Technolog* 28, 35-38.

## Effects of Dietary Supplementation of Arginine and Lysine on Total Number and Volume of Nuclei of The Cardiomyocytes in Laying Quails

Murat Sırrı Akosman<sup>a</sup>, Tuba Bülbül<sup>b</sup>, Aziz Bülbül<sup>c</sup>, Mehmet Akalan<sup>a</sup>, Vural Özdemir<sup>a</sup>

<sup>a</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Anatomy, Afyonkarahisar - TURKEY

<sup>b</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Diseases, Afyonkarahisar – TURKEY

<sup>c</sup>Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Physiology, Afyonkarahisar - TURKEY

### Abstract

This study was carried out to determine what effect of addition of arginine and lysine to layer quail diets on the volume and number of cardiomyocytes nuclei. In the study, quail in the control group were fed with a baseline ration without arginine and lysine supplement (with an arginine: lysine ratio at required level), whereas the hearts used in the experimental groups came from quail that were fed with the baseline ration plus 0.1% arginine, 0.2% arginine, 0.1% lysine, 0.2% lysine, 0.1% arginine + 0.1% lysine and 0.2% arginine + 0.2% lysine. 8 quail hearts were used in each group. As a result, it was determined that, the changes of arginine and lysine ratio caused to deterioration in the cellular structure of the heart.

**Key words:** Arginine, lysine, Nitric oxide, quail

### Özet

Bu araştırma yumurtacı bıldırcın rasyonlarına arjinin ve lizin ilavesinin kalp hücreleri çekirdeklerinin hacmi ve sayısı üzerine etkisini belirlemek amacıyla yapıldı. Araştırmada kontrol grubu arjinin ve lizin ilavesi yapılmayan (arjinin:lizin oranı gereksinim düzeyinde olan) temel rasyonla, deneme grupları ise temel rasyona %0.1 arjinin, % 0.2 arjinin, % 0.1 lizin, % 0.2 lizin, % 0.1 arjinin + %0.1 lizin ve % 0.2 arjinin + % 0.2 lizin katılarak beslenen bıldırcınların kalpleri kullanıldı. Her grupta 8 bıldırcın kalbi kullanılmıştır. Rasyona yalnız arjinin ya da lizin ilavesi kalp hücrelerinin çekirdeklerinin hacmini ve sayısını azaltırken, arjinin ve lizinin beraber ilavesi değişiklik oluşturmadı. Sonuç olarak rasyondaki arjinin ve lizin oranındaki değişimlerin kalbin hücresel yapısında bozulmaya neden olduğu gösterilmiştir.

**Anahtar kelimeler:** Bıldırcın, Arjinin, lizin, kalp

## Introduction

Arginine and lysine are important for poultry nutrition in terms of the promotion and development of growth (Waldroup et al. 1998, Kidd et al. 2001, Cengiz et al. 2008), egg production and egg quality (Novak et al. 2004, Onderci et al. 2006). Body-weight (BW) gain, feed intake (FI) and feed conversion ratio (FCR) in poultry are adversely affected by deficiencies of these amino acids (Kwak et al. 1999, Konashi et al. 2000). In contrast, excessive levels of these amino acids in the diet have been found to result in impaired growth performance (Carev et al. 1998, Cengiz et al. 2008). Studies show that immunity is supported by the addition of Arginine to the diet due to the enhanced release of nitric oxide (NO) from macrophages (Sung et al. 1991, Webel et al. 1998). NO affects the function of various organs, including myocardium, and is produced by several cell types, including cardiomyocytes (Cotton et al. 2002).

## Materials and Methods

In this study, quail in the control group were fed with a baseline ration without arginine and lysine supplement (with an arginine: lysine ratio at required level), whereas the experimental groups were fed with the baseline ration in addition to 0.1% arginine, 0.2% arginine, 0.1% lysine, 0.2% lysine, 0.1% arginine + 0.1% lysine and 0.2% arginine + 0.2% lysine. 8 quail hearts were used in each group. The nutrient composition of the basal diet, including moisture, crude protein, crude fat, crude fibre, crude ash and calcium contents, was determined according to the AOAC (2000). The metabolizable energy level of the basal diet was calculated according to Carpenter and Clegg (1956)

Volume Estimation of cardiomyocyte nuclei., All glass slides were fixed on the platform and their 1/1 scale photos were taken. A 2.5 mm spaced point grid was placed on those images on computer screen in order to measure the total volume by Cavalieri method (Gundersen et al., 1988). The calculations were then performed by the following formula:

$$V = t \times a/p \times \Sigma P \text{ cm}$$

Estimation of total number of cardiomyocyte nuclei. The counting procedure was performed on cardiomyocyte nuclei as counting units according to optical fractionator method (Gundersen, 1986, Myers et al., 2004). cardiomyocyte number was calculated using Shtereom I software (Oguz et al., 2007), Olympus BH2 light microscope (Lang MS 316) with motorized stage (for progress in steps on X and Y axis) and 3.2 MP Cmax camera (Euromex, Holland), with x100 oil-immersion lens objective. The thickness of the tissue measured and the movements in Z axis were controlled by a microcator (Heidenhain, Germany). The area of the counting frame and the step length for X and Y axis was 2209  $\mu\text{m}^2$ , 1100  $\mu\text{m}$ , and 1100  $\mu\text{m}$  respectively. The disector height was determined as 10  $\mu\text{m}$ . The total cell

number was estimated according to following formula (West et al.);  $N = 1/F_{ssf} \times 1/F_{hsf} \times 1/F_{asf} \times \sum Q_{fssf}$ ; Section Sampling Fraction (SSF =1/20), Fhsf: Height Sampling Fraction. The mean section thickness divided to the height of the disector (~25µm /10µm), Faf: Area Sampling Fraction. X-Y step lengths multiplied together and divided to the frame area (1100µm x 1100µm)/ 22092 µm),  $\sum Q$ -; Number of counted cardiomyocyte cells.

### **Results and Discussion**

It is known that nitric oxide is an important agent that plays important parts in the functioning of the heart (Cotton et al. 2002). The conducted research further revealed the presence of NOS enzymes, responsible for the release of nitric oxide. In addition, the level of released nitric oxide is also important in terms of heart health. When this substance is released more or less, defects arise in the functioning of the heart (Balligand et al., 2009, Villanueva and Giulivi 2010). In this context, it is believed that excess of arginine, a nitric oxide donor, was the reason behind decrease in the volume and number of cardiomyocyte nuclei in the arginine fed groups. By contrast, decrease in the lysine groups might be due to decreased arginine levels. This is because excess lysine also disrupts the absorption of arginine.

**Tablo 1.Total number and volume of cardiomyocyte nuclei in groups**

	C	AR1	AR2	LY1	LY2	AL1	AL2	PS	P
V	77.00a	61.40b	66.40b	63.40b	60.60b	76.20a	71.00a	1.643	0.007
TN	25.60a	11.60b	11.60b	17.40a	11.40b	21.00a	20.20a	1.369	0.011

V: Volume, TN: Total number, C: Control, AR: 0.1% Arginine, AR2: 0.2% Arginine, LY: 0.1% Lysine, LY2: 0.2% Lysine, AL1: 0.1%Arginine + 0.1%Lysine, AL2: 0.2%Arginine + 0.2%Lysine, PS: 0.2%Arginine + 0.2%Lysine, a, b: Different letters in the same line are statistically significant (Duncan's multiple range test, P<0.05)

### **Conclusion**

In conclusion, it was detected that the addition solely of arginine or lysine supplements into quail rations decreased the volume and number of cardiomyocyte nuclei. Occur of this effect is thought to due to corruption of the nitric oxide metabolism.

### **References**

KIDD, M.T., PEEBLES, E.D., WHITMARSH, S.K., YEATMAN, J.B., WIDEMAN, R.F. (2001) Growth and immunity of broiler chicks as affected by dietary arginine. *Poult Science* 80, 1535-1542

CENGİZ, .O, ONOL, A.G., SEVİM, O., OZTURK, M., SARI, M., DASKIRAN, M. 2008 Influence of excessive lysine and/or methionine supplementation on growth performance and carcass traits in broiler chicks. *Revue de Medecine Veterinaire*, 159, 230-236.

- WALDROUP, P.W., ENGLAND, J.A., KIDD, M.T., KERR, B.J. (1998) Dietary arginine and lysine in large white toms. 1. Increasing arginine : lysine ratios does not improve performance when lysine levels are adequate. *Poult Science* 77, 1364-1370
- NOVAK, C., YAKOUT, H., SCHEIDELER, S. (2004): The combined effects of dietary lysine and total sulfur amino acid level on egg production parameters and egg components in Dekalb Delta laying hens. *Poult Science*, 83, 977-984. 27.
- ONDERCI, M., SAHIN, N., SAHIN, K., BALCI, T.A., GURSU, M.F., JUTURU, V., KUCUK, O. (2006) Dietary arginine silicate inositol complex during the late laying period of quail at different environmental temperatures. *British Poultry Science* 47, 209-215
- KONASHI, S., TAKAHASHI, K., AKIBA, Y. (2000) Effects of dietary essential amino acid deficiencies on immunological variables in broiler chickens. *British Journal of Nutrition* 83, 449-456.
- KWAK, H., AUSTIC, R.E., DIETERT, R.R. (1999) Influence of dietary arginine concentration on lenfoid organ growth in chickens. *Poult Science* 78, 1536-1541.
- CAREW, L.B., EVARTS, K.G., ALSTER, F.A. (1998) Growth, feed intake and plasma thyroid hormone levels in chicks fed dietary excesses of essential amino acids. *Poult Science*, 77, 295-298.
- WEBEL, D.M., JOHNSON, R.W., BAKER, D.H. (1998) Lipopolysaccharide-induced reductions in body weight gain and feed intake do not reduce the efficiency of arginine utilization for whole-body protein accretion in the chick. *Poult Science* 77, 1893-1898
- SUNG, Y.J., HOTCHKISS, J.H., AUSTIC, R.E., DIETERT, R.R. (1991) L-arginine-dependent production of a reactive nitrogen intermediate by macrophages of a uricotelic species. *Journal of Leukocyte Biology* 50, 49-56
- COTTON, J.M., KEARNEY, M.T., SHAH, A.M. (2002) Nitric oxide and myocardial function in heart failure: friend or foe? *Heart* 88, 564-566.
- AOAC (2000) *Official Methods of Analysis of the Association of Official Analytical Chemists*. 17th ed., Maryland, USA.
- CARPENTER, K.J., CLEGG, K.M., (1956) The metabolizable energy of poultry feedingstuffs in relation to their chemical composition. *Journal of the Science of Food and Agriculture*, 7, 45-51.
- GUNDERSEN, H.J., BENDTSEN, T.F., KORBO, L., MARCUSSEN, N., MOLLER, A., NIELSEN, K., NYENGAARD, J.R., PAKKENBERG, B., SORENSEN, F.B., VESTERBY, A., WEST, M.J. (1988) Some new, simple and efficient stereological methods and their use in pathological research and diagnosis. *Acta Pathologica, Microbiologica et Immunologica Scandinavica*, 96, 379-394.

- MYERS, M., BRITT, K.L., WREFORD, N.G., EBLING, F.J., KERR, J.B. (2004) Methods for quantifying follicular numbers within the mouse ovary. *Reproduction*, 127, 569-580.
- OGUZ, E.O., CONKUR, E.S., SARI, M. (2007) Shtereom I simple windows based software for stereology, volume and number estimations. *IMAGE ANALYSIS & STEREOLOGY*, 26, 45-50.
- BALLIGAND, J.L., FERON, O., DESSY, C. (2009) eNOS activation by physical forces: from short-term regulation of contraction to chronic remodeling of cardiovascular tissues. *Physiological Reviews* 89, 481–534.
- VILLANUEVA, C., GIULIVI C. (2010) Subcellular and cellular locations of nitric oxide synthase isoforms as determinants of health and disease. *Free Radical Biology and Medicine* 49, 307-316.

## Technical and Economic Effect of Constant and Variable Feeding During and After Molting Period in White Free Ranged Hens

Savaş Sarıözkan<sup>a</sup>, Yusuf Konca<sup>b</sup>, Mehmet Küçükoflaz<sup>a</sup>, Aytaç Akçay<sup>c</sup>

<sup>a</sup>Erciyes University, Faculty of Veterinary Medicine, Department of Animal Health Economics and Management, Kayseri-Turkey

<sup>b</sup>Erciyes University, Department of Zootechnics, Faculty of Agriculture, Kayseri-Turkey

<sup>c</sup>Erciyes University, Faculty of Veterinary Medicine, Department of Biometrics, Kayseri-Turkey

### Abstract

The aim of this study is to investigate the effect of constant and variable feeding on molting and post-molting performance and economic parameters in free-ranged white laying hens. For this purpose, a total of 450 white laying hens (9 subgroups of 50 chickens) for 80 weeks were divided into 3 groups. During molting period (14 days), 1<sup>st</sup> group were fed constant 50 gr of barley every day; 2<sup>nd</sup> group were fed with 40 gr barley one day and 60 gr barley another day and 3<sup>rd</sup> group were fed with 30 gr barley one day and 70 gr barley another day. After molting period, the groups were fed constant (Group 1=120 gr feed/day) and variable (Group 2 = 110 or 130 gr feed/day; Group 3 = 100 or 140 gr feed/day) feeding for 50 days. Water was given ad libitum. According to results, there were not significant differences between groups in terms of live weight loss, cease egg production and mortality during molting ( $p>0,05$ ). Also, after molting period total egg production, egg weight and mortality were similar. The income and profitability of 2<sup>nd</sup> group was numerically lower than other groups. In conclusion, during and after molting period variable feeding was no negative effect on technical and economic parameters.

**Key words:** *Constant and variable feeding, Free range, Performance, Profitability*

### Serbest Gezen (Free Range) Beyaz Yumurtacı Tavuklarda Sabit ve Değişken Yemlemenin Tüy Dökümü ve Sonrası Teknik ve Ekonomik Etkileri

#### Özet

Bu çalışmanın amacı, serbest gezen beyaz yumurtacı tavuklarda sabit ve değişken yemlemenin tüy dökümüne ve tüy dökümü sonrası performans ile ekonomik parametrelere etkilerinin araştırılmasıdır. Bu amaçla 80 haftalık toplam 450 adet beyaz yumurtacı tavuk (50'şer tavuktan oluşan 9 alt grublu)

3 gruba ayrılmıştır. Tüy dökümü döneminde 14 gün süreyle 1. Grup tavuklar her gün sabit olarak 50 gr arpa; 2. Grup 40-60 gr arpa ve 3. Grup 30-70 gr arpa verilerek beslenmişlerdir. İkinci aşamada tüy dökümü sonrası 50 gün boyunca yine sabit (Grup 1=120 gr yem/tavuk/gün) ve değişken (Grup 2=110-130 gr yem/tavuk/gün; Grup 3=100-140 gr yem/tavuk/gün) yemleme yapılarak tavuklar beslenmiştir. Tavuklara su ad libitum olarak verilmiştir. Araştırma bulgularına göre; tüy dökümü döneminde gruplar arasında ağırlık kaybı, yumurta üretiminde azalma ve ölüm oranları bakımından istatistiksel farklılık tespit edilmemiştir ( $P>0,05$ ). Teknik parametreler yönünden 2. Grupta özellikle yumurta veriminin rakamsal olarak daha düşük olması, ekonomik olarak da bu grubun karlılığını düşürmüştür. Sonuç olarak, serbest gezen beyaz yumurtacı tavuklarda sabit ve değişken yemlemenin tüy dökümü üzerinde herhangi bir olumsuz etkisinin olmamasının yanı sıra, tüy dökümü sonrasında en düşük yumurta verimi, gelir ve karlılık 2. grupta elde edilmiştir.

**Anahtar kelimeler:** *Free range, Karlılık, Performans, Sabit ve değişken yemleme*

### **Introduction**

The laying hens are molted with different methods. One of these methods is the molting with non feed removal method. In this study free ranged hens were molted by constant and variable feeding. Also after molting the feed was supplied to free ranged hens constant and variable.

### **Material and Methods**

In this study a total of 450 white laying hens (150 hens in each group) for 80 weeks were divided into 3 groups and 3 subgroup in each. During molting period (14 days), 1<sup>st</sup> group were fed constant 50 gr of barley every day; 2<sup>nd</sup> group were fed with 40 gr barley one day and 60 gr barley another day and 3<sup>rd</sup> group were fed with 30 gr barley one day and 70 gr barley another day. After molting period, the groups were fed constant (Group 1=120 gr feed/day) and variable (Group 2 = 110 or 130 gr feed/day; Group 3 = 100 or 140 gr feed/day) feeding for 50 days. Water was given ad libitum.

During molting period, by using live weights of initial and finishing period, weight loss (%) was determined. Cease of egg production and mortality rate (%) was recorded.

After molting period, egg production (%), feed consumption, egg weight and mortality were determined. Also, production cost, income and profit were calculated.

### **Results**

According to results, there were not significant differences between groups in terms of live weight loss, cease egg production and mortality during molting ( $p>0,05$ ). Also, after molting period yield, egg weight and mortality were similar. ( $p>0,05$ ). There was no significant differences in terms of economic parameters like production cost, egg income and profit (Table 1, 2 and 3).

**Table 1. Effect of constant and variable feeding on molting period**

	Groups			p
	1	2	3	
Initial live weight, gr	1,540	1,530	1,550	P>0,05
Finishing live weight, gr	1,240	1,210	1,300	P>0,05
Live weight loss, %	19,40	21,02	16,20	P>0,05
Cease of egg production, day	12,0	11,5	10,5	P>0,05
Mortality, %	4	2	2	P>0,05

**Table 2. Effect of constant and variable feeding after molting period**

Performance parameters	Groups			p
	1	2	3	
%10 yeild, day	4	5	4	P>0,05
%50 yeild, day	20	27	18	P>0,05
Average yield, %	61,7	55,2	62,0	P>0,05
Feed consumption, kg/hen	6	6	6	P>0,05
Egg weight, gr	66,4	66,6	65,8	P>0,05
Mortality rate, %	5,2	5,1	6,1	P>0,05

**Table 3. Effect of applied programs on economic parameters**

Economic parameters	Groups			p
	1	2	3	
Cost, TL/hen	6,98	6,96	6,84	P>0,05
Income, TL/hen	11,20	9,97	11,01	P>0,05
Profit, TL/hen	4,22	3,01	4,17	P>0,05

Egg price = 0,45 TL/adet; Feed Price = 1,2 TL/kg

### Conclusion

Molting hens with non feed removal method is more humanistic and should prefer on field. Feeding with constant and variable both in molting period and after molting period has no negative effect on hens in terms of technical and economic parameters.

### References

- SARIÖZKAN S., (2016). Applicability of Non-Feed Removal Programs to Induce Molting Instead of the Conventional Feed Withdrawal Method in Brown Laying Hens", Brazilian Journal Of Poultry Science, 8: 535-542.
- SARIÖZKAN S., KOCAOĞLU GÜÇLÜ B., KARA K., GÜRÇAN S., (2013) Comparison Of Different Molting Methods And Evaluation Of The Effects Of Postmolt Diets Supplemented With Humate And Carnitine On Performance, Egg Quality, And Profitability Of Laying Hens", Journal Of Applied Poultry Research, 22: 689-699.

KOÇAOĞLU GÜÇLÜ B. KARA K. SARIÖZKAN S. İŞCAN K. M. (2009)  
Farklı kafes yoğunluğunda barındırılan ve farklı düzeyde enerji içeren yemlerle beslenen yumurta tavuklarının rasyonlarına karnitin katılmasının yumurta kalitesi ve bazı biyokimyasal parametrelere etkisi. Erciyes Üniv. Vet. Fak. Derg. 6:1-12.

## New Feeding Strategies in Organic Poultry Breeding

Arda Yıldırım<sup>a</sup>, Hasan Elerođlu<sup>b</sup>, Ahmet Şekerođlu<sup>c</sup>, Mustafa Duman

<sup>a</sup>Gaziosmanpaşa University, Agricultural Faculty, Animal Science department, Tokat, Turkey

<sup>b</sup>Cumhuriyet University, Şarkışla Aşık Veysel Vocational, School, Şarkışla/Sivas, Turkey

<sup>c</sup>Niğde Ömer Halisdemir University, Ayhan Sahenk Faculty of Agricultural Sciences and Technologies, Department of Animal Production and Technologies, Niğde –Turkey

<sup>d</sup>Niğde Ömer Halisdemir University, Bor Vocational, School, Department of Laboratory and Veterinary Health, Bor, Niğde – Turkey

### Abstract

In poultry farming, the most important factor affecting the cost of mixed feeds is the cost of feedstuffs used in feed production. High feedstuff cost increases feed cost, which is reflected on poultry production inputs. Reducing poultry production costs could only be possible with economic feed preparation and use. In order to achieve this, it is necessary to use the economical feedstuffs that can meet the need for the nutrient content of the chickens. In this regard, in poultry rations, the use of atypical feed ingredients in place of or in the presence of some expensive feed ingredients such as corn, soy sauce, fish meal is a strategy used by nutritionist around the world to reduce production costs. Economic regulations on feeding in organic poultry production; the research and development of new, inexpensive and quality feed sources is very important in terms of the future of organic livestock as well as in conventional. To reduce this problem in poultry rations, legume seeds could be used as a source of vegetable protein. Interest in high protein rich legume seeds that are compatible with the ecology of the Mediterranean countries is progressively increased. In this review, the strategies that could be applied in organic poultry feeding, the uses of innovative feedstuffs and research results on organic poultry nutrition have been studied.

**Key words:** *Organic feed, legume seed, feeding strategy, poultry*

## Organik Kanatlı Yetiştiriciliğinde Yeni Besleme Stratejileri

### Özet

Kanatlı yetiştiriciliğinde kullanılan karma yemlerin maliyetini etkileyen en önemli unsur, yem yapımında kullanılan ham maddelerin maliyetidir. Ham madde maliyetinin yüksek olması yem maliyetini artırmakta, bu da kanatlı üretim maliyetine yansımaktadır. Kanatlı üretim maliyetinin düşürülmesi

ancak ekonomik yem yapımı ve kullanımıyla mümkün olabilir. Bunun sağlanması için yemde, yetiştiriciliği yapılan tavuğun besin maddesi ihtiyacını karşılayabilecek özellikteki ekonomik yem hammaddelerinin kullanımı gereklidir. Nitekim kanatlı rasyonlarında mısır, soya kütspesi, balık unu gibi bazı pahalı yem hammaddelerinin yerine veya ikamesinde alışılmamış yem hammaddelerinin kullanımı, üretim maliyetini düşürmek için tüm dünyada beslemeciler tarafından kullanılan bir stratejidir. Organik kanatlı yetiştiriciliğinde yemleme konusunda yapılacak ekonomik düzenlemeler yeni, ucuz ve kaliteli yem kaynaklarının araştırılıp, geliştirilmesi konvansiyonel yetiştiricilikte olduğu gibi organik hayvancılığın geleceği açısından da çok önemlidir. Kanatlı rasyonlarında bu sorunu azaltmak için bitkisel protein kaynağı olarak baklagil daneleri kullanılabilir. Akdeniz ülkelerinin ekolojisine uygun yüksek proteince zengin baklagil danelerine ilgi gittikçe artmaktadır. Bu derlemede, organik kanatlı hayvan beslenmesinde uygulanabilecek stratejiler ve yenilikçi yem hammaddelerinin kullanımı ve organik kanatlı yetiştiriciliği üzerinde yapılan araştırma sonuçları irdelenmiştir.

**Anahtar Kelimeler:** Organik yem, baklagil danesi, besleme stratejisi, kanatlı

## Effects of Dietary Panax Ginseng Leaf Extract on Production Performance and Egg Quality of Laying Hens

Merve Işıl Şen Mutlu, Arda Yıldırım

Gaziosmanpaşa University, Agricultural Faculty, Animal Science department, Tokat, Turkey

### Abstract

A study was conducted to determine the effect of ginseng (*Panax ginseng* C.A. Meyer) leaf on egg production and egg quality characteristics of hens at the beginning of their laying period. Eighty commercial Atak-S brown layers at the age of 20 weeks were randomly allocated to one of four treatments with four replicates of five hens per treatment in a completely randomized design. The birds were fed standard layer diets control (0 mg/kg), 50 mg/kg, 100 mg/kg or 150 mg/kg *Panax ginseng* leaf extract (PGLE) for 12 weeks period. Laying performance was assessed by recording egg production, egg weight daily; feed intake and feed efficiency weekly and egg quality biweekly. The results showed that PGLE supplementation did not have significant ( $P>0.05$ ) effects on body weight, feed intake and feed efficiency while it had effect on egg weight towards increasing ( $P<0.05$ ). Overall, there were no differences among groups in external egg quality parameters ( $P>0.05$ ), while significant increases were observed in albumen and yolk index of internal egg quality. As a result of research, it could be considered that up to 150 mg PGLE/kg in a laying hen's diet did not change the egg production performance of layers and there is only a positive effect on egg weight increase which could contribute to profitability.

**Key words:** Atak-S, egg production, egg quality, Laying hen, *Panax ginseng*

## Yumurtacı Tavuklarda Diyetel Panax Ginseng Yaprak Ekstraktının Yumurta Verimi ve Kalite Özelliklerine Etkisi

### Özet

Araştırma Panax ginseng (*Panax ginseng* C.A. Meyer) yaprak ekstraktının (PGYE) başlangıç yumurtlama dönemindeki ATAK-S (yerli yumurtacı hibrit) kahverengi yumurtacı tavuklarda yumurtlama performansı, yumurta kalite özellikleri ve bazı kan serum parametreleri üzerine etkisini belirlemek amacıyla yürütülmüştür. Benzer canlı ağırlıktaki toplam seksen adet ticari yirmi haftalık yaşta yumurtacı tavuklar tesadüf parselleri deneme deseninde her kafes gözünde beş hayvan olacak şekilde dört tekrardan oluşan dört deneme grubuna dağıtılmışlardır. Hayvanlar on iki haftalık süre boyunca

temel karma yemde kontrol (0 mg/kg), 50 mg/kg, 100 mg/kg ve 150 mg/kg Panax ginseng yaprak ekstraktı içeren yumurtacı tavuk yemleri ile beslenmişlerdir. Yem ve su ad libitum olarak sağlanmıştır. Yumurtlama performansı olarak belirlenen yumurta üretimi, yumurta ağırlığı günlük olarak, yem tüketimi, yemden yararlanma oranı haftalık olarak, yumurta kalitesi ise iki haftalık aralıklarla ölçülmüştür. PGYE ilavesinin canlı ağırlığı, yem tüketimi, yemden yararlanma oranı, yaşama gücü, yumurta verimini etkilemediği ( $P>0,05$ ), yumurta ağırlığını ise önemli düzeyde arttırdığı ( $P<0,05$ ) saptanmıştır. Genel olarak yumurta dış kalite özelliklerinde farklılık gözlenmez iken ( $P>0,05$ ) yumurta iç kalite özelliklerinden yumurta ak ( $P<0,05$ ) ve sarı indeksinde ( $P<0,01$ ) önemli düzeyde artış gözlenmiştir. Araştırma sonucu olarak başlangıç dönemindeki yumurtacı tavukların rasyonuna PGYE ilavesinin yumurta üretim performansını değiştirmedeği, yalnız yumurta ağırlık artışına olumlu etkide bulunması ise yumurta üretim karlılığı açısından katkıda bulunabileceği söylenebilir.

**Anahtar Kelimeler:** *Atak-S, yumurtacı tavuk, yumurta üretimi, yumurta kalitesi, Panax ginseng*

## Effect of Dietary Trace Mineral Sources on Performance, Bone Development and Leg Health of Broilers

Yusuf Uzun, Hasan Rüştü Kutlu

Çukurova University, Agricultural Faculty, Dept. of Animal Science, Adana, TURKEY

### Abstract

The present study conducted to evaluate effects of dietary trace mineral sources in broiler diets on performance, bone development and leg health status. In the trial, broiler chicks were fed with diets differing in trace mineral sources (organic form 25%, organic 25%+inorganic 25%, organic 50% and organic 50%+inorganic 50%) for 6 weeks. At the end of the study, it was observed that total feed consumption, body weight gain, feed efficiency were not significant differences between groups ( $P>0.05$ ). Before slaughtering, some parameters (Gait Scoring, Valgus-Varus and Breast Burn) clinically observed but the results were no significant ( $P>0.05$ ).

**Key words:** *Organic trace mineral, Broiler leg health*

### Özet

Mevcut çalışmada rasyon iz minerallerin etlik piliçlerin performans değerleri, kemik gelişimi ve bacak sağlığına etkileri araştırılmıştır. Denemede broiler civcivler iz mineral kaynak ve miktarları farklı (organik form %25, organik %25+inorganik %25, organik %50 and organik 50%+inorganik 50%) yemlerle altı hafta süreyle beslenmişlerdir. Deneme sonunda piliçlerin toplam yem tüketimi, canlı ağırlık kazançları, yemden yararlanma oranı incelendiğinde muamele etkisinin önemli olmadığı saptanmıştır ( $P>0.05$ ). Hayvanların kesime sevkinden önce klinik gözlemlerde incelenen parametreler (Yürüme Skoru, Valgus-Varus ve Göğüste Yara Şekillenmesi) açısından muamelelerin etkisi önemli bulunmamıştır ( $P>0.05$ ).

**Anahtar kelimeler:** *Organik iz mineral, Broiler bacak sağlığı.*

### Introduction

Broiler (meat) chickens have been subjected to intense genetic selection. In the past 50 years, broiler growth rates have increased by over 300% (from 25 g per day to 100 g per day). There is growing societal concern that many broiler chickens have impaired locomotion or are even unable to walk (Knowles et al., 2008). Trace mineral supplementation of farm animal diets is usually accomplished with inorganic sources. Recent information suggests

that complexed trace mineral sources may improve the bioavailability of these minerals for animals. Trace minerals complexed to organic compounds, such as proteins, short chain peptides or amino acids, are more soluble and mobile to the cell membranes and are more readily absorbed than from inorganic sources. Several trace elements including zinc (Zn), copper (Cu), manganese (Mn), iron (Fe), selenium (Se) and cobalt (Co) have become commercially available for use in animal feeds as organic complexes (Saenmahayak, 2007). In this trail we investigate, whether organic trace mineral vs. inorganic trace mineral and their mixtures would affect growth performance and leg health of broilers.

**Materials and Methods**

One day old 100 Ross 308 Broiler male chicks, were used in the experiment for 6 weeks. Feeds used in the trial were 0-11 days starter, 11-23 days grower, 23-36 days grower 2 and 36-42 days finisher diets containing macro and micro nutrients besides trace minerals as pre-mix. The birds were fed 5 basal diets; control group (100% inorganic trace mineral), 25% organic trace mineral group, 25% organic trace mineral + 25% inorganic trace mineral group, 50% organic trace mineral group and 50% organic trace mineral + 50% organic trace mineral group. During trail, feed consumption, feed conversion ratio (FCR), final body weight were assessed. Before slaughter gait scoring, valgus-varus status and breast burn clinically observed.

**Results and Discussion**

The results obtained at the end of the six weeks period showed that, total feed consumption, body weight gain, feed efficiency were not significant differences between groups (P>0.05). End of trail before slaughtering animals, some parameters ( Gait Scoring, Valgus-Varus and Breast Burn) clinically observed, results were no significant differences (P>0.05).

Table 1. Effect of dietary organic and inorganic trace merial on feed comsuption of broilers

Parameters	Weeks					
	1	2	3	4	5	6
C	97.8b	435.6	998.1	1846b	3020	4275ab
25OF	102.9ab	445.0	1013	1945ab	3157	4487a
25OI	105.3ab	445.4	1033	1920ab	3053	4211b
50OF	101.6ab	441.7	1032	1947a	3118	4371ab
50OI	108.5a	452.5	1048	1944a	3122	4397ab
SED**	1.376	3.500	7.192	12.01	18.97	30.44
(P=)*	0.201	0.697	0.264	0.083	0.214	0.074

C: Control (100% inorganic form), 25OF: 25% Organic form, OI: 25% Organic + 25% Inorganic form, 50OF: 50% Organic form, 50OI: 50% organic + 50% Inorganic form, \*: P<0.05; \*\*: P<0.01; NS: Not significant (P>0.05), SED\*\*: standard error of difference between means.

**Table 2. Effect of dietary organic and inorganic trace merial on body weight gain of broilers**

Parameters	IBW	Weeks					
		1	2	3	4	5	6
C	43.08	125.9	427.0	861.3	1477	2188 <sup>b</sup>	2722
25OF	43.01	131.0	436.4	864.0	1487	2295 <sup>ab</sup>	2841
25OI	43.08	130.9	428.7	898.8	1528	2220 <sup>ab</sup>	2703
50OF	43.03	129.8	437.5	906.9	1561	2274 <sup>ab</sup>	2834
50OI	43.04	136.9	441.7	906.7	1540	2309 <sup>a</sup>	2837
SED**	0.405	1.636	4.291	7.552	11.70	15.56	26.11
(P=)*	0.999	0.371	0.823	0.172	0.169	0.117	0.304

IBW: Initial body weight (g), C: Control (100% inorganic form), 25OF: 25% Organic form, OI: 25% Organic + 25% Inorganic form, 50OF: 50% Organic form, 50OI: 50% organic + 50% Inorganic form, \*: P<0.05; \*\*: P<0.01; NS: Not significant (P>0.05), SED\*\*: standard error of difference between means.

**Table 3. Effect of dietary organic and inorganic trace merial on FCR of broilers**

Parameters	Weeks					
	1	2	3	4	5	6
C	0.779	1.032	1.164	1.253 <sup>b</sup>	1.380	1.572
25OF	0.784	1.023	1.181	1.31 <sup>a</sup>	1.381	1.589
25OI	0.805	1.040	1.152	1.258 <sup>ab</sup>	1.381	1.565
50OF	0.783	1.011	1.138	1.250 <sup>b</sup>	1.373	1.548
50OI	0.805	1.034	1.160	1.263 <sup>ab</sup>	1.351	1.553
SED**	0.005	0.007	0.006	0.005	0.005	0.007
(P=)*	0.553	0.799	0.382	0.006	0.507	0.503

C: Control (100% inorganic form), 25OF: 25% Organic form, OI: 25% Organic + 25% Inorganic form, 50OF: 50% Organic form, 50OI: 50% organic + 50% Inorganic form, \*: P<0.05; \*\*: P<0.01; NS: Not significant (P>0.05), SED\*\*: standart error of difference between means.

**Table 4. Effect of dietary organic and inorganic trace merial on Gait scoring, valgus-varus and breast burn of broilers**

Parameters	Gait Scoring	Valgus	Varus	Breast Burn
C	2.650	0.333 <sup>ab</sup>	0.111	0.038
25OF	2.545	0.454 <sup>ab</sup>	0.045	0.041
25OI	2.636	0.190 <sup>b</sup>	0.095	0.040
50OF	2.434	0.565 <sup>a</sup>	0	0
50OI	2.040	0.458 <sup>ab</sup>	0.083	0.017
SED**	0.133	0.022	0.023	0.7905
(P=)*	0.612	0.599	0.613	0.098

C: Control (100% inorganic form), 25OF: 25% Organic form, OI: 25% Organic + 25% Inorganic form, 50OF: 50% Organic form, 50OI: 50% organic + 50% Inorganic form, \*: P<0.05; \*\*: P<0.01; NS: Not significant (P>0.05), SED\*\*: standard error of difference between means.

### **Conclusion**

It is concluded that 25% organic trace mineral inclusion can achieve 100% inorganic trace mineral performance without any performance losses.

### **References**

- KNOWLES, T. G., KESTIN, S. C., HASLAM, S. M., BROWN, S. N., GREEN, L. E., BUTTERWORTH, A., ... NICOL, C. J. (2008). Leg Disorders in Broiler Chickens: Prevalence, Risk Factors and Prevention. *PLoS ONE*, 3(2), e1545. <http://doi.org/10.1371/journal.pone.0001545>
- SAENMAHAYAK, B. (2007). Complexed trace mineral supplementation of broiler diets. Auburn, Ala.

## Phytase In Poultry Diets

Şehnaz Özatay

Çanakkale Onsekiz Mart Üniversitesi, Ezine Meslek Yüksekokulu, Ezine/Çanakkale

### Abstract

For poultries, the constituents of diets are generally plant-based ingredients like the seeds of some of plants. In these diets, there are phytates which make complex with minerals. For example phosphorus and calcium which are very important for growth performance and egg shell quality of poultries. Phytase is the enzyme that can initiate the release of phosphate from phytate. Addition of phytase to high phytate containing diets improves phosphorus digestibility due to release of phosphorus. Nowadays, several scientific studies examines different doses of phytase in laying hens to evaluate the needs for improving performance parameters.

**Key words:** *Egg shell, Growth performance, Phytate, Phytase, Poultry*

### Kanathların Beslenmesinde Fitazın Yeri

#### Özet

Kümes hayvanları için olan diyetlerin bileşenleri, genellikle bazı bitkilere ait tohumlardır yani bitki esaslıdır. Bu diyetlerde, mineraller ile kompleks oluşturan fitatlar bulunmaktadır. Örneğin, kümes hayvanlarının büyüme performansı ve yumurta kabuğu kalitesi için çok önemli olan fosfor ve kalsiyum gibi. Fitaz, fitatdan fosfatın serbest kalmasını sağlayan bir enzimdir. Yüksek fitat içeren diyetlere fitaz ilavesi, belli oranda fosfor salınmasını sağlayarak fosfor sindirilebilirliğini artırır. Günümüzde, çeşitli bilimsel çalışmalarda, performans parametrelerinin iyileştirilmesi için yumurtlayan tavukların ihtiyaçlarını değerlendirebilmek için farklı fitaz dozları incelemiştir.

**Anahtar kelimeler:** *Büyüme performansı, Fitat, Fitaz, Kümes hayvanları, Yumurta kabuğu*

#### Antinutritive Effect of Phytate

Phytate is known to be an anti-nutrient, affecting an increase in mucus production and the endogenous loss of amino acids altering patterns of sodium (Na) secretion into the gut, and influencing the absorption of minerals such as calcium (Ca) and zinc (Zn) (Applegate and Angel, 2004).

Phosphorus (P) is predominately stored in mature seeds as a mineral complex known as phytin. The molecule in its uncomplexed-state is referred to as phytic acid or phytate. Phytinphosphorus within a given feedstuff is variable, but typically averages 72 and 60 percent of total seed phosphorus in corn and soybean meal, respectively. Phytic acid is highly reactive and readily forms complexes with Ca, Fe, Mg, Cu, Zn, carbohydrates, and proteins. These complexes are substantially less soluble in the small intestine and, therefore, less likely to interact with phytase. For this reason, phytin is often considered to be an anti-nutrient because of its ability to bind with other nutrients rendering those nutrients as well as the phosphorus contained in the phytin molecule partially or completely unavailable to the animal (Applegate and Angel, 2004). In general, oilseed meals and cereal by-products contain large amount of phytate P, where as cereals and grain legumes contains only moderate amount (Butani and Parnerkar, 2015).

Plant ingredients used to formulate diets for poultry may contain from 0.7 to 3.5% of phytates (myo-inositol hexakisphosphates) in a form of poorly soluble Ca-Mg, K-Mg, or mono-ferric and zinc salts of phytic acid (Dayyani, etc. 2013).

### **Phytases and Microbial Phytases**

The phytate can be hydrolysed by phytases. There are three sources of phytases namely plant phytase, intestinal phytase and microbial phytase (Butani and Parnerkar, 2015). When phytases act on the phytate molecule, releasing P, they also increase the solubility of the phytate while reducing its anti-nutritional effect. A clear evolution of products can be seen; there has been a move away from fungal origin products towards bacterial products and then subsequently to further modified bacterial products. These new products can deliver higher levels of P release per unit of activity, and are also capable of destroying a higher percentage of the phytate in the diet (Doeschate, 2013).

### **Growth Performance and Feed Efficiency**

Phytases are most active in the gastric region of the intestinal tract, principally as a result of the low pH being favorable for soluble, unchelated phytate. This environment is intensely proteolytic, however, and for the phytase to be effective it must be capable of functioning at low pH and resisting hydrolysis by pepsin. The *E.coli* derived enzymes have been shown to exhibit a pH profile which is marginally superior to that of the *Aspergillus* and *Peniophora* phytases, and moreover to be the most stable to pepsin attack (Dayyani, etc. 2013). Several trials with higher doses of phytase using diets with normal levels of P have already shown better poultry performance, but this improvement in performance was always correlated to an increase in

P digestibility even if the diet did not have lower P levels. Interestingly, in all these trials the increase in performance with higher doses of phytase was correlated to an improvement in the feed conversion ratio (Doeschate, 2013). Dietary ingredients and feed processing seem to be the most important factors related to the diet, while age and type of birds could also affect phytate (P) utilization (Vali and Jalali, 2011). According to Tischler et al. 2015, low P diet with phytase supplementation ensures acceptable egg shell strength, even thinner shell but less broken eggs due to likely more flexible shell. Also, according to Johnson, L.A. et al 2014, the results of their research are indicative that phytase supplementation in poultry pea-based diets has a positive impact.

### Conclusion

Various cations can chelate strongly between two phytate groups or weakly with a single phosphate group. As a result, phytic acid can bind various mineral elements and amino acids, and reduce their bio-availability (Butani and Parnerkar, 2015). Dietary phytate concentrations may be reduced by the inclusion of selected, low-phytate feedstuffs or dephytinised feed ingredients. There is a distinct possibility that phytate negatively influences protein and energy utilisation in poultry and, as these influences would be ameliorated by phytase. Responses in amino acid digestibilities following phytase supplementation are variable and the underlying mechanisms have not been completely understood. The impact of phytase on protein and energy utilisation may be more positive than generally realized, but this should become increasingly evident if greater phytate degradation rates can be achieved (Butani and Parnerkar, 2015). Currently, most of the phytases that are commercially available to the feed industry are derived from micro-organisms, especially fungi and bacteria (Woyengo and Nyachoti, 2011).

### References

- APPLEGATE, T.J. AND ANGEL R. (2004) Phytase: Basics of enzyme function. *Purdue Extension Knowledge to Go*. pp.1-5.
- BUTANI, J.B. AND PARNERKAR, S. (2015) Role of microbial phytase in broiler- A review. *Journal of Livestock Science*. 6: 113-118.
- DAYYANI, N., ABADI, M.B.B., AND FARHANI, A.A.A. (2013) Phytate and phytase in poultry nutrition. *International Journal of Advanced Biological and Biomedical Research* 1(11): 1403-1408.
- DOESCHATE, R. (2013) A review of phytase in poultry diets, *Feed Compounder*. pp.22 September/October.
- JOHNSON, L.A., DEEP, A. AND CLASSEN, H. (2014) Digestibility and performance responses of broiler chickens fed a pea-based diet with different levels of dietary microbial phytase. *University of Saskatchewan Undergraduate Research* 1(1): 39-44.

- TİSCHLER, A., HALAS, V. AND TOSSENBERGER, J. Effect of dietary NPP level and phytase supplementation on the laying performance over one year period. *Poljoprivreda*. 21: 68-72.
- VALI, N. AND JALALI, M.A. (2011) Influence of Different Levels of Phytase Enzyme on Japanese Quail (*Coturnix japonica*) Performance. *Agriculturae Conspectus Scientificus* 76(4): 387-390.
- WOYENGO, T.A. AND NYACHOTI, C.M. (2011) Review: Supplementation of phytase and carbohydrases to diets for poultry. *Canadian Journal of Animal Science*. 91: 177-192.

## Effect of Shiitake Mushroom (*Lentinula edodes*) Inclusion to Quail Diets on Growth Performance

İsmail Ülger, Çağatay Ay, Mahmut Kaliber

Erciyes University Faculty of Agriculture Department of Animal Science Kayseri Turkey

### Abstract

This study was conducted to determine the effect of Shiitake mushroom (*Lentinula edodes*) supplementation on growth performance of Japanese quail (*Coturnix coturnix japonica*). A total of 220 quails, ten day old, were randomly divided into 4 equal groups and dried Shiitake mushroom (SM) powder was administered at the doses of 0 (control group), 5, 10 and 20 g/kg of diets for 4 weeks. There were significant effects of dietary treatments on body weight (BW,  $P<0.01$ ), body weight gain (BWG,  $P<0.05$ ) and feed conversion ratio (FCR,  $P<0.05$ ). SM supplementation resulted in a decrease in BW and BWG and an increase in FCR, however feed intake did not change among treatment groups ( $P>0.05$ ).

**Key words:** *Body Weight, Feed Conversion Ratio, Feed Intake, Fungi, Poultry.*

### Bıldırcın Rasyonlarına Şitaki Mantarı (*Lentinula edodes*) İlavesinin Büyüme Performansı Üzerine Etkisi

#### Özet

Bu araştırma, Şitaki mantarı (*Lentinula edodes*) ilavesinin Japon bıldırcınlarının (*Coturnix coturnix japonica*) büyüme performansı üzerine olan etkilerinin belirlenmesi amacıyla yürütülmüştür. Toplam 220 adet 10 günlük yaştaki bıldırcın homojen 4 gruba ayrılmış ve rasyonlarına 4 hafta süre ile 0 (kontrol grubu), 5, 10 ve 20 g/kg düzeyinde kurutulmuş Şitaki mantarı (SM) tozu ilave edilmiştir. Muamelenin canlı ağırlık (CA,  $P<0.01$ ), canlı ağırlık kazancı (CAK,  $P<0.05$ ) ve yemden yararlanma oranı (YYO,  $P<0.05$ ) üzerine olan etkileri önemli bulunmuştur. SM ilavesi CA ve CAK değerlerinde bir düşüşe ve YYO değerinde bir yükselmeye neden olurken, yem tüketimi bakımından gruplar arasında önemli farklılıklar oluşmamıştır ( $P>0.05$ ).

**Anahtar kelimeler:** *Canlı ağırlık, Kanatlı, Mantar, Yem tüketimi, Yemden yararlanma oranı.*

## Introduction

The fact that antibiotics are no longer available to use in livestock, especially poultry diets to promote performance has triggered research to evaluate feed additives that can be used as natural alternatives to antibiotics (Cross **et al.**, 2007). Recently, natural materials such as medicinal plants, mushrooms and herbs have been investigated. Mushrooms have long been appreciated as an important source of bioactive compounds of medicinal value (Breene, 1990). Generally, mushrooms are rich in dietary fiber, minerals, vitamins and low in fat (Manzi **et al.**, 2001). Moreover, mushrooms contain various polyphenolic compounds recognized as an excellent antioxidant (Ishikawa **et al.**, 1984). Especially, Shiitake mushroom (*Lentinus edodes*) is the second most popular and the third widely cultivated edible mushroom in the world (Chang, 1996). Such mushrooms and herbs may also act as prebiotics and thereby enhance colonization resistance of the host gut to potential pathogens and can operate as alternatives to antibiotic growth promoters in poultry (Asadi-Dizaji **et al.**, 2014).

Therefore, the objective of the present study was to investigate the effect of supplementation of SM at different levels on body weight (BW), body weight change (BWG), feed intake (FI) and feed conversion (FCR) parameters of Japanese quails.

## Materials and Methods

In this research, a total of 220 Japanese quails (*Coturnix coturnix japonica*) at 10 days old were used. The birds are randomly assigned to one control and three experimental groups based on their initial body weight (Table 1), comprising five replicates of 11 birds each. They were fed a basal diet (SM0) or the basal diet supplemented with either 5 (SM5), 10 (SM10) or 20 (SM20) g/kg of SM. Basal diet contained maize-soybean and formulated to meet the nutrient requirements of quails as recommended by NRC (1994). The experiment was lasted for 28 days and water and diets were offered ad libitum to quails. The lighting cycle was 23 h/day maintained at all growth times.

BW and FI data of quails were recorded at weekly intervals. BWG and FCR were also calculated from these data. Then, experimental data were statistically analyzed by a one-way ANOVA and the means were compared by the Duncan's multiple-range test using SPSS software (SPSS, 1999).

## Results and Discussion

The average BW, BWG, FI and FCR values of treatment groups are shown in Table 1. There were significant differences in body BW ( $P<0.01$ ), BWG ( $P<0.05$ ) and FCR ( $P<0.05$ ). However, SM addition into diets did not significantly alter the FI ( $P>0.05$ ).

Table 1. Growth performance parameters of quails fed diets supplemented with different levels of Shiitake mushroom

Parameters	SM0	SM5	SM10	SM20	SEM	P
IBW	30.18	29.13	28.68	29.45	0.277	0.104
FBW	178.85 <sup>a</sup>	175.03 <sup>ab</sup>	167.63 <sup>b</sup>	164.39 <sup>b</sup>	1.408	0.001
BWG	148.67 <sup>a</sup>	145.90 <sup>a</sup>	138.95 <sup>b</sup>	134.94 <sup>b</sup>	1.460	0.012
TFI	515.79	513.79	512.66	505.02	1.721	0.276
FCR	3.47 <sup>b</sup>	3.52 <sup>b</sup>	3.69 <sup>a</sup>	3.74 <sup>a</sup>	0.037	0.040

IBW: Initial body weight(g), FBW: Final body weight (g), BWG: Body weight gain (g), TFI: Total Feed Intake (g), FCR: Feed conversion ratio (Feed conversion ratio: feed intake/live weight gain), SM0: Control, 0 g/kg SM; SM5: 5 g/kg SM; SM10: 10 g/kg SM; SM20: 20 g/kg SM; SEM: Standart error of mean; P: Probability value; <sup>a,b</sup>: Means in the same row with different superscripts differ significantly (P<0.05).

Final BW values were measured as 178.85, 175.03, 167.63 and 164.39 g for the SM0, SM5, SM10 and SM20 treatment groups, respectively (P<0.01). Increased SM levels in the diet of quails resulted in a linear decrease in BW. Similarly, BWG linearly decreased by increasing doses of SM supplementation. The BWG values of SM0, SM5, SM10 and SM20 groups were 148.67, 145.90, 138.95 and 134.94 g, respectively (P<0.05). Therefore, the FCR was negatively influenced by SM supplementation (P<0.05). The FCR values were calculated as 3.47, 3.52, 3.69 and 3.74 for the SM0, SM5, SM10 and SM20 groups, respectively; herein, a lower FCR value means a better performance. Also, the FI of quails was not significantly affected by SM inclusion (P>0.05), but there was a numerical decrease with increasing supplemental SM levels.

## Conclusion

As a conclusion, the inclusion of SM in diets induced negative effects on BW, BWG and FCR of quails. Also, increasing amounts of SM resulted in a worsening growth performance.

This paper is summarized from the master thesis of the second author (Institute of Natural and Applied Sciences, Erciyes University, Kayseri, Turkey) and supported by the Scientific Research Projects Department of Erciyes University, Turkey (Project no: FYL-2016-7030).

## References

- ASADI-DIZAJI, A., SHAHRYAR, H.A., SHADDEL-TILI, A., MAHERISIS, N., GHIASI-GHALEHKANDI, J., (2014) Effect of common mushroom (*Agaricus bisporus*) levels on growth performance and carcass yields of Japanese quails (*Coturnix coturnix Japonica*). *Bulletin of Environment, Pharmacology and Life Sciences*, 3: 1-5.
- BRENE, W.M. (1990) Nutritional and medicinal value of specialty mushrooms. *Journal of Food Protection*, 53: 883-894.

- CHANG, R. (1996) Functional properties of edible mushrooms. *Nutrition Reviews* 54: 91-93.
- CROSS, D.E., MCDEVITT, R.M., HILLMAN, K. and ACAMOVIC, T. (2007) The effect of herbs and their associated essential oils on performance, dietary digestibility and gut microflora in chickens from 7 to 28 days of age. *British Poultry Science*, 48: 496-506.
- ISHIKAWA, Y., MORIMOTO, K. and HAMASAKI, T. (1984) Falvoglaucin, a metabolite of *Eurotium chevalieri*, its antioxidation and synergism with tocopherol. *Journal of American Oil Chemists Society*, 61: 1864-1868.
- MANZI, P., AGUZZI, A. and PIZZOFERRATO, L. (2001) Nutritional value of mushrooms widely consumed in Italy. *Food Chemistry*, 73: 321–325.
- NATIONAL RESEARCH COUNCIL (1994) Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.
- SPSS INC. (1999) SPSS base 9.0 applications guide. SPSS Inc. Headquarters, Chicago, Illinois, p. 233.

## Relationship between Nutrition and Intestinal Enzymes in Poultry: Review

Emre Yilmaz<sup>a</sup>, Soner Uysal<sup>a</sup>, Mehmet Gul<sup>a</sup>

<sup>a</sup>Ataturk University, Faculty of Veterinary, Animal Feeding and Nutritional Diseases Department

### Abstract

It has problems with the digestive system due to some anatomical and physiological characteristics such as having a monogastric stomach structure of the poultry and shortness of the digestive tract and fragility of the intestinal microflora (beneficial and harmful). As is known, digestive enzymes in poultry are inadequate. In the compiled literature, enzymes in poultry digestion system were affected by many external factors. Knowing these factors is very important because it can prevent feed wastage and malnutritional degradation as well yield losses.

**Keywords:** *digestive enzymes, nutrition, poultry.*

### Introduction

Many of the enzymes secreted by the stomach, pancreas and the small intestine of poultry are available before hatching and increase with feed consumption. The chicks are hatching by amylase, maltase and sucrose reserves. Pancreatic amylase reaches its maximum value on 8th day (Nitsan et al., 1991). Maltase activity decreased until the 18th day and the activity of the sucrose enzyme increased 2-fold and began to decrease the in 35th day after the hatching. Although lipase activity can be determined on day 7, the activity of trypsin can only be determined in 18 days (Celik and Acikgoz, 2006). Due to the digestive system structure of the poultry, it is necessary to know the importance of the endogenous enzymes and to disclosure of relationship the relation of the enzymes with the nutrition.

### Effect of Feeding on Digestive Enzymes

*The Effect of Exogenous Enzymes, Organic Acids, Plant Extracts and Minerals*

It is known that feed containing antinutritional factors increase the intestinal viscosity and reduce the rate of diffusion the nutrients and digestive enzymes, inhibit the interactions in the mucosal surface and caused enviromental problems (Choct, 1997; McDonald et al., 2001). Addition of exogenous enzymes to poultry feeds have effect lowering intestinal viscosity, enhancing digestion and absorption, promoting exogenous enzymes (Yuan et al., 2008; Alagawany et al., 2017). However, in a study, it was determined that excessive use of exogenous enzymes reduced the endogenous enzyme activity (Yuan et al., 2008). Over-

phytate intake cause to reduce proteolytic activity in poultry (Kapica and Puzio, 2004). Essential oils, secondary metabolites produced by plants, have an effect appetite stimulating and endogenous enzyme enhancing. In a study reported that plant extracts were not alone effective on the viscosity and successful results could be obtained with the addition of the enzyme+plant extracts (Basmacioglu et al., 2010). It was reported that organic acids were low effective on digestive enzymes and successful results could be obtained with the addition of the enzyme+organic acids (Jang et al., 2004). Protease inhibitors reduce proteolytic digestion, amino acid absorption and protein availability of feed proteins by suppressing the activities of trypsin, chymotrypsin and amylase enzymes in the small intestine. Legume plants contain various amounts of  $\alpha$ -amylase inhibitors that slow down digestion (Peksen and Artik, 2012). Tannin, another antinutritional factor found in legumes, complexes with proteins and precipitates them. When there is no adverse effect at low doses, but when given in high doses; is adversely affected pancreatic development, trypsin, chymotrypsin,  $\alpha$ -amylase and disaccharidases (Carmona et al., 1996). It has been reported that Cr (Upadhayay and Chikitsa, 2014), Zn (Hu et al., 2013), Cu (Ma and Guo, 2008) improve pancreas development and usually increase the release of endogenous enzymes.

#### *The Effect of Probiotics, Prebiotics and Propolis*

The addition of probiotically *Bacillus subtilis* to rations has no effect on intestinal enzymes (Zhu et al., 2017), amylase level in the small intestine increases with the addition of *Lactobacillus spp.* (Jin vd., 2000), *Enterococcus faecium* also reduce  $\alpha$ -amylase, lipase, trypsin and chymotrypsin activities (Matur et al., 2007). Addition of 2.0 or 4.0 g/kg FOS in dietary prebiotically has been reported to increase amylase and protease enzyme activity (Xu et al., 2003). Propolis is a resinous and balsamic substance produced by bees from plant extracts. Propolis is known to be an enhancing effect of the efficiency performance as well as antibacterial, antifungal, antiviral, antioxidant, antiinflammatory and immunomodulatory properties (Seven et al., 2007). However, a study has shown that propolis  $\alpha$ -amylase activity is reduced, while disaccharidases (sucrose and maltase) are increased (do Amaral Duarte et al., 2017).

#### *Effect of Feed Restriction, Feed Context and Feed Processing*

In a study reported that amylase, lipase and chymotrypsin activities have been increased following 7-14 days of feed restriction, but not advantageous in later periods. This study showed that early-age feed restriction may have a greater effect on enzyme activities (Pinheiro et al., 2004). The activity of digestive enzymes is affected by the composition and quality of the feed (Kohl et al., 2017). There may be amino acid deficiency. Chicks fed ad libitum with low protein feeds have a negative effect on disaccharidases (Swatson et al., 2002). It was reported that threonine amount in chickens fed low protein does not affect digestive enzymes, there is a positive relationship between increased threonine content (0.6%) and increased trypsin activity (Azzam et al., 2017), amylase and lipase

activity were maximized at the level of 0.77% threonine (Li et al., 2016). It has been stated that increasing digestible amino acids and metabolic energy (ME) have no effect on serum amylase, lipase, protease, pancreatic amylase and lipase activity but increased the level of pancreatic protease when the level of digestible amino acids increases from 100% to 114% (Ivanovich et al., 2017). High fiber content increased sucrase activity in the small intestine and carbohydrases is increased in high starch feed (Kohl et al., 2017). Low dietary ME levels have been reported to increase pancreatic lipase, trypsin, amylase and pepsin activity in the first 21 days, but high ME values reduce pancreatic weight (Zhu et al., 2014). Feeding with insoluble fiber-containing rations was observed a increase proventricular pepsin, chymotrypsin activity after 5 weeks and an increase in pepsin, trypsin and chymotrypsin activity after 10 weeks. (Yokhana et al., 2015). Enzyme activity is expected to change because the application of processes such as heat treatment, fermentation for changes the content of the nutrients it contains. In one study, it was observed that replacing fermented soybean meal with soybean meal at the ration increased trypsin, lipase and protease activities. (Feng et al., 2007).

### Conclusion

Recent studies have examined the effect of feeding on enzymes, such as the fact that the present production method is based on obtaining more products with lesser cost as well that nutrition has a high share in production costs. In the future, feed waste should be avoided against the possibility of nutrient shortage. Although there is a lot of study on the subject, there are still points that we are not understand and more work is needed in this area.

### References

- ALAGAWANY, M., ATTIA, A.I., IBRAHIM, Z.A., MAHMOUD, R.A. and EL-SAYED, S.A. (2017). The effectiveness of dietary sunflower meal and exogenous enzyme on growth, digestive enzymes, carcass traits, and blood chemistry of broilers. *Env Sci and Poll Res*, 24(13): 12319-12327.
- AZZAM, M.M.M., DONG, X.Y. and ZOU, X.T. (2017). Effect of dietary threonine on laying performance and intestinal immunity of laying hens fed low-crude-protein diets during the peak production period. *J Anim Physiol Anim Nutr* 101: e55-e66. doi:10.1111/jpn.12559.
- BASMACIOGLU, M.H., BAYSAL, S., MISIRLIOGLU, Z., POLAT, M., YILMAZ, H. and TURAN, N. (2010). Effects of oregano essential oil with or without feed enzymes on growth performance, digestive enzyme, nutrient digestibility, lipid metabolism and immune response of broilers fed on wheat–soybean meal diets. *Br J Poult Sci*, 51: 67–80.
- CARMONA, A., BORGUDD, L., BORGES, G. and LEVY-BENSHIMOL, A. (1996). Effect of black bean tannins on in vitro carbohydrate digestion and absorption. *J Nutr Biochem*, 7(8): 445-450.

- CELIK, L. and ACIKGOZ, Z. (2006). Kanatli hayvanlarda sindirim sisteminin gelismisi ve besleme ile sindirim sisteminin gelismisi arasindaki iliski. *Hay Urt*, 47(2): 38-47.
- CHOCT, M. (1997). Feed non-starch polysaccharides: chemical structures and nutritional significance *Feed Milling Int*, 191:13-26.
- DO AMARAL DUARTE, C.R., EYNG, C., MURAKAMI, A.E., VARGAS, M.D and NUNES, R.V. (2017). Propolis residue inclusion in the diet affects digestive enzyme activity in broiler chickens. *Semina: Ciências Agrárias*, 38(1): 417-428.
- FENG, J., LIU, X., XU, Z.R., WANG, Y.Z. and LIU, J.X. (2007). Effects of fermented soybean meal on digestive enzyme activities and intestinal morphology in broilers. *Poul Sci*, 86(6): 1149-1154.
- HU, C.H., QIAN, Z.C., SONG, J., LUAN, Z.S. and ZUO, A.Y. (2013). Effects of zinc oxide-montmorillonite hybrid on growth performance, intestinal structure, and function of broiler chicken. *Poul Sci*, 92(1): 143-150.
- IVANOVICH, F.V., KARLOVICH, O.A., MAHDAVI, R. and AFANASYEVICH, E. I. (2017). Nutrient density of prestarter diets from 1 to 10 days of age affects intestinal morphometry, enzyme activity, serum indices and performance of broiler chickens. *Anim Nutr*, 3(3): 258-265.
- JANG, I.S., KO, Y.H., YANG, H.Y., HA, J.S., KIM, J.Y., KIM, J.Y. and LEE, C.Y. (2004). Influence of essential oil components on growth performance and the functional activity of the pancreas and small intestine in broiler chickens. *Asia Aust J Anim Sci*, 17(3): 394-400.
- JIN, L.Z., HO, Y.W., ABDULLAH, N. and JALALUDIN, S. (2000). Digestive and bacterial enzyme activities in broilers fed diets supplemented with *Lactobacillus* cultures. *Poult Sci*, 79(6): 886-891.
- JORDINSON M., GOODLAD R.A., BRYNES A., BLISS P., GHATEI M.A., BLOOM S.R., FITZGERALD A., GRANT G., BARDOCZ S., PUSZTAI A., PIGNATELLI M. and CALAM J. (1999). Gastrointestinal responses to a panel of lectins in rats maintained on total parenteral nutrition. *Am J Physiol*, 276:G1235-G1242.
- KAPICA, M., and PUZIO, I. (2004). Influence of dietary phytase and 1, 25-dihydroxycholecalciferol supplementation on the activity of digestive enzymes in chickens. *Bull Vet Inst Pulawy*, 48: 519-522.
- KOHL, K.D., CIMINARI, M.E., CHEDIACK, J.G., LEAFLOOR, J.O., KARASOV, W.H., MCWILLIAMS, S.R. and CAVIEDES-VIDAL, E. (2017). Modulation of digestive enzyme activities in the avian digestive tract in relation to diet composition and quality. *J Comp Phy B*, 187(2): 339-351.
- KNUCKLES B.E., KUZMICKY D. D. and BETSCHART A.A. (1985). Effect phytate and partially hydrolyzed phytate on invitro protein digestibility. *J Food Sci*, 50: 1080- 1082.

- LI, J.M., ZHANG, X.Y., YUAN, C., MIAO, L.P., YAN, H.X., DONG, X.Y., and ZOU, X.T. (2016). Effects of dietary L-threonine levels on antioxidant capacity, digestive enzyme activities, and antibody production of Xinyang green-shell laying hens. *J Appl Poul Res*, 25(3): 422-427.
- MA, Y.L. and GUO, T. (2008). Intestinal morphology, brush border and digesta enzyme activities of broilers fed on a diet containing Cu<sup>2+</sup>-loaded montmorillonite. *Br Poul Sci*, 49(1): 65-73.
- MATUR, E., ULKER, C., ARSLAN, M., ELIF, E., AKYAZI, I., and EVREN, E. (2007). The effects of *Enterococcus faecium* NCIMB10415 on the development of pancreas and small intestine and on activity of pancreatic digestive enzymes in broiler chickens. *Archiv fur Geflu*, 71(4): 162.
- MCDONALD, D.E., PETHICK, D.W., MULLAN, B.P. and HAMPSON, D.J. (2001). Increasing viscosity of the intestinal contents alters small intestinal structure and intestinal growth, and stimulates proliferation of enterotoxigenic *Escherichia coli* in newly-weaned pigs. *Br J Nutr*, 86: 487-498.
- NITSAN Z., BEN-AVRAHAM G., ZOREF Z. and NIR I. (1991). Growth and development of the digestive organs and some enzymes in broiler chicks after hatching. *Br Poult Sci*, 32: 515-523.
- PEKSEN, E. and ARTIK, C. (2012). Antibesinsel maddeler ve yemelik tane baklagillerin besleyici deęerleri *OMU Zir Fak Derg*, 20(2): 110-120.
- PINHEIRO, D.F., CRUZ, V.C. and VICENTINI PAULINO, M.L. (2004). Effect of early feed restriction and enzyme supplementation on digestive enzyme activities in broilers. *Poul Sci*, 83(9): 1544-1550.
- SEVEN, I., AKSU, T. and TATLI SEVEN, P. (2007). Propolis ve hayvan beslemede kullanımı. *J YY Univ Vet Med*, 18(2): 79-84.
- UNI Z., TAKO E., GAL-GARBER O. and SKLAN D. (2003). Morphological, molecular, and functional changes in the chicken small intestine of the late-term embryo. *Poult Sci*, 82: 1747-1754.
- XU, Z. R., HU, C.H., XIA, M.S., ZHAN, X.A. and WANG, M.Q. (2003). Effects of dietary fructooligosaccharide on digestive enzyme activities, intestinal microflora and morphology of male broilers. *Poul Sci*, 82(6): 1030-1036.
- UPADHAYAY, U.P.P.D.D. and CHIKITSA, P. (2014). Modes of action and beneficial applications of chromium in poultry nutrition, production and health: A review. *Int J Pharm*, 10(7): 357-367.
- YOKHANA, J.S., PARKINSON, G. and FRANKEL, T.L. (2015). Effect of insoluble fiber supplementation applied at different ages on digestive organ weight and digestive enzymes of layer-strain poultry. *Poul Sci*, 95(3), 550-559.
- YUAN, J., YAO, J., YANG, F., YANG, X., WAN, X., HAN, J. and ZHOU, N. (2008). Effects of supplementing different levels of a commercial enzyme

complex on performance, nutrient availability, enzyme activity and gut morphology of broilers. *Asia Aust J Anim Sci*, 21(5): 692.

ZHU, H.L., HU, L.L., HOU, Y.Q., ZHANG, J. and DING, B.Y. (2014). The effects of enzyme supplementation on performance and digestive parameters of broilers fed corn-soybean diets. *Poul Sci*, 93(7): 1704-1712.

ZHU, P., XU, X., QI, Y., SHI, S. and WANG, H. (2017). Effects of *Bacillus subtilis* on growth performance and intestinal digestive function of yellow broilers. *Euro Poul Sci*, 81.

## Olive Leaf as Local Feed Additive for Sustainable Poultry Nutrition

Pınar Özdemir<sup>a</sup>, Hatice Basmacıoğlu-Malayoğlu<sup>b</sup>, İsmail Yavaş<sup>c</sup>

<sup>a</sup>International Center for Livestock Research and Training, Lalahan-Ankara,

<sup>b</sup>Ege University, Agriculture Faculty, Department of Animal Science, Bornova-İzmir,

<sup>c</sup>Ankara University, Agriculture Faculty, Department of Animal Science, Dışkapı-ANKARA

### Abstract

Use of local feedstuffs and additives are one of the sustainable animal feeding strategies. Turkey has an important place in olive and olive oil production in the world. During the harvesting and processing of olive, significant amount of olive leaves are obtained. Most researches showed that olive leaves (powder or extract) contain high amount of polyphenol compound and therefore it has strong antimicrobial and antioxidant effect. The use of olive leaves in sustainable poultry nutrition as local feed additives is important considering the social, economic and environmental aspects. In this review, use of olive leaf in poultry nutrition as a local feed additive is focused.

**Key words:** *Sustainability, olive leaf, local feed additive, antimicrobial, antioxidant*

## Sürdürülebilir Kanatlı Kümes Hayvanlarının Beslenmesinde Yerel Yem Katkı Maddesi Olarak Zeytin Yaprağı

### Özet

Sürdürülebilir hayvan besleme stratejilerinden biri yerel yem hammadde ve katkı maddelerin kullanımınıdır. Dünya zeytin ve zeytinyağı üretiminde Türkiye önemli bir yere sahiptir. Zeytinin toplanması ve işlenmesi sırasında önemli miktarda zeytin yaprağı açığa çıkar. Bu yan ürünün (toz veya ekstraktının) yüksek düzeyde polifenolik bileşik içerdiği ve buna bağlı olarak özellikle güçlü bir antimikrobiyal ve antioksidan etkiye sahip olduğu çok sayıda yapılan çalışmalarla ortaya konmuştur. Zeytin yaprağının sürdürülebilir kanatlı hayvanların beslenmesinde yerel yem katkı maddesi olarak değerlendirilmesi sosyal, ekonomik ve çevresel açıdan oldukça önemlidir. Bu derlemede, sürdürülebilir kanatlı hayvanların beslenmesinde zeytin yaprağının yerel yem katkı maddesi olarak kullanımına dikkat çekilmiştir.

**Anahtar kelimeler:** *Sürdürülebilirlik, zeytin yaprağı, yerel yem katkı maddesi, antimikrobiyal, antioksidan*

## **Introduction**

The high and rising cost of commercial feeds has led to significant research on the use of local feeds to feed poultry, with a number of potential local feed sources in our country, such as agricultural-industrial by-products. With sustainable agriculture, the country can reach healthy and safe local foods at more affordable prices using its local resources.

There has been a phenomenal growth in poultry production in the last 4-5 decades. The poultry industry has shown a great improvement in our country since the 1990s. While poultry meat production was at 217 thousand tons in 1990, it reached 2.102 thousand tons in 2016 (BESD-BIR, 2018). In the same way, the number of eggs was 7700 thousand in 1990, it reached 19.280 thousand in 2017 (TUIK, 2018).

The aim of poultry feed sector is to keep profitability at the highest level by using the cheapest new raw materials or increasing the use of non-traditional materials with some strategy (feed enzymes, digestible amino acid formulation). An important part of the cost of poultry feeds is energy and protein sources. One way to reduce the price is to provide economic resources or to find and use alternative sources such as regional feeds, biofuel by-products, insects, bacteria, seaweed and algae, human garbage, other waste products, worms or grass, plant extracts and industrial by-products (Wientjes et al., 2011). The olive leaf from by-products can be used as natural, human-friendly and sustainable local animal feed additive in animal nutrition.

In this review, we will focus on the use of olive leaf, which is a sustainable local feed additive in poultry nutrition.

## **What is sustainability and sustainable animal husbandry?**

Sustainability generally refers to environmental, social and economic sustainability (Adams, 2006, Figure 1). When we hear the word "sustainability" we tend to think of a way to keep renewable fuel sources, carbon emissions reduced, the environment protected and the planet's sensitive ecosystems balanced. In brief, sustainability does not compromise our lifestyle to protect our natural surroundings, human and ecological health, and sustain innovation (Egan, 2010). Sustainable animal husbandry, which is one of them, includes a system to improve the protection of natural agricultural resources and the conversion of adequate and high quality foodstuffs, which are needed by the rapidly increasing world population, at reasonable costs. Unfortunately, many widely-used livestock production methods are currently unsustainable. Sustainable animal husbandry can provide to increased food production, as well as makes a positive impact on environmental goods and services. The way to achieve this is to keep the economy alive in the short and long term, to improve the quality of life of farmers and to improve the practices for this purpose.

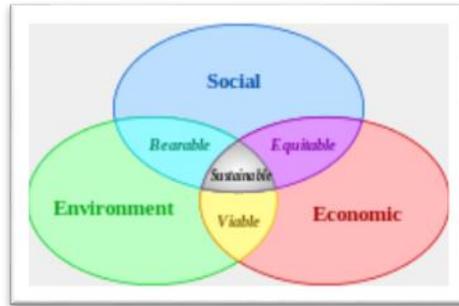


Figure 1. Definitions of sustainability (Adams, 2006)

### **Sustainable animal nutrition**

Animal feed and feeding is the basis of the animal husbandry system. It has impacts on animal yield, product safety and quality, animal welfare and health, profit, agricultural land use, water pollution and greenhouse gas emission (FAO, 2014). It is estimated that by 2050 global food production will increase by 60% and the sustainability of animal diets is crucial in the development of livestock production in future. The fundamental elements of sustainable animal nutrition around the planet aimed to protect the environment and natural resource base and one of these elements is to use locally available feed resources, re-use food waste and industrial by-products in animal diets. In recent years, there has been an increase in the use of alternative feedstuffs in animal feeding strategies. In this respect locally available olive leaf, has emerged as an important feed additive in poultry nutrition in recent years.

### **Olive leaf**

Olive (*Olea europaea* L.) fruit, oil and leaves have an ancient history of nutritional, medicinal and traditional usages. Both olive tree culture and olive oil industry produce large amounts of by-products. The olive leaf is one of the tree byproducts, which are obtained through either the pruning or harvesting process or fall due to different climatic factors. It has been estimated that pruning produces 25kg of by-products (twigs and leaves) per tree per year. Leaves represent 5% of the weight of olives in oil extraction (Nefzaoui, 1983) and 2017/2018 287.000 tons of olive oil was estimated in Turkey (IOOC, 2018).

The olive leaf is an important source of bioactive compounds and it is rich in polyphenols such as: oleuropein, hydroxytyrosol, tyrosol, elenolic acid, caffeic acid, p-coumaric acid, vanilic acid, luteolin, rutin, apigenin-7-glucoside and verbascoside (Benavente-Garcia et al., 2000). The studies revealed the antimicrobial (Tripoli et al., 2005), antioxidant (Visioli et al.,

2002; Basmacıoğlu and Aktaş, 2011), antiinflammatory (Visioli et al., 1998) and antiviral (Fredrickson, 2000) effects of olive leaf powder and its extract.

### **Olive leaf as feed additives in poultry nutrition**

Erener et al. (2009) investigated that the effect of antibiotic (500 mg chlortetracycline /kg, positive control), vitamin E (200 mg  $\alpha$  tocopherol acetate / kg body weight) and olive leaf extract (0, 75, 150, 300 and 600 mg oleuropein / kg ) on performance, some blood parameters, intestinal microflora, blood and meat lipid oxidation of broilers. It has been reported that doses of 300 and 600 mg / kg of olive leaf extract (OLE) increased the feed consumption, body weight gain and improved feed conversion ratio. No difference in body weight was observed among the groups. Cayan and Erener (2015) showed that dietary supplemented olive leaf powder had no effect on feed intake, egg weight, egg yield, feed conversion ratio and egg quality parameters while it increased final body weight of hens. While dietary grape seed extract (containing 100 ppm and 200 ppm proanthocyanidin) had no effects on performance of broilers, olive leaf (containing 100 ppm and 200 ppm oleuropein) and pomegranate extracts increased body weight of broilers and decreased feed conversion ratio (Atılgan, 2012).

Oke et al. (2017) reported that 15 ml olive leaf extract supplementation to drinking water increased final body weight, feed consumption and improved feed efficiency during the heat stress. Jabri et al. (2017) also reported that supplementation of 10 and 20 ml/L olive leaf extract increased final body weight and 10ml/L olive leaf extract has an effective microbial activity against cecal pathogenic bacteria. In contrast to these findings, Yavas (2013) showed that no difference on performance parameters in broilers diet fed with olive leaf powder (5g/kg diet) but supplementation of 10 and 20 g/kg olive leaf powder had an antimicrobial activity. Similarly, Aktaş (2012) reported that dietary olive leaf extract supplementation of laying hen diets with 5g/kg olive leaf extract did not have a significant effect on egg production, feed conversion ratio and feed intake. However, liver MDA value decreased and liver glutathione value increased in laying hens fed olive leaf extract. In addition, the supplementation of olive leaf extract significantly decreased MDA value in yolk of egg stored at room temperature compared to the control.

### **Conclusion**

Consumers expects producer to provide safe and affordable animal products, while maintaining environmental quality and biodiversity. The use of locally available feed resources, re-use food waste and industrial by-products is an important step towards achieving this. Studies with olive leaves supplementation to broiler feed or water evaluated that olive leaf may be

used in broiler diets as natural additive. The agro-industrial waste may contribute to sustainable poultry nutrition.

## References

- ADAMS, W.M. (2006). "The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century." Report of the IUCN Renowned Thinkers Meeting, 9–31 January 2006. Retrieved on: 2009-02-16.
- AKTAS, B. (2012). Omega-3 yağ asitlerince zenginleştirilmiş yumurta tavuğu karma yemlerine farklı bitkisel ekstraktların ilavesinin yumurta verimi, kalitesi, lipid peroksidasyonu ve antioksidan kapasite üzerine etkileri. Doktora tezi, E.Ü Fen Bilimleri Enstitüsü, İzmir. 177s
- ATILGAN, D. (2012). Etlik piliç karma yemlerine doğal antimikrobiyal olarak üzüm çekirdeği, zeytin yaprağı ve nar kabuğu ekstraktları ilavesinin besi performansı, serum ve bağırsak parametreleri üzerine etkilerinin karşılaştırılması. Y. Lisans Tezi. GOP Üniversitesi, Fen Bilimleri Enstitüsü, Zootekni Anabilim Dalı, Tokat. 66s
- BASMACIOĞLU-MALAYOĞLU, H., AKTAŞ, B. (2011). Zeytinyağı işleme yan ürünlerinden zeytin yaprağı ile zeytin karasuyunun antimikrobiyal ve antioksidan etkileri. *Hayvansal Üretim*, 52: 49-58.
- BENAVENTE-GARCIA, O., CASTILLO, J., LORENTE, J., ORTUNO, A., DEL RIO, J. A. (2000). Antioxidant activity of phenolics extracted from *Olea europaea* L. Leaves. *Food Chemistry*, 68:457-462.
- BESD-BIR, (2018). [http://www.besd-bir.org/assets/documents/Tyrkiye\\_kanatli\\_eti\\_yretimi.pdf](http://www.besd-bir.org/assets/documents/Tyrkiye_kanatli_eti_yretimi.pdf). Erişim tarihi: 19.02.2018.
- CAYAN, H., ERENER, G. (2015). Effect of olive leaf (*Olea europaea*) powder on laying hens performance, egg quality and egg yolk cholesterol levels. *Asian Australas. J. Anim. Sci.* 28(4) : 538-543.
- EGAN, T. (2010). Sustainability: Carrying Capacity & Ecological Footprints. New York Times, US California: Slumburbia. February 10.
- ERENER, G., OCAK, N., OZTURK, E., CANKAYA, S., OZKANCA, R., ALTOP A. (2009). Zeytin yaprağı ekstraktının etlik piliçlerin performans, bazı kan parametreleri ve kör bağırsak mikroflorası üzerine etkileri. Tübitak 107O820 Proje Kesin Rapor Özeti, Mart 2009, SAMSUN.
- FAO. (2014). Towards a concept of Sustainable Animal Diets. *FAO Animal Production and Health Report*. No. 7. Rome, Italy.
- FREDRICKSON, W.R. (2000). Method and composition for antiviral therapy with olive leaves, Inventor, F and S Group, Inc., US patent 6 117.884.
- IOOC, (2018). International Olive Oil Council, World Olive Oil Figures, Madrid, Spain.

- JABRI, J., KACEM, H., YAICH, H., ABID, K., KAMOUN, M., REKHIS, J., MALEK, A. (2017). Effect of Olive leaves extract supplementation in drinking water on zootechnical performances and cecal microbiota balance of broiler chickens. *Journal of new sciences, Sustainable Livestock Management*, 4(2): 69- 75.
- NEFZAOU, A. (1983). Etude de l'utilisation des sous-produits de l'olivier en alimentation animale en Tunisie. Div. de la production et de la Sante Animales. FAO. Rome. 92p.
- OKE, O.E, EMESHILI, U.K., IYASERE, O.S., ABIOJA, M.O., DARAMOLA, J.O., LADOKUN, A.O., ABIONA, J.A., WILLAMS, T.J., RAHMAN, S.A., ROTIMI, S.O., BALOGUN, S.I., ADEJUYIGBE, A.E. (2017). Physiological responses and performance of broiler chickens offered olive leaf extract under a hot humid tropical climate. *J.App.Poult.Res.* 26(3): 376–382.
- TRIPOLI, E., GIAMMANCO, M., TABACCHI, G., DI MAJO, D., GIAMMANCO, S., LA GUARDIA, M. (2005) The phenolic composition of olive oil: structure, biological activity, and beneficial effects on human health. *Nutr Res Rev.*, 18: 98–112.
- TUIK, (2018). [http://www.tuik.gov.tr/PreTablo.do?alt\\_id=1002](http://www.tuik.gov.tr/PreTablo.do?alt_id=1002). Erişim tarihi: 19.02.2018.
- VISIOLI, F., BELLOSTA, S., GALLI, C. (1998). Oleuropein, the bitter principles of olives, enhances nitric oxide production by mouse macrophages. *Life Sci.*, 62: 541–546.
- VISIOLI, F., POLI, A., GALLI, C. (2002). Antioxidant and other biological activities of phenols from olives and olive oil. *Medicinal Research Reviews*, 22(1): 65-75.
- WIENTJES, Y., BRUMMEL, K., PEGGE, M., JONG, R., USTARROZ, E. (2011). Sustainable feed for chicken meat. Project ACT (YMC-60809) Commissioned by: Pluimvee met Smak.
- YAVAS, İ. (2013). Etlik piliç karma yemlerine ilave edilen zeytin yaprağının performans, bazı kan parametreleri ve bağırsak mikroflorası üzerine etkileri. Yüksek Lisans Tezi, E.Ü Fen Bilimleri Enstitüsü, İzmir. 109s.

## A Natural Feed Additive in Poultry Feeding: Resveratrol

Mükremin Ölmez<sup>a</sup>, Mustafa Makav<sup>b</sup>, Hüseyin Avni Eroğlu<sup>c</sup>, Tarkan Şahin<sup>a</sup>

<sup>a</sup>Kafkas Üniversitesi, Veteriner Fakültesi, Hayvan Besleme ve Beslenme Hastalıkları Anabilim Dalı, 36100, Kars

<sup>b</sup>Kafkas Üniversitesi, Veteriner Fakültesi, Fizyoloji Anabilim Dalı, 36100, Kars

<sup>c</sup>Çanakkale Onsekiz Mart Üniversitesi, Tıp Fakültesi, Fizyoloji Anabilim Dalı, 17100, Çanakkale

### Abstract

Resveratrol, a polyphenolic compound; is an antioxidant nutrient that is used for many properties such as inhibiting cancer cells and preventing cellular inflammation by regulating structure and functions of gut, improving growth and yield performance. The main use of resveratrol in poultry feed is to use it as a feed additive. In feeding studies made by adding resveratrol to feeds; yield performance and immunoreaction increased, degenerations and infections decreased. This effect resveratrol is linked to strong antioxidant, anti-inflammatory and immunomodulator effects, as well as inhibiting free radicals from interacting with cellular DNA, increasing digestion and absorption capacity. In this review, the effectiveness and applications of resveratrol on poultry feeding are explained.

**Key words:** *Animal Nutrition, Antioxidant, Feed Additives, Resveratrol.*

### Kanatlı Beslemede Doğal bir Yem Katkı Kaynağı: Resveratrol

#### Özet

Polifenolik bir bileşik olan Resveratrol; antioksidan bir besin olup, bağırsak yapısını ve fonksiyonlarını düzenleyerek, büyüme ve verim performansını artırmakla beraber kanser hücrelerini inhibe etmek ve yangı gidermek gibi birçok özelliği için kullanılmaktadır. Resveratrolün kanatlı beslemede temel kullanım amacı yem katkı maddesi olarak yemlere katılmasıdır. Yemlere resveratrol ilave edilerek yapılan besleme çalışmalarında; verim performansının ve immun yanıtın yükseldiği, dejenerasyonların ve enfeksiyonların azaldığı tespit edilmiştir. Bu etkileri resveratrolün, serbest radikallerin hücresel DNA ile etkileşime girmesini engellemesi, sindirim ve emilim kapasitesini arttırmasıyla birlikte kuvvetli antioksidan, antiinflamatuvar ve immunmodülatör etkilerine bağlanmaktadır. Bu derlemede, resveratrolün kanatlı besleme üzerine etkinliği ve uygulamaları anlatılmaktadır.

**Anahtar kelimeler:** *Antioksidan, Kanatlı Besleme, Resveratrol, Yem katkı.*

## **Introduction**

People's consciousness with the developing age and technology has increased the desire to consume natural and healthy food. In this context, antibiotics used for many years as growth promoters have been banned in the European Union and in many countries since 2006 due to the formation of resistant strains of bacteria and residue in foodstuffs, food safety and public health concerns. Thus aromatic plant extracts and purified components of new additives have been seen as part of future nutritional strategies. These products have many advantages over antibiotics that are prohibited to use. Resveratrol (3,5,4'-trihydroxytrans-stilbene); *Polygonum cuspidatum*, grape peel, nuts, *Yucca schidigera*, and a natural polyphenolic compound found in wine at high concentration. Resveratrol, antioxidant, anti-aging anti-inflammatory, as well as the role of regulating energy metabolism.

## **Source of Resveratrol**

Grape and grape products (eg wine), peanuts, hazelnuts, mulberries, strawberries, raspberries, Japanese pellets, *Yucca schidigera* and turmeric plants are widely resveratrol. At the same time resveratrol is produced by biotechnological and chemical methods.

## **Chemical Structure**

The chemical composition of resveratrol is 3, 5, 4'-trihydroxystilbene derived from stilbene. Resveratrol can pass cell membranes passively due to its chemical and physical properties. It can also interact with membrane receptors (extracellular and intracellular molecules). For this reason, the cellular mechanism of action activates signaling pathways either by binding to cell gonadal receptors or by acting in the nucleus. Resveratrol is found in the blood circulation in three different forms, glucuronide, sulfate or free forms. The free form can form complexes by binding to albumin and low density lipoprotein (LDL).

## **Use in Poultry**

It has been reported that broiler chicks fed with feeds supplemented with polyphenol-rich grape products have a higher ratio of crypt depth to intestinal microflora level and small intestinal villus length, and the results may have an effect on biochemistry and physiology of gastrointestinal system.

In a feeding study on quails; Feed consumption, egg production and egg external and internal quality criteria excluding egg yolk width of resveratrol supplements (200 or 400 mg / kg) and serum vitamin A concentration in egg yolks were not statistically affected during the 4-16 week period in quail feeds. On the other hand, when the feed supplemented with 200-400 mg / kg resveratrol was compared with the control group, concentrations of blood and egg yolk malondialdehyde and liver heat-shock protein decreased, but

the level of vitamin A in the blood increased in the laying quail fed with resveratrol-enriched feed.

In a study of in vitro resveratrol (3.85 µg mL<sup>-1</sup>) supplemented with duck enteritis virus (DEV) infection; Resveratrol has been found to reduce enteral viral replication by 50%. It has been noted that this reduction in viral load may be due to inhibition of viral replication in the host cell.

## Conclusion

Resveratrol activity, the successful poultry sector, and at the same time the need to concentrate research activities on the use of resveratrol to achieve healthy and natural products.

## References

- ALAGAWANY, M.M., FARAG, M.R., DHAMA, K., ABD EL-HACK, M.E., TĪWARĪ, R. and ALAM, G.M. (2015) Hayvan ve tavukçulukta beslenme katkı maddesi olarak resveratrolün mekanizmaları ve yararlı uygulamaları: Bir derleme. *International Journal of Pharmacology* **11**: 213-221.
- BAUR, J. A., PEARSON, K. J., PRICE, N. L., JAMIESON, H. A., LERIN, C., KALRA, A., PRABHU, V. V., ALLARD, J. S., LOPEZ-LLUCH, G., LEWIS, K., PISTELL, P. J., POOSALA, S., BECKER, K. G., BOSS, O., GWINN, D., WANG, M., RAMASWAMY, S., FISHBEIN, K.W., SPENCER, R. G., LAKATTA, E. G., LE COUTEUR, D., SHAW, R. J., NAVAS, P., PUIGSERVER, P., INGRAM, D. K., DE CABO, R., and SINCLAIR, D. A. (2006) Resveratrol improves health and survival of mice on a high-calorie diet. *Nature* **444**: 337-342.
- BAUR, J.A. and SINCLAIR, D.A. (2006) Therapeutic potential of resveratrol: the in vivo evidence. *Nature reviews Drug discovery* **5**: 493-506.
- BAXTER, R.A. (2008) Anti-aging properties of resveratrol: Review and report of a potent new antioxidant skin care formulation. *Journal of Cosmetic Dermatology* **7**: 2-7.
- BERNARD, E., BRITZ-MCKIBBIN, P. and GERNIGON, N. (2007) Resveratrol photoisomerization: An integrative guided-inquiry experiment. *Journal of chemical education* **84**: 1159-1159.
- BRENES, A. and ROURA, E. (2010) Essential oils in poultry nutrition: Main effects and modes of action. *Animal Feed Science and Technology* **158**: 1-14.
- CHEEKE, P. R.; PIACENTE, S.; OLESZEK, W. (2006) Anti-inflammatory and anti-arthritis effects of *Yucca schidigera*: a review. *Journal of inflammation* **3**: 6.
- DELMAS, D., AİRES, V., LIMAGNEETAL, E., (2011) Transport, stability, and biological activity of resveratrol. *Annals of the New York Academy of Sciences* **1215**: 48-59.
- GAMBİNİ, J., INGLÉS, M., OLASO, G., LOPEZ-GRUESO, R., BONET-COSTA, V., GIMENO-MALLENCH, L., MAS-BARGUES, C., ABDELAZİZ, K.M., GOMEZ-CABRERA, M.C., VİNA, J., BORRAS, C. (2015) Properties of resveratrol: in vitro and in vivo studies about metabolism, bioavailability, and biological effects in animal models and humans. *Oxidative medicine and cellular longevity*, 2015.

- GÜMÜŞ, R.ve İMİK, H. (2012). Saponinlerin Hayvan Beslemede Yem Katkı Maddesi Olarak Kullanımı. *Atatürk Üniversitesi Veterinerlik Bilimleri Dergisi* **7**.
- HAO, R.Y., LI, Y.X., YU, F., ZHAO, Y. and ZHENG, X.N. (2011) Effects of resveratrol on lipid peroxidation in mice with high fat and high cholesterol diet. *J. China Med. Univ* **40**: 17-25.
- LIU, L.L., HE, J.H., XIE, H.B., YANG, Y.S., LI, J.C., and ZOU, Y. (2013) Resveratrol induces antioxidant and heat shock protein mRNA expression in response to heat stress in black-boned chickens. *Poultry Science* **93**: 54-62.
- POPOVIĆ, S., KOSTADINOVIĆ, L., PUVAČA, N., and LEVIĆ, J. (2015) Growth Performance And Blood Biochemical Parameters Of Broiler Chickens Fed Diet Included Medical Herbs Mixture. *Proceedings of the 4th International Congress New Perspectives and Challenges of Sustainable Livestock Production* October 7 – 9, Belgrad- Sırbistan.
- RUBIOLO, J. A. and VEGA, F. V. (2008) Resveratrol protects primary rat hepatocytes against necrosis induced by reactive oxygen species. *Biomedicine & Pharmacotherapy* **62**: 606-612.
- SAHİN, K., AKDEMİR, F. ORHAN, C., TUZCU, M., HAYIRLI, A. and SAHİN, N. (2010) Effects of dietary resveratrol supplementation on egg production and antioxidant status. *Poult. Science* **89**: 1190-1198.
- SHEU, S. J., LİU, N. C., OU, C. C., BEE, Y. S., CHEN, S. C., LİN, H. C. and CHAN, J. Y. (2013) Resveratrol Stimulates Mitochondrial Bioenergetics to Protect Retinal Pigment Epithelial Cells From Oxidative Damage Mitochondrial Bioenergetics in Cytoprotection. *Investigative ophthalmology & visual science* **54**: 6426-6438.
- SRİDHAR, M., SUGANTHİ, R.U. and THAMMİAHA, V. (2015) Effect of dietary resveratrol in ameliorating aflatoxin B1-induced changes in broiler birds. *Journal of Animal Physiology and Animal Nutrition* **99**:1094-1104.
- ŞEHİRLİ, Ö., TOZAN, A., OMURTAG, G. Z., CETİNEL, S., CONTUK, G., GEDİK, N., and ŞENER, G. (2008) Protective effect of resveratrol against naphthalene-induced oxidative stress in mice. *Ecotoxicology and environmental safety* **71**: 301-308.
- TİMMERS, S., KONİNGS, E., BİLET, L., HOUTKOOPER, R. H., VAN DE WEİJER, T., GOOSSENS, G. H., HOEKS, J., VAN DER KRİEKEN, S., RYU, D., and KERSTEN, S. (2011) Calorie restriction-like effects of 30 days of resveratrol supplementation on energy metabolism and metabolic profile in obese humans. *Cell Metabolism* **14**: 612–622.
- VİVEROS, A., CHAMORRO, S., PİZARRO, M., ARİJA, I., CENTENO, C. and BRENES, A. (2011) Effects of dietary polyphenol-rich grape products on intestinal microflora and gut morphology in broiler chicks. *Poultry Science* **90**: 566-578.
- VUONG, THU V., FRANCO, C., ZHANG, W. (2014) Treatment strategies for high resveratrol induction in *Vitis vinifera* L. cell suspension culture, *Biotechnology Reports* **1**: 15-21.
- XU, J.; YİN, Z., Lİ, L., CHENG, A., JİA, R., SONG, X., LU, H., DAİ, S., LV, C., LİANG, X., HE, C., ZHAO, L., SU, G., YE, G., SHİ, F. (2013) Inhibitory Effect of Resveratrol against Duck Enteritis Virus In Vitro, *PLoS one* **8**: e65213.

- YAN, Y., YANG, J.Y., MOU, Y.H., WANG, , L.H., ZHOU, Y.N. and WU, C.F. (2012) Differences in the activities of resveratrol and ascorbic acid in protection of ethanol-induced oxidative DNA damage in human peripheral lymphocytes. *Food and Chemical Toxicology* **50**: 168–174.
- YANG, I., KİM, E., KANG, J., HAN, H., SUL, S., PARK, S.B. AND KİM, S.K. (2012) Photochemical generation of a new, highly fluorescent compound from non-fluorescent resveratrol. *Chemical Communications* **48**: 3839-3841.
- ZHANG, C., LUO, J., YU, B., ZHENG, P., HUANG, Z., MAO, X., JUN, H., JİE, Y., JĪALĪ C., and CHEN, D. (2015) Dietary resveratrol supplementation improves meat quality of finishing pigs through changing muscle fiber characteristics and antioxidative status. *Meat science* **102**: 15-21.
- ZHANG, C., YANG, L., ZHAO, X., CHEN, X., WANG, L., GENG, Z. (2017) Effect of dietary resveratrol supplementation on meat quality, muscle antioxidative capacity and mitochondrial biogenesis of broilers. *Journal of the Science of Food and Agriculture*.
- ZHU, W., CHEN, S., LĪ, Z., ZHAO, X., LĪ, W., SUN, Y., ZHANG, Z., LĪNG, W., FENG, X. (2014) Effects and mechanisms of resveratrol on the amelioration of oxidative stress and hepatic steatosis in KKAY mice. *Nutrition & Metabolism* **11**: 35.

## Use of Quinoa (*Chenopodium Quinoa* Willd) Seed in Poultry Nutrition

Sibel Canoğulları Doğan, Sema Yaman, İlknur Uçak

Nigde Ömer Halisdemir University, Faculty of Agricultural Science and Technologies,  
Animal Production and Technologies Department, Niğde

### Abstract

Quinoa (*Chenopodium quinoa* Willd.) seed is one of the most remarkable foods in recent years due to its high nutritional value. Quinoa seeds contain 77.6% carbohydrate, 12.9% protein and 6.5% lipid. Especially Quinoa seeds is rich in oleic and unsaturated fatty acids such as linoleic acid. It also has a stable amino acid structure and contains high amounts of methionine (4-10 g / kg KM) and lysine (51-64 g / kg KM). Quinoa seeds are rich in mineral nutrients (3.0%) and are found in higher levels of potassium, calcium, magnesium, phosphorus and iron content, vitamin E and B vitamins than corn, barley, wheat and oat. The quinoa oil has relatively high levels of vitamin E content (0.59-2.6 mg / 100 g). It is also rich in antioxidants such as polyphenols.

Quinoa seeds contain various anti-nutrients such as saponins, phytic acid, trypsin inhibitors and tannins. It is an alternative food because of nutrient content and it can be used in both human and animal nutrition. Quinoa seeds reduce serum total cholesterol, LDL and triglycerides. The quinoa seed has a good potential as feed in the broilers and performance can be improved by taking the husk of the quinoa seed. Again, the effect of anti nutrients can be reduced by processing the quinoa before it is used in compound feed. In this review, the general structure of the quinoa seed and the use of it as an alternative feed material in poultry feeding will be given.

Key words: quinoa seed, poultry nutrition

**Key word:** *Quinoa seed, poultry*

### Introduction

Quinoa (*Chenopodium quinoa* Willd.) plants from the Andean region in South America possess a huge genetic variability which allows its adaptation and growth under adverse environmental conditions, such as drought, hail, frost and high altitude (Jacobsen, 2003). Quinoa (*Chenopodium quinoa* Willd.) has received much attention in most recent years because of its exceptional nutritional value and potential health benefits. Quinoa seeds contain 77.6% carbohydrate, 12.9% protein and 6.5% lipid (Ando *et al.*, 2002). It has an oil rate of 2.0%e9.5%, and is rich in terms of essential fatty acids such as linoleic

and alpha-linolenic acids. (Maradini Filho *et al.*, 2015) It also presents a balanced amino acid composition with a higher amount of lysine (5–8%) and methionine (2.4–5.1%). Quinoa seeds are rich in mineral nutrients (3.0%) and are found in higher levels of potassium, calcium, magnesium, phosphorus and iron content, vitamin E and B vitamins than corn, barley, wheat and oat. (Hirose *et al.*, 2010). Quinoa oil contains relatively high levels of vitamin E (0.59–2.6 mg/100 g) (James, 2009).

Polyphenols in quinoa, including phenolic acids, flavonoids and tannins make up the bioactive secondary plant metabolites that contribute to diverse physiological properties such as antimicrobial, antioxidant, anti-inflammatory, antitumor and anti-carcinogenic effects (Benavente-Garcia & Castillo, 2008). Its antioxidant capacity is associated to its content of phenolic compounds, such as  $\alpha$ -tocopherols (vitamin E) (Schneider, 2005). Several anti-nutritional factors have been found in quinoa, such as saponins, tannins, protease inhibitors and phytic acid (Ruales and Nair, 1993). Quinoa seeds reduce serum total cholesterol, LDL and triglyceride content (Pasko *et al.*, 2010). The quinoa seed has a good potential as feed in the broilers and performance can be improved by taking the husk of the quinoa seed. The effect of anti-nutrients can be reduced by processing the quinoa e before it is used in compound feed.

In this review, the general structure of the quinoa seed and the use of it as an alternative feed material in poultry feeding will be given.

### **Nutritional Value of Quinoa**

In comparison to most cereals, quinoa seeds have a higher nutritional value (Matiacevich *et al.* 2006). The protein content of quinoa seeds varies from 8% to 22%, which is higher on average than that in common cereals such as rice, wheat, and barley. The major component in quinoa consists of carbohydrates, and varies from 67% to 74% of the dry matter. Starch makes about 52–60%. Quinoa contains from 2% to 10% fat. Quinoa is a rich source of essential fatty acids such as linolenic (18:2n-6: 52%) and linolenic (18:3n-6: 40%) . Quinoa is a good source of minerals. It contains more calcium, magnesium, iron, and zinc than common cereals, and the iron content is particularly high. Quinoa contains more riboflavin (B2) and  $\alpha$ -tocopherol than rice, barley, or wheat. Quinoa seeds can be a source of vitamin E (Valencia-Chamorro, 2003).

### **Antioxidant Activity**

One of the main activities demonstrated for quinoa seeds is the antioxidant activity. Quinoa seeds not only contain many extractable phytochemicals with strong antioxidant activities, but also have various bound phenolic acids and even flavonoids in quinoa. These compounds can be liberated by alkaline, acid, and enzymatic hydrolyses. At least 19 bound phenolic

compounds in the residue of quinoa are, predominantly phenolic acids, but also flavonoids. Ferulic acid and p-coumaric acid, protocatechuic acid, 4-hydroxybenzoic acid, and 8,5'-diferulic acid are the major phenolic acids found in most fractions, and quercetin and kaempferol are the main flavonoids (Tang *et al.*, 2016).

### **Nutritional Disadvantages**

Saponins and phytic acid are the main disadvantageous factors in quinoa. Other inhibitors, trypsin inhibitor and tannins, are present in low levels (Valencia-Chamorro, 2003).

### **Animal Experiments**

In the literature review, very few studies were found on the use of quinoa seed in poultry feed. Jacobsen *et al.*, (1997) investigated the effect of dietary inclusion of quinoa on broiler growth performance. They found that inclusion of whole quinoa seed in mash feed, at levels of 100-400 g kg<sup>-1</sup> resulted in a significantly linear depression in the growth of chickens. Removing most of the bitter tasting saponins by dehulling only improved the live weight gain slightly for chickens in the period 6-13 days. Thus, the growth depression was apparently caused mainly by factors other than the bitter tasting compounds in the hulls. In the second experiment with pelleted feed, incorporation of 150 g kg<sup>-1</sup> quinoa seed resulted in performance comparable to that of the control group and no beneficial effect was found by removing about 85% of the saponins by dehulling. Eassawy *et al.*, (2016) determined the effect of dietary inclusion of quinoa seeds extract (QSE) as a natural antioxidant on broiler chicken performance, economical efficiency, meat quality and oxidative parameters of chickens' meat under refrigerated storage conditions. They concluded that the dietary inclusion of quinoa seeds extract in broilers' diet as a natural antioxidant have a positive effect on broilers performance, meat quality and also improved the chicken meat oxidative stability during refrigerated storage up to 7 days.

More research is needed on the most economical way of processing quinoa so that it can successfully be used in poultry diets.

### **References**

- ANDO, H., CHEN, Y., TANG, H., SHIMIZU, M., WATANABE, K. and MITSUNAGA, T. (2002). Food components in fractions of quinoa seed. *Food Science and Technology Research*, 8(1):80-84.
- BENAVENTE-GARCIA, O. and CASTILLO, J. (2008) Update on uses and properties of citrus flavonoids: New findings in anticancer, cardiovascular, and anti-inflammatory activity. *Journal of Agricultural and Food Chemistry*, 56(15): 6185-6205.

- EASSAWY, M.M.T., ABDEL-MONEIM M. A. and EL-CHAGHABY, G.A. (2016) The Use of Quinoa Seeds Extract as a Natural Antioxidant in Broilers' Diets and its Effect on Chickens' Performance and Meat Quality. *Mansoura Journal of Animal and Poultry Production*, 7(5): 173-180.
- HIROSE, Y., FUJITA, T., ISHII, T. and UENO, N. (2010) Antioxidative properties and flavonoid composition of *Chenopodium quinoa* seeds cultivated in Japan. *Food Chemistry*, 119: 1300–1306.
- JACOBSEN, E.E., SKALHAUGE, B. and JACOBSEN, S.E. (1997) Effect of dietary inclusion of quinoa on broiler growth performance. *Animal Feed Science Technology*, 65:5-14
- JACOBSEN, S. E. (2003) The worldwide potential for quinoa (*Chenopodium quinoa* Willd.). *Food Reviews International* 19(1–2):167–177.
- JAMES, L.E.A. (2009) Chapter 1 Quinoa (*Chenopodium quinoa* Willd.): Composition, chemistry, nutritional and functional properties. *Advances in Food and Nutrition Research*, 58:1–31.
- MARADINI FILHO, A.M., PIROZI, M.R., DA SILVA BORGES, J.T., PINHEIRO SANT'ANA, H.M., PAES CHAVES, J.B. and DOS REIS COIMBRA, J.S. (2015) Quinoa: nutritional, functional and antinutritional aspects. *Critical Reviews in Food Science and Nutrition*, 24;57(8):1618-1630.
- MATIACEVICH, S.B., CASTELLION, M.L., MALDONADO, S.B. and BUERA, M.P. (2006) Water-dependent thermal transitions in quinoa embryos. *Thermochimica Acta*, 448: 117–122.
- PASKO, P., ZAGRODZKI, P., BARTON, H., CHŁOPICKA, J. and GORINSTEIN, S. (2010) Effect of Quinoa seeds (*Chenopodium quinoa*) in diet on some biochemical parameters and essential elements in blood of high fructose-fed rats. *Plant Foods for Human Nutrition*, 65:333–338.
- RUALES, J. and NAIR, B.N. (1993) Saponins, phytic acid, tannins and protease inhibitors in quinoa (*Chenopodium quinoa*, Willd) seeds. *Food Chemistry*, 48(2):137-143.
- SCHNEIDER, C. (2005) Chemistry and biology of vitamin E. *Molecular Nutrition & Food Research*, 49:7–30.
- TANG Y, ZHANG B, LI X, CHEN PX, ZHANG H, and LIUR TSAO, R. (2016) Bound phenolics of quinoa seeds released by acid, alkaline, and enzymatic treatments and their antioxidant and  $\alpha$ -glucosidase and pancreatic lipase inhibitory effects. *Journal of Agricultural and Food Chemistry*, 64:1712-1719.
- VALENCIA-CHAMORRO, S.A. (2003) Quinoa. In: Caballero B.: *Encyclopedia of Food Science and Nutrition*. Vol. 8. Academic Press, Amsterdam. 4895–4902.

## Fenugreek (*Trigonella foenum- graecum L.*) Seeds can be used as Feed Material in Poultry Nutrition

Şefika Nur Özçelik, Ahmet Şahin

Ahi Evran University Agriculture Faculty Animal Science Department, Kırşehir, 40100

### Abstract

On the literature, the health benefits of fenugreek seed and its usage in animal nutrition have been well illustrated. Therefore, this study was aimed to determine the nutrient contents of fenugreek seeds since there has been insufficient study on its nutritional value. The nutrient contents of fenugreek seed- dry matter, crude protein, ether extract, crude fiber, nitrogen free extracts and metabolizable energy were analysed as 94.1, 23.5, 5.5, 15.8, 45.4 % and 2649 Kcal/kg DM. To conclude, fenugreek seeds can be used as feed materials in poultry nutrition due to their nutrient contents, especially for crude protein and ME contents.

**Key words:** Fenugreek seed, nutrient content, poultry nutrition

## Çemen (*Trigonella foenum- graecum L.*) daneleri kanatlı beslemede yem materyali olarak kullanılabilir

### Özet

Literatürde çemen tohumunun sağlığa yararı ve hayvanlarda kullanımı oldukça iyi gösterilmiştir. Besin değeri üzerine yeterli çalışma olmadığından, bu çalışma, çemen bitkisinin tohumunun besin madde kompozisyonunu belirlemeyi amaçlamıştır. Çemen tohumunun besin madde içerikleri, kuru madde, ham protein, ham yağ, ham selüloz, nitrojensiz öz madde ve metabolize olabilir enerji değerleri sırasıyla % 94.1, 23.5, 5.5, 15.8, 45.4 ve 2649 kcal/kg KM olarak analiz edilmiştir. Sonuç olarak, çemen daneleri, besin madde içeriği ve özellikle ham protein ve ME bakımından kanatlı beslemede yem hammaddesi olarak kullanılabilir.

**Anahtar kelimeler:** Çemen danesi, besin madde içeriği, kanatlı besleme

### Introduction

Fenugreek (*Trigonella foenum- graecum L.*) is an annual leguminous medicinal and aromatic crop. This legume crop belonging to the family of Fabaceae is native to an area extending from Iran to northern India (Acharya

et al.,2006). This plant is cultivated for seed production in Turkey, especially in Konya and Kayseri provinces. Fenugreek's many features have potential our agri-food industry. The fenugreek is sowed in spring and its seeds are harvested about 130-140 days after sowing. Its seeds have been usually used as herbal additive for human foods, mainly as spices. The whole seed or its ground powder is used in pickles, vegetable dishes and spice powder. These seeds, as dietary supplementation, have been studied in poultry nutrition to increase growth performance, to decrease blood cholesterol, and increase well-being in chicken (Safaa, 2007; Abbas, 2010; Alloui et al., 2012; El-Shafei et al., 2013; Patel et al., 2014; Toaha et al., 2016). Even though raw fenugreek seeds have maple flavour and bitter taste, birds do not reject to consume it within the diet. Therefore, there has been a need to study to explore the nutritional composition of fenugreek seed in more detailed manner and propagate its usage on farm animals as feeding material in addition to supplemental feed ingredients.

### Material and Methods

As MSc study of the first author, fenugreek was cultivated in the Research Field of Agriculture Faculty of Ahi Evran University, Kırşehir, Turkey. Seed samples were analyzed with 4 replicates and calculated for the dry matter (DM %), crude protein (CP %), ether extracts (EE%), crude fiber (CF%), crude ash (CA,% ), nitrogen free extract (NFE %) according to the standard methods (Kutlu, 2008; Goering and Van Soest, 1970). The metabolizable energy (ME, MJ/Kg DM) contents of seeds were calculated from values of ingredients by using the formula (Lodhi and Singh, 1976) as given below;

$$\text{ME for poultry (MJ/Kg DM)}=1.549 + 0.0102 \text{ CP} + 0.0275 \text{ EE} + 0.0148 \text{ NFE} - 0.0034 \text{ CF}$$

### Results and Discussion

The nutritional contents of fenugreek seed are given in Table 1 below. According to Table 1, the fenugreek seed analysis showed that it contained 94.1 % dry matter, 23.5 % crude protein, 5.5% crude oil, 15.8% crude fibre, 3.9% crude ash, 45.4% nutrition fee extract, 17.2 % ADF, 32.4 % NDF and 1.3% ADL. The calculated ME content of fenugreek seed for poultry was 2649 Kcal/kg DM. These findings are agree with those of El Nasri & El Tinay (2007) and Naidu et al.(2011). The crude protein content of seed was 23.5 % which is suitable for broiler diets but its metabolizable energy content was less than 3000 kcal/kg. Its high proportion of protein (20–30%) as well as content amino acid, 4-hydroxyisoleucine, which has high potential for insulin-stimulating activity. Ether extract of fenugreek seed was obtained about 5.0-6.8 %. On the literature, the lipids of fenugreek seeds

range from 5% to 10%, which is predominantly linoleic, linolenic, oleic, and palmitic acids. Also, fenugreek seed also contains flavonoids, coumarins, saponins and more calcium, phosphorous, iron, zinc, and manganese than most legumes (Petropoulos, 2002). It should be used with other feedstuffs in formulating poultry diet. Its crude fiber content quite higher than cereals. That is why the dietary inclusion of fenugreek is limited by its fibre content. Its 15% is of galactomannan, a soluble fiber, and, also, prebiotic, having health benefit effects on human and animals. For this reason, fenugreek seeds have been considered as feed/food additive in nutrition, especially on diabetes, other metabolic and coronary diseases. The detailed information on the biochemistry and usage of fenugreek seeds on health were given the publications of Petropoulos (2002) and Olaiya & Soetan (2014).

Table 1. The nutritional contents of fenugreek (% , n=4)

Nutrients	Mean	Minimum	Maximum	Standart Deviation	Coefficient of Variation
Dry matter	94.1	93.9	94.2	0.14	0.01
Crude protein	23.5	23.3	23.8	0.25	0.01
Ether extract	5.5	5.0	6.8	0.86	0.16
Crude fibre	15.8	15.7	16.1	0.22	0.01
Crude ash	3.9	3.9	3.9	0.02	0.01
Nitrogen free extract	45.4	44.3	46.3	0.90	0.02
ADF	17.2	16.8	17.4	0.30	0.02
NDF	32.4	29.9	34.3	1.81	0.06
ADL	1.3	1.0	1.7	0.29	0.22
ME (kcal/kg)	2649	2617	2709	40.70	0.01

### Conclusion

In conclusion, fenugreek seeds can be used as raw material in poultry nutrition due to their nutrient contents. Also, their functional biochemical contents tell us fenugreek seed should be used as feed additive as well.

### References

- ABBAS, R. J. (2010). Effect of using fenugreek, parsley and sweet basil seeds as feed additives on the performance of broiler chickens. *Int. J. Poult. Sci.* 9(3):278-282.
- ACHARYA, S., SRICHAMOREN, A., BASU, S., OORAIKUL, B. and BASU, T. (2006). Improvement in the nutraceuticals properties of fenugreek (*Trigonella foenum graecum* L.). *Songklanakan J.Sci. Technol.* 28:1-29.
- ALLOUI, N., BEN AKSA, S., ALLOUI, M.N. and IBRIR, F. (2012). Utilization of Fenugreek (*Trigonella Foenum Graecum*) as Growth Promoter for Broiler Chickens. *J. World's Poult. Res.* 2(2): 25-27.

- EL NASRI, N.A. and EL TINAY, A.H. (2007). Functional properties of fenugreek (*Trigonella foenum graecum*) protein concentrate. *Food Chemistry* 103:582–589.
- EL-SHAFEI, A. A. HASSAN, M. S. H. AL-GAMAL, M. A. and EL-SAYED, O. A. (2013). Influence of Fenugreek and Copper Sulfate Levels in The Diets on Physiological and Productive Performance of Laying Japanese Quail. *Egypt. Poult. Sci.* 32 (4):909-930.
- GOERING, H.K. and VAN SOEST, P.J. (1970). *Forage Fibre Analyses, Agriculture Handbook, No:379, Washington D.C.*
- KUTLU, H.R.(2008).Yem Değerlendirme ve Analiz Yöntemleri Ders Notu. Erişim tarihi 05.06.2016. <http://www.zootekni.org.tr/upload/File/sunular/tm.pdf>.
- LODHI, G., SINGH, D. and ICHHPONANI, J. (1976). Variation in nutrient content of feedingstuffs rich in protein and reassessment of the chemical method for metabolizable energy estimation for poultry. *The Journal of Agricultural Science* 86(2):293-303.
- NAIDU, M.M., SHYAMALA, B.N., NAIK,J.P., SULOCHANAMMA, G. and SRINIVAS, P. (2011). Chemical composition and antioxidant activity of the husk and endosperm of fenugreek seeds. *LWT - Food Science and Technology* 44: 451-456.
- OLAIYA, O.C. and SOETAN, O.K. (2014). A review of the health benefits of fenugreek (*Trigonella foenum-graecum* L.):Nutritional, Biochemical and pharmaceutical perspectives. *Am. J. Soc. Issues Humanit. Fenugreek Special Issue (March/April):* 3–12.
- PATEL, R.M., GARG, D.D., PATEL, V.R., VAHORA, S.G., KATARIYA, M.A. and CHOUBEY, M. (2014). Effect of dietary supplementation of garlic (*Allium sativum*) and fenugreek (*Trigonella foenum-graecum* L.) seed powder on growth performance and blood biochemical parameters in broilers. *Indian Journal of Poultry Science* 49(1): 17-20.
- PETROPOULOS, G. A. (2002). *Fenugreek -The genus Trigonella*, Pp. 1-127. 1st ed. Taylor and Francis, London and New York.
- SAFAA, H. M.(2007).Effect of dietary garlic or fenugreek on cholesterol metabolism in laying hens. *Egypt Poult Sci.* 27(4):1207-1221.
- TOAHA, S.M., MOLLAH, B.R. and AHAMMAD, M.U. (2016). Use of dietary fenugreek (*Trigonella foenum-graecum* L.) seed for the production of safe broiler lean meat. *Res. Agric. Livest. Fish.* 3 (2):305-314.

## Feeding Ecobiol® (*Bacillus Amyloliquefaciens* CECT 5940) Improves Performance of Broiler Chickens

Alvaro Ortiz<sup>a</sup>, Lavinia Stef<sup>b</sup>, Ancuta Ion<sup>a</sup>

<sup>a</sup>Evonik Nutrition & Care GmbH,

<sup>b</sup>Banat University of Agricultural Sciences and Veterinary Medicine Timisoara,

### Abstract

The objective of this trial was to determine the efficacy of feeding *Bacillus amyloliquefaciens* CECT 5940 (Ecobiol®) on broiler performance. Three hundred Ross 308 males were randomly distributed in two treatments; basal diet (Control) and basal diet supplemented with *B. amyloliquefaciens* CECT 5940 ( $1.0 \times 10^6$  cfu/g of feed). Body weight gain was numerically higher in birds fed Ecobiol® compared to the unsupplemented group. Feed conversion ratio was significantly lower in the probiotic group at day 20 ( $P=0.003$ ) and at day 35 ( $P=0.037$ ). The results demonstrate that Ecobiol® is able to improve efficiency in high performing birds.

**Key words:** Broiler, Gut-Health, Performance, Probiotic

### Introduction

Under commercial conditions, broilers chickens are continuously exposed to stressful conditions that can increase their susceptibility to intestinal disturbances resulting in reduced performance, immune suppression and increased mortality. Antibiotics are widely used to improve performance under such challenging conditions (Dibner and Richards, 2005). However, in the last several years antibiotics have been banned in many countries and the veterinary authorities are putting a lot of pressure on antibiotic usage in animal production. In reaction to these demands, producers are searching for alternatives to replace the effects/benefits of antibiotics. The range of the potential replacers is very wide. One of the most promising groups are probiotics. Probiotics have been shown to improve the development and maintenance of the stable gut microbiome in poultry, which leads to reduced enteric diseases and improved growth performance (Ducatelle et al., 2015). Ecobiol® is a probiotic designed for gut microbiota management that can be used to enhance performance. It contains a fast growing, naturally occurring strain: *Bacillus amyloliquefaciens* CECT 5940 with an inherent capacity to produce lactic acid, and the ability to influence interactions between different bacterial populations. This strain is closely associated with intestinal mucosa and tolerates the gastric and bile secretions.

Based on the potential of probiotic to improve intestinal microbial balance, it was hypothesized that *Bacillus amyloliquefaciens* CECT 5940 can improve the performance of broilers when added in the feed. Therefore, this trial was conducted with an objective to determine the efficacy of feeding *B. amyloliquefaciens* CECT 5940 (Ecobiol®) on broiler performance under European feeding conditions.

### Materials and Methods

The experiment was conducted at the University of Agricultural Studies and Veterinary Medicine of Banatului, Timisoara, Romania. Three hundred Ross 308 male day-old chicks with an initial body weight (BW) of  $42 \pm 3$  g were randomly distributed in two dietary treatments, each with 25 replicates and 6 birds per pen. Dietary treatments included a basal control diet (Control) and a basal diet supplemented with  $1.0 \times 10^6$  cfu of *B. amyloliquefaciens* CECT 5940 per g of feed. Diets were based on corn, wheat and soybean meal, formulated according to Ross 308 guidelines and fed in mash form. All birds had *ad libitum* access to water and feed in a three phase feeding program: 0 – 10 days, 11 – 20 days and 21 – 35 days. Due to the extremely controlled sanitary conditions in the trial facility, diets did not contain coccidiostats, no vaccination was conducted in the flock and no medication was administered. Feed intake, BW and mortality were recorded during the study at the end of each feeding phase. Additionally, 25 chickens from each treatment on day 35 were slaughtered. The cecum of the birds was collected and packed in a freezing box and sent to a microbiology laboratory for bacterial analyses (*E. coli* and coliform count) using serial dilution and plate counting methodology. *E. coli* and coliforms were the chosen pathogens being typical bacteria involved in dysbacteriosis processes.

### Results

The ceca from probiotic-supplemented group had a 68% lower coliform count ( $4.25 \times 10^8$  cfu vs.  $1.37 \times 10^8$  cfu) and a 79% lower *E. coli* count ( $3.6 \times 10^8$  vs  $7.61 \times 10^7$ ) than in control group. The results of the performance are presented in Table 1. Final BW at day 35 was numerically higher in the probiotic group (2,114 g) compared to the Control group (2,086 g) Due to very good housing and management conditions, no mortalities were recorded. Feed conversion ratio (FCR) was significantly lower in the probiotic group at 20 days of age (1.344 vs. 1.316) and at 35 days of age (1.533 vs. 1.508). Larger difference in the FCR at d 20 implies that feeding Ecobiol® improves performance when the gut-challenges are higher during the grower phase. Trial performance values are very much in line in comparison with the Ross 308 recommendations for male broilers (FCR=1.537 g/g), which demonstrate that the performance of the control animals was already high, perhaps due to high quality of management

conditions. If all nutrients requirements are met and the animals are not exposed to physiological stress in the way of sub-optimal management or pathogen exposure, then the favorable influence of probiotics may not be quite significant (Otutumi et al., 2012). This could be the possible reason why only numerical differences in the BW were observed. However, despite these good management conditions, feeding Ecobiol® significantly improved the feed efficiency.

Table 1. Growth performance of broiler chickens fed Ecobiol® compared to the control diet.

	Body weight (g)			Feed intake (g)			Feed conversion (g/g)		
	10 d	20 d	35 d	10 d	20 d	35 d	10 d	20 d	35 d
Control	238.1	820.5	2086.3	216.4	1051.2	3134.1	1.094	1.344 <sup>b</sup>	1.533 <sup>b</sup>
Ecobiol®	239.4	830.9	2113.9	215.2	1042.8	3119.6	1.082	1.316 <sup>a</sup>	1.508 <sup>a</sup>
P value	0.628	0.303	0.312	0.622	0.340	0.672	0.425	0.003	0.037

### Conclusions

Dietary inclusion of Ecobiol® (*B. amyloliquefaciens* CECT 5940) significantly improved feed conversion ratio in broilers in a 35-d growth period.

In addition, counts of coliform bacteria and *E.coli* were numerically lower in the ceca of birds fed Ecobiol® indicating well balanced microflora in the intestine contributing to the higher performance of the birds.

Overall, results of this study demonstrate that *B. amyloliquefaciens* CECT 5940 is able to improve broiler performance even when the performance of the animals is close or equal to genetic potential of the breed.

### References

- DIBNER, J. J., AND J. D. RICHARDS. (2005). Antibiotic growth promoters in agriculture: history and mode of action. *Poultry science* 84: 634-643.
- Ducatelle, R. et al. (2015). A review on prebiotics and probiotics for the control of dysbiosis: present status and future perspectives. *Animal : an international journal of animal bioscience* 9: 43-48.
- Otutumi, L.K. et al. (2012). Variations on the Efficacy of Probiotics in Poultry. In E. C. Rigobelo (Ed.), *Probiotic in Animals*. (pp. 203-230). Publisher: InTech.

## Use of Licorice Root (*Glycyrrhiza glabra*) in Poultry Feed as Active Ingredient

Sibel Canoğulları Doğan<sup>a</sup>, İlknur Uçak<sup>a</sup>, Sema Yaman<sup>a</sup>, Mikail Baylan<sup>b</sup>

<sup>a</sup>Nigde Ömer Halisdemir University, Faculty of Agricultural Science and Technologies, Animal Production and Technologies Department, Niğde

<sup>b</sup>Çukurova University, Agriculture Faculty, Animal Science Department, Adana.

### Abstract

Interest in aromatic plants and extracts has been increased following the ban of antibiotics use in animal nutrition in 2006 due to the risk of animal and human health. These plants and extracts are natural and reliable substances and they have been used widely for medical purposes and as spices for centuries. Since food safety is at the forefront nowadays, the use of natural additives and extracts have gained of importance. For this reason, great emphasis is placed on the use of plants and extracts containing antioxidant active compounds in their structure. As a matter of fact, these plants and extracts have some characteristics such as antimicrobial, antioxidant, antilipidemic, antifungal, antiviral, digestive system stimulator and also have some positive effects on organism such as optimizing performance, improving feed efficiency and vitality.

Licorice root (*Glycyrrhiza glabra*) is among the oldest and most widely known medical plants in the world. A large number of pharmacologically active compounds have been isolated from the Licorice root plant. The main components of these bioactive compounds are triterpenoid saponins and various types of phenolic compounds. Experiments on animals have shown that the bioactive substances contained in the plant caused significant decreases in plasma total lipid, cholesterol, triglyceride, LDL, VLDL and increases in the HDL-cholesterol content. It has been shown that licorice root causes an increase in antioxidant enzyme activity.

This review provides a brief overview on general structure of the Licorice root and its use as an active ingredient in poultry nutrition.

**Key Words:** Active Ingredient, Animal Nutrition, Aromatic Plant, Extracts, Licorice Root

### Introduction

Licorice plant has been used for many years in traditional herbal medicine. Compounds and pharmacological effects have been revealed through scientific research conducted over the last 25-30 years (Asl and Hosseinzadeh, 2008). A large number of pharmacologically active

compounds have been isolated from licorice plant and have been identified and verified by modern analytical techniques. The majority of these bioactive compounds form triterpene saponins (4-20%) and various types of phenolic compounds (Tan et al., 2010; Fiore et al., 2008).

It has been reported that glabridin has strong antioxidant activity from the main isoflavonoid compounds of the plant (Shibata, 2000). Glycyrrhizin and glycyrrhizinic acid, the main compounds of the triterpen saponins, are mainly antioxidant (Doğan, 2004), anti-inflammatory (Yokota et al., 1998) and anti-ulcer (Aly et al., 2005), anti-viral (Fiore et al., 2008; Utsunomiya et al., 1997), anti-allergic, anticarcinogenic and immunomodulatory effects have been demonstrated as a result of clinical and experimental studies (Asl and Hosseinzadeh, 2008; Shibata, 2000). Other important effects of glycyrrhizin and glycyrrhizinic acid have been reported to have cardioprotective, hepatoprotective and plasma lipid-lowering effects (Nakagawa et al., 2004, Visavadiya and Narasimhacharya, 2006).

Studies on the effects of triterpenoid saponins and flavonoid compounds possessed by licorice root on the human and experimental animals have been intensified in recent years. In studies conducted with licorice root, especially broiler chickens were used and a limited number of studies were found for the effect on laying hens. This review provides a brief overview on general structure of the Licorice root and its use as an active ingredient in poultry nutrition.

## **Active Ingredients**

### ***Saponins***

Licorice root contains triterpenoid saponins (4–20%), mostly glycyrrhizin, a mixture of potassium and calciumsalts of glycyrrhizic acid (also known as glycyrrhizic or glycyrrhizinic acid, and a glycoside of glycyrrhetic acid) which is 50 times as sweet as sugar (Blumenthal et al., 2000).

### ***Flavonoids***

Licorice root include flavonoids and chalcones such as liquiritin, liquiritigenin, rhamnoliquiritin, neoliquiritin, chalcones isoliquiritin, isoliquiritigenin, neoisoliquiritin, licuraside, glabrolide and licoflavonol (Williamson, 2003).

### ***Isoflavones***

Isoflavonoid derivatives present in licorice include glabridin, galbrene, glabrone, shinpterocarpin, licoisoflavones A and B, formononetin, glyzarin, kumatakenin (Williamson, 2003).

## **Antioxidant Activity**

The isolated compounds from *G. Glabra* were identified as the isoflavans Hispaglabridin A (1), Hispaglabridin B (4), Glabridin (3), and 4\*-O-Methylglabridin (2), the two chalcones, isoprenylchalcone derivative (5) and

Isoliquiritigenin (6), and the isoflavone, Formononetin (7) (Vaya et al., 1997). Constituents 1–6 are very potent antioxidants toward LDL oxidation with Glabridin being the most abundant and potent antioxidant ) (Vaya et al., 1997). The isoflavone derivatives of *G. Glabra* such as glabridin inhibited lipid peroxidation in rat liver microsomes and protected mitochondrial functions from oxidative stresses (Haraguchi et al., 2000).

### **Animal Experiments**

Licorice root is a traditional medicine used mainly for the treatment of peptic ulcer, hepatitis C, and pulmonary and skin diseases, although clinical and experimental studies suggest that it has several other useful pharmacological properties such as antiinflammatory, antiviral, antimicrobial, antioxidative, anticancer activities, immunomodulatory, hepatoprotective and cardioprotective effects (Asl and Hosseinzadeh, 2008). Safari and Zahedi (2016) investigated the effect of different levels supplementation of *Glycyrrhiza glabra* extract on growth performance in male quail. They fed quails with five experimental diets (0, 0.5, 1, 1/5 and 2 g/kg) between 1 and 42 days of age. They found that the addition of *Glycyrrhiza glabra* did significantly influence quail body weight and feed intake during both the starter (1-21 days) and grower (21-42) periods of the study ( $P<0.05$ ), but did not there was not any significant effect on feed conservations ratio during the experiment ( $P>0.05$ ). In general, *Glycyrrhiza glabra* stimulated growth rate and feed efficiency of quail when included in certain types of poultry diets. Salary et al. (2014) determined the effect of supplementation of licorice and aloe vera extracts in drinking water on carcass characteristics, some serum parameters, and broiler chicken performance. They explained that the inclusion of licorice and A. vera extracts at the levels of 0.4% in drinking water have positive effects on broiler chicken performance. The used medicinal plant extracts reduce abdominal fat accumulation. Moradi et al.(2013) conducted a study to evaluate the effect of *Glycyrrhiza glabra* root (licorice) extract (LE) administration through drinking water on the performance and some immunological parameters of broiler chickens. The experimental treatments was comprised a control (no inputs) and/or three levels of LE (0.1, 0.2 and 0.3 mg/L drinking water). There was not a significant difference in body weight; feed intake and feed conversion ratio, immunological parameters including antibody titers against Newcastle disease and Influenza viruses, heterophil and lymphocyte percentages and heterophil to lymphocyte ratio as well as liver and lymphoid organ among the birds given the control or the LE levels during the experiment. Sedgi et al. (2010) explained that birds receiving diets containing licorice extract had lighter abdominal fat pads compared to those fed the prebiotic or control diets. Blood cholesterol concentrations decreased significantly in birds

receiving the high level of licorice in their starter and grower diets as compared to the control.

Because of the active ingredient of licorice this plant can be used in poultry nutrition instead of synthetics feedstuffs.

### References

- ALY, AM, AL-ALOUSI, L. and SALEM, H.A. (2005) Licorice: a possible anti-inflammatory and antiulcer drug. *AAPS Pharm SciTech*, 6:E74–82.
- ASL, M.N. and HOSSEINZADEH, H. (2008) Review of pharmacological effects of *Glycyrrhiza* sp. and its bioactive compounds. *Phytotherapy Research*, 22:709–24.
- BLUMENTHAL, M., GOLDBERG, A. AND BRINCKMANN, J. (2000) Herbal Medicine: Expanded commission monographs. American Botanical Council: Newton, 233–236.
- DOĞAN, Y. (2004) Ratlarda meyan Kökünün Oksidatif –Antioksidatif Sistem Üzerine Etkileri. Harran Üniversitesi Sağlık Bilimleri Enstitüsü Yüksek Lisans Tezi.
- FIGLIO, C., EISENHUT, M., KRAUSSE, R., RAGAZZI, E., PELLATI, D., ARMANINI, D. and BIELENBERG, J. (2008) Antiviral effects of glycyrrhiza species. *Phytotherapy Research*, 22:141-148.
- HARAGUCHI, H., ISHIKAWA, H., MIZUTANI, K., TAMURA, Y. and KINOSHITA, T. (1998) Antioxidative and superoxide scavenging activities of retrochalcones in *Glycyrrhiza inflata*. *Bioorganic & Medicinal Chemistry Letters*, 6: 339–347.
- NAKAGAWA, K., KISHIDA, H., ARAI, N., NISHIYAMA, T. and MAE, T. (2004) Licorice flavonoids suppress abdominal fat accumulation and increase in blood glucose level in obese diabetic KK-A(y) mice. *Biological and Pharmaceutical Bulletin*, 27: 1775-1778.
- SAFARI, A. and ZAHEDI, A. (2016) The effect of different levels supplementation of *Glycyrrhiza glabra* extract on growth performance in male quail. *International journal of Advanced Biological and Biomedical Research*, 4(2): 214–219
- SALARY, J., KALANTAR, M., SAHEBI ALA MK. RANJBAR, K. and HEMATI MATIN H.R. (2014) Drinking water supplementation of licorice and aloe vera extracts in broiler chickens. *Scientific Journal of Animal Science*, 3(2): 41-48.
- SEDGHI, M., GOLIAN, A., KERMANSHAHI, H. and AHMADI, H. (2010) Effect of dietary supplementation of licorice extract and a prebiotic on performance and blood metabolites of broilers. *South African Journal of Animal Science*, 40(4):371-380.
- SHIBATA, S. (2000) A drug over the millennia: Pharmacognosy, chemistry and pharmacology of licorice. *Yakugaku zasshi*, 120:849-862.
- TAN, G., ZHU, Z., ZHANG, H., ZHAO, L., LIU, Y., DONG, X., LOU, Z., ZHANG, G. and CHAI, Y. (2010) Analysis of phenolic and triterpenoid compounds in licorice and rat plasma by high-performance liquid chromatography diode-array detection, time-of-flight mass spectrometry and quadrupole ion trap mass spectrometry. *Rapid Communications in Mass Spectrometry*, 24:209–218.

- UTSUNOMIYA, T., KOBAYASHI, M., POLLARD, R.B. and SUZUKI, F. (1997) Glycyrrhizin, an Active Component of Licorice Roots, Reduces Morbidity and Mortality of Mice Infected with Lethal Doses of Influenza Virus. *Antimicrobial Agents and Chemotherapy*, 41(3): 551-556.
- VAYA, J., BELINKY, P.A. and AVIRAM, M. (1997) Antioxidant constituents from licorice roots isolation, structure elucidation and antioxidative capacity toward LDL oxidation. *Free Radical Biology and Medicine*, 23:302-313.
- VISAVADIYA N. P. and NARASIMHACHARYA A. V. R. L. (2006) Hypocholesterolaemic and antioxidant effects of *Glycyrrhiza glabra* (Linn) in rats. *Molecular Nutrition & Food Research*, 50:1080-1086.
- WILLIAMSON, E.M. (2003) Licorice. In *Potter's Cyclopedia of herbal medicines*. C W Daniels: Saffron Walden, UK, 269-271.
- YOKOTA, T., NISHIO, H., KUBOTA, Y. and MIZOGUCHI, M. (1998) The inhibitory effect of glabridin from licorice extracts on melanogenesis and inflammation. *Pigment Cell Research*, 11:355-361.

## **Lupine in Diets for Broilers, Commercial Laying Hens, and Layer Parental Flock**

**E. Andrianova, I. Egorov, V. Fisinin, E. Grigoryeva**

Federal Scientific Center "All-Russian Research and Technological Institute of Poultry" of Russian Academy of Sciences, Sergiev Posad, Russia;

### **Abstract**

Trials on broilers, commercial laying hens, and layer parental flock proved that cultivars of lupine with low alkaloid content can be included into the diets as a protein source at the levels up to 15%.

**Key words:** *Broiler Chicks, Laying Hens, Lupine, Live Bodyweight, Feed Conversion Ratio, Hatchability of Eggs.*

### **Introduction**

Soybean meal containing 33-40% of crude protein is the most important protein source in diets for productive animals and poultry. Many countries (including Russia) are constrained to import it or replace with locally available protein sources including sunflower cake and different legumes (peas, faba beans, vetch, lupine). Recently particular emphasis was gained by lupine as a crop capable of yielding large harvests in the regions where the cultivation of soy beans is impossible.

Genetic selection of lupine provided different cultivars with increased protein content (up to 40%) and low concentrations of antinutritive factors (alkaloids); these cultivars could be effectively used in diets for animals and poultry to solve the problem of protein shortage. The aim of our study was the determination of reasonable levels for the inclusion of new low-alkaloid lupine cultivars into the diets for different production groups of poultry (broilers, parental and commercial layer flocks).

### **Materials and Methods**

The modern cultivars of lupine were studied as a possible substitution of animal-derived protein sources, soybean meal and sunflower cake in diets for broilers. The chicks (Cobb 500 and Cobb Avian 48) were raised from 1 to 36-38 days of age in the Institute's vivarium. The nutritional values of the diets corresponded to the recommendations for these crosses. The unsexed chicks (315 birds per treatment) were housed in cage batteries R-15 (Russia) or Big Dutchman (Germany) under standard management conditions.

Laying hens of commercial and parental flocks (cross SP-789, 30 birds per treatment) were housed in KBN cage batteries (Russia) for 6 months of the productive season. Eggs for incubation were taken from the parental hens at

the peak of egg production (35 weeks of age) and in the end of reproductive season (58 weeks of age). Hens were artificially inseminated according to the standard protocol; individual dose of diluted sperm was 0.1 ml. The sperm was diluted (1:3) with new patented medium designed in our Institute. One hundred eggs from each treatment at both ages were incubated in "Danki" incubator (constant regime). From 1 to 18 days of incubation temperature was set on 37.7°C and controlled (0.1°C) by a sensor; from day 19 to hatch the temperature was set on 37.2°C. Relative humidity was 52-53 and 52-75%, respectively.

### Results and Discussion

The substitution of 10 and 15% (on total diet basis) of narrow-leaved lupine (alkaloid content 0.025%) for the sunflower cake was found to improve average live bodyweight (BW) in broilers by 1.23 and 0.22%; FCR by 3.57 and 2.38%. To the contrary, the inclusion of 20% of the lupine led to the significant decline in live BW (by 7.64% compared to control).

The supplementation of vegetable diets with 15% of lupine instead of soybean meal improved live BW by 0.65% and FCR by 0.59%; the additional supplementation of this lupine-supplemented diet with phytase (100 ppm) improved live BW by 1.80% compared to control.

The use of white lupine ("Gamma" cultivar) led to the similar results. The substitution of "Gamma" lupine for sunflower cake and soybean meal (10% of lupine in total diet) improved live BW in broilers by 2.59%. The supplementation of diet with 20% of white lupine with 100 ppm of phytase improved live BW by 1.7% in compare to control; the mixture of phytase and "MEK-SH-4" enzyme preparation (Russia) significantly improved live BW compared to control (by 7.8%,  $P<0.01$ ) and improved FCR by 10.4%. The digestibility and availabilities of nutrients from experimental diets were similar to control.

Inclusion into the diets for layers of 15 and 20% of narrow-leaved lupine ("Dikaf-14" cultivar) together with phytase (60 ppm) improved the egg production during the productive period by 2.53 and 4.85%, the output of egg mass by 2.78 and 1.02%, respectively, and improved accumulation in eggs of vitamins and carotenoids. Similar diets with 15 and 20% of white lupine "Gamma" improved the egg production during the productive period by 2.08 and 0.83%, the output of egg mass by 4.16 and 1.57% in compare to control. The concomitant improvements in feed conversion expressed as kg of feed per 10 eggs laid were 2.17-0.72% and as kg of feed per 1 kg of egg mass laid 3.82-1.54%.

It was also found that the dehulling of lupine allows the production of plant protein source with protein content no less than 40% and fiber content 3.5%. The use of this protein source in broiler diets was found to improve live BW by 5.58-4.57%. The inclusion of 7-15% of the dehulled lupine into the diets

for layers of parental flock improved the intensity of lay at 35 weeks of age by 3.5-1.89%; hatchability of eggs was 87-88-94.0% vs. 84.38% in control. At 58 weeks of age egg fertility in treatments fed lupine was 100; 99; 95 and 96% vs. 94% in control; hatchability of eggs 89.00; 88.89; 91.58 and 92.71% vs. 81.17% in control. The intensity of lay at 58 weeks of age was 76.67; 79.68; 83.66 and 79.46% vs. 75.86% in control.

### **Conclusions**

Trials on broilers, commercial laying hens, and layer parental flock proved that cultivars of lupine with low alkaloid content can be included into the diets as a protein source at the levels up to 15%.

## **A Research on The Determination of The Performance Properties of Imported Grand Parent Female Strains Being Raised in The Eskişehir Geçit-Kuşağı Research Institute**

**Emrah Oğuzhan<sup>a</sup>, Ramazan Yetişir<sup>b</sup>, İsmail Özkan<sup>a</sup>,  
Halil Harman<sup>a</sup>, Sinan Çağlak<sup>a</sup>**

<sup>a</sup>Eskişehir Geçit Kuşağı Araştırma Enstitüsü,

<sup>b</sup>S. Ü. Ziraat Fakültesi Zootekni Bölümü,

### **Abstract**

In this research, partial production (28-44 wks.) data of imported A1, A2 and A3 grand parent (GP) female strains being raised in the institute were determined at the male family level. Totally 42 male family data, each strain having 14 families, were used in the study. During this period, Live Weight (LW), Livability, Egg Production (EP) [hatching and total; % and number, hen-day (HD) and hen housed (HH)], Egg Weight (EW), Egg Mass (EM, kg/per hen), Feed Consumption (FC, daily g/hen/day and total kg/hen) and Feed Conversion Ratio (FCR: g feed/egg, hatching and total) data were obtained. These data were analyzed statistically (one way), means were compared (LSD) and the results obtained were summarized below.

LW of A1, A2 and A3 GP strains at 28 and 44 wks. were determined as 3007-3763, 3010-3880 and 2994-3843 g, respectively. In both period, difference between parent strains for LW were not statistically significant. Livability values of the strains were determined as 99.65%, 99.67% and 99.55%, respectively. The difference between strains for livability were also not statistically different. With respect to daily and total FC, and FCR for hatching and total egg, the difference between strains were found significantly ( $P<0.01$ ) different. For FC (daily and total), A1 strain were showed higher ( $P<0.01$ ) values than the two others. With respect to FCR for hatching and total egg, the differences between the strains were found statistically significant ( $P<0.01$ ). According to the these values, A1 strain were showed lower (better) ( $P<0.01$ ) FCR, as to the A2 and A3 strains. Daily and total FC for A1, A2 and A3 strains were determined as *161.5 g and 19.22 kg, 160.4 g and 19.00 kg, and 160.7 g and 19.12 kg*, respectively. FCR values for hatching and total EP of strains were determined as 241.8 and 216.1, 285 and 253.7, and 269.1 and 229.9 g, respectively. With respect to both FCR, while difference between A1 and A3 were not significant, the differences between A1 and A2 were statistically significant ( $P<0.01$ ), on the favor of A1 strain. For both criteria, A1 and A3 strains were showed higher ( $P<0.01$ ) values then the A2 strain. With respect to the hatching and total EP (% and number, HD and HH) the differences between the strains were

statistically significant ( $P<0.01$ ). For these properties, while the difference between A1 and A3 strains were not significant, for A1 and A2 were found significantly different ( $P<0.01$ ), on the favor of A1 strain. Considering the hatching and total EP (HD and HH), FCR and the other properties, it can be stated that A1 strain is better than the other two strain, and A3 strain is take part in the second position. These results are important with respect to showing the properties of these strains which are going to distributed to the commercial hatchery operations by the government (GTHB), now a days.

**Key Words:** *Broiler parent strain, hatching egg production, feed consumption, feed conversion ratio, egg weight, egg mass produced.*

### **Eskişehir Geçit Kuşağı Araştırma Enstitüsünde Yetiştirilen, İthal Etlik Piliç Büyük Ebeveyn Ana Soylarının, Performans Özelliklerinin Belirlenmesi Üzerinde Bir Araştırma**

#### **Özet**

Bu araştırmada; belirtilen enstitüde yetiştirilmekte olan A1, A2 ve A3 kodlu, ithal broyler büyük ebeveyn (BE) ana soylarının kısmi verimleri (28-44 hafta) baba familyası düzeyinde belirlenmiştir. Her ebeveyn soyundan 14 olmak üzere, toplamda 42 baba familyasına ait dişilerin verileri kullanılmıştır. Bu süreçte; Canlı Ağırlık (CA), Yaşam Gücü (YG), Yumurta Verimi (YV) [kuluçkalık ve toplam; adet ve %, tavuk-gün(TG) ve Tavuk-kümes(TK)], Yumurta Ağırlığı(YA) ve Yumurta Kütlesi (YK), Yem Tüketimi (YT) ve Yem Değerlendirme Sayısı (YDS: g yem/adet yumurta, kuluçkalık ve toplam) verileri elde edilmiştir. Bu veriler istatistik analize (tek yönlü) tabi tutularak, ortalamalar karşılaştırılmış (AÖF) ve sonuçları aşağıda özetlenmiştir.

A1, A2 ve A3 BE ebeveyn soylarında 28 ve 44. haftalarda CA değerleri, sırasıyla, 3007-3763, 3010-3880 ve 2994-3843 g olarak belirlenmiştir. Her iki dönemde de ebeveyn soyları arasındaki CA bakımından farklılıklar önemsiz çıkmıştır. Ebeveyn soylarında yaşama gücü (YG) değerleri ise, sırasıyla, %99.65, %99.67 ve %99.55 olarak belirlenmiştir. Aralarındaki farklılıklar yine önemsiz bulunmuştur. Günlük YT (g/tav/gün) ve toplam YT (kg/tavuk), ve YDS (kuluçkalık ve toplam yumurta, g yem/yum) bakımından soylar arasındaki farklılıklar önemli ( $P<0.01$ ) bulunmuştur. Günlük YT ve toplam YT bakımında A1 hattı diğerlerinden yüksek ( $P<0.01$ ) (geri) değer göstermiştir. Kuluçkalık ve toplam YV için YDS değerleri bakımından hatlar arası farklılıklar önemli ( $P<0.01$ ) bulunmuştur. Bu değerler bakımında A1 hattı A2 ve A3 hatlarına göre daha düşük (iyi) ( $P<0.01$ ) YDS değeri göstermişlerdir. Günlük ve toplam YT bakımından ortalama değerler A1, A2 ve A3 hatlarında, sırasıyla, 161.5 g ve 19.22 kg, 160.4 g ve 19.00 kg ve

160.7 g ve 19.12 kg olarak belirlenmişlerdir. Kuluçkalık ve toplam YV için YDS değerleri ise, hatlarda sırasıyla, 241.8 ve 216.1, 285.9 ve 253.7, 269.1 ve 229.9 g olarak belirlenmiştir. Her iki YDS değerleri bakımından A1 hattı ile A3 hattı arasındaki farklar önemsiz çıkmasına rağmen A1 ve A2 hatları arasındaki farklar A1 lehine önemli ( $P<0.01$ ) bulunmuştur. Araştırma sürecinde ortalama YA ve üretilen YK bakımından hatlar arası farklılıklar da önemli ( $P<0.01$ ) bulunmuştur. Her iki kriter bakımından da A1 ve A3 hatları A2 hattından daha yüksek ( $P<0.01$ ) değer göstermişlerdir. Kuluçkalık ve toplam YV bakımından (% ve adet, TG ve TK) hatlar arasındaki farklılıklar önemli ( $P<0.01$ ) bulunmuştur. Bu özellikler bakımında A1 ve A3 arasındaki farklar önemsiz çıkarken, A1 ile A2 arasındaki farklar A1 lehine önemli ( $P<0.01$ ) bulunmuştur. Kuluçkalık ve toplam YV (TG ve TK), YDS değerleri ve diğer özellikler dikkate alındığında A1 soyunun diğer ikisine (A2 ve A3) nazaran daha iyi olduğu söylenebilir. Bu sonuçlar, GTHB'nın kuluçkacı ticari işletmelere dağıtmayı düşündüğü bu hatların özelliklerini yansıtması bakımından önemli ve aktüeldir.

**Anahtar Kelimeler:** *Broyles ebeveyn soyu, kuluçkalık yumurta verimi, yem tüketimi ve yem çevirimi, yumurta ağırlığı, yumurta kütlesi.*

## Effects of Arginine-Silicate-Inositol Complex on Bone Mineralization in Laying Hens

Cemal Orhan<sup>a</sup>, Mehmet Tuzcu<sup>b</sup>, Nurhan Sahin<sup>a</sup>, Kazim Sahin<sup>a\*</sup>

<sup>a</sup>Department of Animal Nutrition and Nutritional Disorders, Faculty of Veterinary Medicine Firat University Elazig 23119 Turkey; <sup>b</sup>Division of Biology Faculty of Science Firat University Elazig 23119 Turkey

### Abstract

Arginine-silicate-inositol complex (ASI; 49.5-8.2-25 g/kg) has been formulated to augment calcium metabolism. The silicon and inositol in the complex increase arginine bioavailability. The objective of this study was to evaluate the effects of ASI complex on the tibia bone mineralization in laying hens during the peak laying period. A total of 360 laying hens, 25 weeks old, were randomly divided into 3 groups consisting of 6 replicate of cages, 20 birds per cage. The groups were fed a basal diet and the basal diet supplemented with 500 or 1000 mg ASI complex per kilogram for 90 days. As the ASI complex supplementation level increased, there were increases in the bone mineral density (BMD) ( $P < 0.01$ ) and bone ash ( $P < 0.0001$ ). Concentrations of bone Ca ( $P < 0.001$ ) and P ( $P < 0.01$ ) increased, whereas there were no differences in bone weight and bone length ( $P > 0.05$ ). In conclusion, provision of dietary ASI complex to laying hens during the peak laying period improved bone quality as reflected by improved BMD via increasing Ca and P concentration.

**Key words:** *Arginine-silicate-inositol complex, bone, laying hens*

### Acknowledgements

The study was funded by Small and Medium Business Development and Support Administration of Turkey (KOSGEB) and also in part by Turkish Academy of Sciences (Ankara, Turkey).

### Arginin-Silikat-İnositol Kompleksinin Yumurta Tavuklarında Kemik Mineralizasyonu Üzerindeki Etkileri

### Özet

Arginin-silikat-inositol kompleksi (ASI; 49.5-8.2-25 g/kg), kalsiyum metabolizmasını arttırmak için formüle edilmiştir. Kompleks içindeki silikon ve inositol arjinin biyoyararlanımını artırmaktadır. Bu çalışmanın amacı, ASI kompleksinin yumurtlamanın pik döneminde olan yumurtacı tavuklarda tibia kemik mineralizasyonu üzerindeki etkilerini değerlendirmektir. Toplam

360 adet yumurta tavuğu (25 haftalık yaşta) altı alt gruptan oluşan ve her kafeste 20 hayvan olacak şekilde rastgele 3 gruba ayrıldı. Gruplara bazal diyet ve 90 gün boyunca kilogram başına 500 veya 1000 mg ASI kompleksi katılan bazal diyet uygulandı. ASI kompleksi katkısı seviyesi arttıkça kemik mineral yoğunluğunda (KMY) ( $P < 0.01$ ) ve kemik külünde ( $P < 0.0001$ ) artışlar oldu. Kemik Ca ( $P < 0.001$ ) ve P ( $P < 0.01$ ) konsantrasyonları artarken, kemik ağırlığı ve kemik uzunluğu açısından fark tespit edilmedi. ( $P > 0.05$ ). Sonuç olarak, yumurta piki dönemi boyunca tavuk rasyonlarına ASI kompleksinin katılması, Ca ve P konsantrasyonunu arttırmak suretiyle KMY artırmakta ve kemik kalitesini iyileştirmektedir.

**Anahtar Kelimeler:** Arginin-silikat-inositol kompleksi, kemik, yumurta tavuğu

# **POSTER PRESENTATIONS**

## **SESSION 5**

### **GENETICS AND GENOMICS**

## **Carcass Traits As Influenced By Different Body Weight Categories In Four Close-Bred Flocks Of Japanese Quail (*Coturnix Coturnix Japonica*)**

**Ahmed Sultan Jatoi<sup>a</sup>, Erum Bughio<sup>a</sup>, Jibran Hussain<sup>b</sup>, Muhammad Hayat Jaspal<sup>c</sup>, Shahid Mehmood<sup>b</sup>, Abdul Waheed Sahota<sup>b</sup>, Khalid Javed<sup>d</sup>, Athar Mahmud<sup>b</sup>, Reema Bughio<sup>e</sup> And Hafiz Muhammad Ishaq<sup>f</sup>**

<sup>a</sup> Department of Poultry Production, Faculty of Animal Production and Technology, Shaheed Benazir Bhutto University of Veterinary and Animal Sciences, Sakrand, Pakistan

<sup>b</sup> Department of Poultry Production, <sup>c</sup>Department of Livestock Production, <sup>d</sup>Department of Meat Science Technology, Faculty of Animal Production and Technology, University of Veterinary and Animal Sciences, Lahore, Pakistan

<sup>e</sup>Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan

<sup>f</sup> Department of Livestock and Poultry Production, Bahauddin Zakariya University, Multan, Pakistan

### **Abstract**

The present study was conducted to investigate effect of different body weight categories in four close-bred flocks of Japanese quails on their carcass traits. For this purpose, 432 adult (12 weeks-old), quails comprising 108 males and 324 females were used. The results showed that dressed weight (g) in imported and local flocks of Japanese quails differed significantly ( $P < 0.05$ ) in female quails. With respect to body weight categories, a significant difference ( $P < 0.05$ ) was recorded for dressed weight and dressing percentage in both the sexes. The imported flock of male Japanese quails differed significantly ( $P < 0.05$ ) from all the other local flocks in relative weight of gizzard (filled and empty). The relative heart weight and intestinal weight in local-3 flock of male quails differed significantly ( $P < 0.05$ ) from imported and all other local flocks. The interaction between flocks and body weight was significant ( $P < 0.05$ ) for heart, gizzard and intestinal weight only in male quails. The interaction between flocks and body weight was significant ( $P < 0.05$ ) for reproductive tract length and number of mature ovarian follicles.

**Key words:** *Dressed Weight, Dressing Percentage, Giblets, Visceral Organs*

## Effect of Parental Body Weight on Somebody Measurements in Sexed Progeny of Japanese Quail (*Coturnix Coturnix Japonica*) Studied at Different Ages

Erum Bughio<sup>a</sup>, Ahmed Sultan Jatoi<sup>a</sup>, Jibran Hussain<sup>b</sup>, Muhammad Hayat Jaspal<sup>c</sup>, Shahid Mehmood<sup>b</sup>, Abdul Waheed Sahota<sup>b</sup>, Khalid Javed<sup>d</sup>, Athar Mahmud<sup>b</sup>, Reema Bughio<sup>e</sup> And Hafiz Muhammad Ishaq<sup>f</sup>

<sup>a</sup>Department of Poultry Production, Faculty of Animal Production and Technology, Shaheed Benazir Bhutto University of Veterinary and Animal Sciences, Sakrand, Pakistan

<sup>b</sup>Department of Poultry Production

<sup>c</sup>Department of Livestock Production

<sup>d</sup>Department of Meat Science Technology, Faculty of Animal Production and Technology, University of Veterinary and Animal Sciences, Lahore, Pakistan

<sup>e</sup>Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan

<sup>f</sup>Department of Livestock and Poultry Production, Bahauddin Zakariya University, Multan, Pakistan

### Abstract

The present study was conducted at Avian Research and Training (ART) Center, Lahore, for the duration of 6 weeks in order to observe and identify the effect of parental body weight (BW) on somebody measurements in sexed progeny of Japanese quail. The parents {(both male and female from 4 different closed bred stocks (CBS))} were divided into 3 BW categories (heavy, medium and small). A total of 108 experimental units were maintained on the basis of 3 different paternal and maternal body weight categories and 4 different CBS's (M, K, S and Z). The analysis of data using General Linear Model (GLM) procedures in Randomized Complete Block Design (RCBD) factorial arrangement with the help of SAS 9.1 and comparison of means using Duncan's Multiple Range (DMR) test depicted significant effects of maternal body weight on intestinal, shank and keel length of progeny through-out the experiment and keel angle during the 3<sup>rd</sup> week while paternal body weight showed significant effects on the progeny's intestinal length and keel length through-out the experiment and shank length during the 3<sup>rd</sup> and 4<sup>th</sup> week. Male and female progeny showed significant variation in intestinal length, shank length and keel length through-out the experiment, further significant variation was observed in intestinal length, shank length, keel length and keel angle during 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> week indifferent close bred stocks while the interaction between different CBS as well as maternal and paternal body weight also generated significant results.

**Key words:** Japanese Quail, Paternal Body Weight, Maternal Body Weight, Body Measurements.

## Effect of SNP's on The Secondary Protein Structure of Prolactin Gene In Long-Term Selected Japanese Quail

Kemal Karabağ<sup>a</sup>, Emel Tüten Sevim<sup>b</sup>

<sup>a</sup>Akdeniz University, Faculty of Agriculture, Antalya/Turkey

<sup>b</sup>Akdeniz University, Graduate School of Natural and Applied Sciences, Antalya/ Turkey

### Abstract

In this study, secondary protein structure differences of Prolactin (Prl) gene and identification of possible single nucleotide polymorphisms (SNP) were determined in 94 individuals from two Japanese quail genotypes (HBW, LBW), which were selected for 15 generations in reverse direction in terms of body weight, and one control quail genotype. Thus, 121 base at Prl gene were sequenced and 3 SNP at Prl sequence were detected. It can be said that it has occurred important differences at Prl gene coding sequences as a results of SNPs according to selection.

**Keywords:** *Japanese Quail, Prolactin, Protein Structure, Selection, SNP*

### Uzun Dönem Selekte Edilmiş Japon Bildircinlarında Prolaktin Geninin Sekonder Protein Yapısına SNP'lerin Etkisi

#### Özet

Bu çalışmada, bir kontrol grubu ve canlı ağırlık açısından zıt yönde 15 generasyon selekte edilmiş iki Japon Bildircin genotibinden (YCA,DCA) 94 kişi de Prolaktin (Prl) geninin sekonder protein yapısındaki farklılıklar ve muhtemel tek nükleotid polimorfizmleri (SNP) belirlenmiştir. Böylece, Prl geninde 121 baz sekanslanmış ve sekansta 3 SNP tespit edilmiştir. SNP'lerin sonucu olarak seleksiyona göre Prl geni kodlayan dizilerde önemli farklılıklar oluşturduğu söylenebilir.

**Anahtar Kelimeler:** *Japon Bildircini, Prolaktin, Protein Yapısı, Seleksiyon, SNP*

#### Introduction

Japanese quail is one of the economically important species of poultry. As a result of breeding studies, commercial genotypes with high meat and egg yield were developed. However, undesirable genes can be selected together with the genes expressing the desired characteristics in the studies carried

out with the classical breeding methods. For this reason, Japanese quails need to be investigated by using molecular methods.

Nowadays, molecular genetics develops very fast in terms of method and technology. These developments allow to investigate the identification of genetic variation in various loci and the relationships between yield characteristics. In this context; it was thought that the prolactin gene was effective on the phenotypic characteristics in quail lines that were selected in opposite directions along 15 generations in terms of body weight. It is aimed to identify of possible SNPs in the prolactin gene and identify relationship with some yields that are economically important.

### **Materials and Methods**

Japanese quails (*Coturnix coturnix japonica*) that were selected in opposite directions along 15 generations in terms of body weight and were not selected a group have been used as animal material.

RNA extraction was made by principle of homogenization of the tissue, disintegration of the cell wall, denaturation of the DNA-protein complex, inactivation of ribonucleases and removal of other molecules. Pcr amplification was performed by using 3 different primers for prolactin gene.

### **Results**

121 base at prolactin gene were sequenced and 3 SNPs at prolactin sequence were detected. It was observed that the SNPs detected did not alter the amino acid and secondary protein structure.

### **Conclusion**

In conclusion, it has been seen that long-term selection leads to both genotypic and phenotypic changes in poultry farm animals and significant changes in the genes that were studied.

### **References**

- ALIPANAH, M., SHOJAIAN, K. and BANDANI, H.K. (2011). The Polymorphism of Prolactin Gene in Native Chicken Zabol Region. *Journal of Animal and Veterinary Advances*. 10 (5): 619-21.
- Begli H.E., ZEREHDARAN S., HASSANI S., ABBASI M.A. and AHMADI A.K. (2010). Polymorphism in Prolactin and PEPCK-C Genes and Its Association with Economic Traits in Native Fowl of Yazd Province. *Iranian Journal of Biotechnology*. 8 (3): 172-7.
- SHIMADA K., ISHIDA H., SATO K., SEO H., MATSUI N. (1991). Expression of PRL Gene in Incubation Hens. *Journal of Reproduction and Fertility*. 9: 147-54.

## Oncogenic Viruses on Poultry

Kemal Karabağ<sup>a</sup>, Berkant İ. Yıldız<sup>b</sup>

<sup>a</sup>Akdeniz University, Faculty of Agriculture, Antalya/Turkey

<sup>b</sup>Akdeniz University, Graduate School of Natural and Applied Sciences, Antalya/ Turkey

### Abstract

Avian oncogenic viruses are considered to be important pathogens with great economic impact on the poultry industry (Wang et al., 2014). Avian oncogenic viruses include retroviruses such as reticuloendothelialysis (REV) and Avian Leukosis Virus (ALV), as well as the highly contagious herpesvirus Marek's Disease Virus (MDV) (Gopal et al., 2012). Avian oncogenic viruses are occurred major economic loses for the poultry industry (Witter and Schat, 2003). Avian oncogenic viral lesions are similar and it is difficult to make a differential diagnosis based on histopathology (Wang et al., 2014). Therefore, the ongenic diseases caused by viruses and their molecular mechanisms need to be better researched, especially in our country.

**Key words:** Poultry, oncogenic viruses, Avian Leukosis , Marek's Disease

## Kanatlılarda Onkojenik Virüsler

### Özet

Avian onkojenik virüsleri, kanatlı hayvan endüstrisi üzerinde büyük ekonomik etkileri olan, önemli patojenler olarak kabul edilmektedir (Wang vd. 2014). Avian onkojenik virüsleri, oldukça bulaşıcı bir herpesvirüs olan Marek Hastalığı Virüsü (MDV) yanı sıra Avian Leukosis Virüsü (ALV) ve Retiküloendoteliosis Virüsü (REV) gibi retrovirüsleri kapsamaktadır (Gopal vd. 2012). Avian onkojenik virüsleri, kanatlı hayvan endüstrisi için büyük ekonomik önemi olan, kanatlı hayvanların önemli patojenleri olarak kabul edilmektedir (Witter ve Schat, 2003). Avian onkojenik virüs kaynaklı lezyonlar çoğunlukla birbirine benzer ve histopatolojiye dayalı ayırıcı tanı yapmak zordur (Wang vd. 2014). Bu nedenle virüslerin neden olduğu onjenik hastalıklar ve moleküler mekanizmaları, özellikle ülkemizde daha iyi araştırılmalıdır.

**Anahtar Kelimeler:** Kanatlı, Onkojenik Virüsler, Avian Leukosis, Marek Hastalığı

### Introduction

The commercially important neoplastic diseases of poultry are Marek's disease, which is caused by a herpesvirus, and the avian leukoses and

reticuloendotheliosis, which are caused by retroviruses (Payne and Venugopal, 2000). MDV is classified in the *Alphaherpesvirus* genus and transforms T lymphocytes, not only resulting in the formation of skin and visceral tumors but also causing immunosuppression, neurological symptoms, and ocular lesions until tumors become visible (Osterrieder et al.). ALV subgroups belong to the Alpharetrovirus genus and are generally associated with lymphoid leukosis, with tumors primarily in the bursa of Fabricius and visceral organs (Fadly et al.), but ALV subgroup J (ALV-J) targets cells of the myeloid lineage, inducing late-onset myelocytomatosis (Venugopal et al.). REV is in the *Gammaretrovirus* genus and causes a group of disease syndromes that are unrelated to those caused by the leukosis/ sarcoma (L/S) group of viruses; it transforms pre-B and pre-T lymphocytes, causing bursal and T-cell lymphomas in chicken and turkeys (Davidson, 2009).

### Conclusion

In conclusion, oncogenic viruses in chickens cause major diseases and major economic losses. Therefore, the causes of the diseases caused by these viruses and their molecular mechanisms need to be better researched, especially in our country.

### Referencess

- DAVIDSON, I. (2009). The knowledge that human tumor virology can gain from studies on avian tumor viruses. *Adv. Tumor Virol.* 1: 9 –19.
- FADLY, A.M., ZAVALA, G. and WITTER, R.L. (2008). Reticuloendotheliosis, p 568 – 588. *In* Saif YM, et al (ed), *Diseases of poultry*, 12th ed. Iowa State Press, Ames, IA.
- OSTERRIEDER, N., KAMİL, J.P., SCHUMACHER, D., TISCHER, B.K. and TRAPP, S. (2006). Marek's disease virus: from miasma to model. *Nat. Rev. Microbiol.* 4: 283–294.
- PAYNE, L.N. and VENUGOPAL, K. (2000). Neoplastic diseases: Marek's disease, avian leukosis and reticuloendotheliosis, *Rev. sci. tech. Off. int. epiz.*, 544-564.
- VENUGOPAL, K., HOWES, K., FLANNERY, D.M.J. and PAYNE, L.N. (2000). Isolation of acutely transforming subgroup J avian leukosis viruses that induce erythroblastosis and myelocytomatosis. *Avian Pathol.* 29: 327–332.
- WITTER, R.L. and SCHAT, K.A. (2003). Marek's disease, p 407–465. *In* Saif YM, et al (ed), *Diseases of poultry*, 11th ed. Iowa State University Press, Ames, IA.
- WANG, L.C., HUANGA, D., PUB, C.E., WANGA, C.H. (2014). Avian oncogenic virus differential diagnosis in chickens using oligonucleotide microarray. *Journal of Virological Methods*, 45–50.

## Effect of SNP's on The Secondary Protein Structure of Insulin-Like Growth Factor-1 Gene In Long-Term Selected Japanese Quail

Kemal Karabağ<sup>a</sup>, Ayşe Alemlı<sup>b</sup>

<sup>a</sup>Akdeniz University, Faculty of Agriculture, Antalya/Turkey

<sup>b</sup>Akdeniz University, Graduate School of Natural and Applied Sciences, Antalya/ Turkey

### Abstract

In this study, secondary protein structure differences of Insulin-Like Growth Factor-1 (Igf-1) gene and identification of possible single nucleotide polymorphisms (SNP) were determined in totally 94 individuals from two Japanese quail genotypes (HBW, LBW), which were selected for 15 generations in reverse direction in terms of body weight, and one control quail genotype. Thus, 199 base were sequenced in Igf-1 gene and 5 SNPs were identified in IGF-1 sequence were detected. It can be said that there were important differences at Igf-1 gene coding sequences as a results of SNPs according to selection.

**Keywords:** *Insulin-Like Growth Factor-1 Gene, Japanese Quail, Selection, SNP*

### Uzun Dönem Seleksiyona Tabi Tutulmuş Japon Bildircinlarında Sekonder Protein Yapısı ve İnsülin Benzeri Büyüme Faktörü -1 Geni Arasındaki İlişkinin SNP'lere Etkisi

#### Özet

Bu araştırmada, 15 nesil boyunca canlı ağırlık bakımından seleksiyona tabi tutulmuş iki Japon bildircini genotipi (YCA, DCA) ve bir kontrol grubu olarak toplamda 94 bireyde sekonder protein yapısı ve insülin benzeri büyüme faktörü-1 (IGF -1) geni arasındaki ilişki ve olası tek nükleotid polimorfizmleri (SNP'leri) belirlenmiştir. Bu sayede, IGF -1 geninde 199 baz sekanslanmıştır ve IGF-1'de 5 SNP belirlenmiştir. Bu araştırmanın neticesinde IGF -1 geninin kodlayıcı sekanslarda önemli farklılıklar meydana getirdiği söylenebilir.

**Anahtar Kelimeler:** *İnsülin Benzeri Büyüme Faktörü-1, Japon Bildircin, Seleksiyon, SNP*

## Introduction

Japanese quails are one of the most improved breeds because of shorter generations than other poultry and the many other advantages of breeding. Also conventional breeding method is not selective in terms of undesirable properties. For these reasons; after the breeding for commercial genotypes with high meat and egg yield, it has been researched using molecular methods. Japanese quails have been selected in opposite directions along 15 generations selected in terms of body weight. As a result of this investigation IGF -1 gene was effective on the phenotypic characteristics in quail lines. It is intended to identify possible SNPs in the IGF -1 gene and to identify some economically important yields.

## Material Methods

Japanese quails (*Coturnix coturnix japonica*) were selected in opposite directions along 15 generations in terms of body weight and were not selected a group have been used as animal material.

RNA extraction was made by principle of homogenization of the tissue, disintegration of the cell wall, denaturation of the DNA-protein complex, inactivation of ribonucleases and removal of other molecules. Pcr amplification was performed by using 3 different primers for IGF -1 gene.

## Results

199 base at IGF -1 gene were sequenced and 5 SNPs at IGF -1 sequence were detected. It was observed that the SNPs detected did not alter the amino acid and secondary protein structure.

## Conclusion

In the context of this study it has been seen that long-term selection leads to both genotypic and phenotypic changes in poultry farm animals and significant changes in the genes that were studied.

## References

- ABBASI H.A. and KAZAMI M. (2011). Detection of Polymorphism of the Insulin-Like Growth Factor-I (IGF-I) Gene in Mazandaran Native Chicken Using PCR-RFLP Method. *African Journal of Biotechnology*. 10 (61): 13351-4.
- BAŞTÜRK E, Nodüler Guatr Oluşumunda İnsülin Benzeri Büyüme Faktörünün (IGF-1) Rolü. Uzmanlık Tezi. Dr. Lütfi Kırdar Kartal Eğitim ve Araştırma Hastanesi, İstanbul

- GE, W., DAVIS, M.E., HINES, H.C., IRVIN, K.M. and SIMMEN, C.M., (2003). Association of Single Nucleotide Polymorphisms in the Growth Hormone and Growth Hormone Receptor Genes with Serum Insulin-Like Growth Factor I Concentration and Growth Traits in Angus Cattle. *Journal of Animal Science*. 81: 641-8.
- KIM, M.H., SEO, D.S. and K.O., Y. (2004). Relationship Between Egg Productivity and Insulin-Like Growth Factor-I Genotypes in Korean Native Ojol Chickens. *Poultry Science*. 83: 1203-8.
- LEI, M.M., NIE, H.Q., PENG, X., ZHANG, D.X. and ZHANG, X.Q. (2005). Single Nucleotide Polymorphisms of the Chicken Insulin-Like Factor Binding Protein 2 Gene Associated with Chicken Growth and Carcass Traits. *Poultry Science*. 84: 1191-8.
- SATO, S., OHTAKE, T., UEMOTO, Y., OKUMURA, Y. and KOBAYASHI, E., (2012). Polymorphism of Insulin-Like Growth Factor 1 Gene is Associated with Breast Muscle Yields in Chickens. *Animal Science Journal*. 83: 1-6.
- WANG, W., OUYANG, K., OUYANG, J., LI, H., LIN, S. and SUN, H. (2004). Polymorphism of Insulin-like Growth Factor I Gene in Six Chicken Breeds and Its Relationship with Growth Traits. *Asian-Asian-Australasian Journal of Animal Sciences*. 17 (3): 301-4.

## Some Plumage Mutations of Japanese Quail Resulting from The Level of Inbreeding

Moise Noubandiguim<sup>a</sup>, Musa Sarica<sup>b</sup>

<sup>a</sup>Ondokuz Mayıs University, Faculty of Science and Letters, Department of Biology, Samsun, Turkey

<sup>b</sup>Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun, Turkey

### Abstract

Japanese quail is very susceptible to inbreeding depression because it increases homozygosity and exposes deleterious recessive mutations. Mutations have been further classified into plumage mutation, eggshell color and other much more. Plumage mutations have played an important role in breeding, production of quails and in research fields. The roux mutation, which can be used for auto-sexing at 1<sup>st</sup> day of age; the curly mutation, which is associated with increased growth performance; the imperfect albinism and silver have also been frequently utilized as biomedical animal models to elucidate the regulatory mechanisms for pigmentation.

**Key words:** *Inbreeding, Japanese Quail, Plumage Mutation*

### Bıldırcınlarda akrabalık düzeyinden kaynaklanan bazı tüy mutasyonları

#### Özet

Bıldırcınlar kan yakınlığı depresyonuna çok duyarlı olduğu için akrabalık düzeyi ile farklı mutasyonlar ortaya çıkabilmektedir. Mutasyonlar, tüy mutasyonları ve diğer mutasyonlar olarak kategorize edilmiştir. Tüy mutasyonları bıldırcın ıslahı, üretimi ve araştırma alanlarında önemli bir rol oynamaktadır. Günlük yaşta cinsiyet ayırımına imkân veren roux renk mutasyonu; artan büyüme performansı ile ilişkili olan kıvrıkcık mutasyon; eksik albinizm ve dominant gümüş renklilik, pigmentasyon ve düzenleyici mekanizmaları aydınlatmak için biyomedikal hayvan modelleri yaygın olarak kullanılmıştır.

**Anahtar kelimeler:** *Akrabalık düzeyi, Japon bıldırcını, Tüy mutasyonları*

## **Introduction**

Several aspects account for the utility of Japanese quail such as firstly, it has attained economic importance as an agricultural species producing eggs and meat and secondly, its small body size coupled with its short generation interval, resistance to diseases, rendered it an excellent laboratory animal. Japanese quail (*Coturnix Japonica*) are very susceptible to inbreeding depression, probably because of the heavy genetic load that they carry (Sittmann et al. 1966). Inbreeding depression term used to describe the reduction of genetic variation due to the increase in inbreeding levels. The level of inbreeding is simply how closely the relatives are related across the sire and dam lines. High level of inbreeding increases homozygosity and exposes deleterious recessive mutations carried by a population (Keller and Waller 2002). Mutation with major effect may play a disproportionate role in the evolution of high rates of inbreeding. Mutations have been categorized as morphological, behavioral or muscular and so on. Morphological mutations have been further classified into plumage color, plumage system, eggshell color and morphogenetic mutations. Therefore, in this article, we mostly review plumage color mutations and plumage system mutations of Japanese quail which are of interest both on biological standpoint; for comparative studies between avian species, and on zootechnical standpoint whereas for identifying commercial selection lines or crosses. This mutation may be used for commercial production as pure line or auto-sexing in cross breeding production systems with colored and wild plumage line.

## **Plumage Color Mutations**

In this study, only plumage color of quail a result of known mutations (extended brown, yellow, silver, Pansy, roux, Panda and imperfect albino) have been described. Here, also other mutations such as new color variant rusty and new feather structure phenotype (curly) not yet known at the molecular level have been also described. Shimakura (1940) reported that first plumage color mutation in Japanese quail, brown-splashed white, and recognized the advantages of using Japanese quail as a laboratory research animal. About 20 years later, Padgett and Ivey (1959) also again proposed the advantages of Japanese quail as a laboratory research animal. Since then, use of Japanese quail has become wide spread in the biomedical research fields. In the recent past, a special attention was given to the study of its plumage and several major genes have been described, linkage and epistasis relationships were explored and some genes were mapped and for tagging commercial quail lines with a visible plumage trait, like the fawn mutation or like the sex-linked roux mutation (Minvielle et al., 1999). However, the causative genes for mutant phenotypes of Japanese quail were unclear until the 20<sup>th</sup> century; most of the mutations were found in Japanese quail have been merely documented and described (Nakane and Tsudzuki, 1998;

Minvielle et al., 1999). The detection of causative genes mutant phenotypes has been reported after 2006. The rusty mutation is a new addition to the panel of plumage mutations available for comparative studies in poultry. It was developed in 2000 from a founding base (G0) made of a single rusty female bred to a wild-type male from another origin and it was followed by sib mating of the all wild-type G1 quail to produce G2 and G3 pedigreed progeny and selection of the few rusty G4 birds (Minvielle et al., 2005).

### **Plumage System Mutations**

The feather is an excellent model for evolution and development due to its complex structure and vast diversity. These structural traits of the feather can be inherent in the development of the feather. They can also be induced by materials that are placed on the feathers after development, which alter the absorption or reflection of light. Therefore, every detail in the feather structure, such as its shape and color must be determined by new instructions added to the genetic code. The information regarding all feathers physical structures lies hidden in DNA, as does the number of barbules, the distance between feathers and all of other details. However, the effects of natural selection and mutation, which the theory of evolution maintains are unconscious and random, cannot explain how the genetic information for such a perfect structure arose in a bird's DNA. For example, in some Japanese quails curly, fray, short barb and porcupine, feathers are available; while most Japanese quails have the wild-type normal feather structure. However, in this study, only new curly feather structure was described concerning the plumage system mutations. The curly feathers mutation was developed in 2001 from group mating 6 founding (G0) curly quail. Starting in G3, only quail for which the curly phenotype observed at 10 days of age expressed as most strongly were kept for breeding. The positive effect of the curly mutation increases body weight at 5 weeks of age (Minvielle et al., 2005).

### **Conclusion**

All plumage color mutations described only two have been localized on the Z chromosome, the imperfect albinism allelic series and the brown mutation in the Japanese quail (*Coturnix coturnix japonica*). From the point of view of possible use in agricultural fields (industrial) few mutations have also been investigated, such as the roux mutation, which can be used for auto-sexing at age of a day (Minvielle et al., 1999); the recessive white gene; the Dominant Lethal Yellow mutation; genetic analysis of brown plumage color in quail (Yilmaz and Caglayan, 2008); and genes determining yellow and dotted white plumage patterns in Japanese quails. In addition to these agricultural fields uses, the imperfect albinism, and silver have also been frequently utilized as biomedical animal models. The two new curly and rusty

mutations will enrich the small number of plumage mutations already available in Japanese quail for studying the genetics and the biology of feathers, research field with many perspectives.

### References

- KELLER, L. AND WALLER, D. (2002). Inbreeding effects in wild populations. *Trends in Ecology & Evolution*. 17 (5): 230–241.
- MINVIELLE, F., HIRIGOYEN, E. and BOULAY, M. (1999). Associated Effects of the Roux Plumage Color Mutation on Growth, Carcass Traits, Egg Production and Reproduction of Japanese Quail. *Poultry Science*. 78:1479–1484.
- MINVIELLE, F., KAYANG, B.B., INOUE-MURAYAMA, M., MIWA, M., VIGNAL, A., GOURICHON, D., NEAU, A., MONVOISIN, J.L., AND ITO, S. (2005). Microsatellite mapping of QTL affecting growth, feed consumption, egg production, tonic immobility and body temperature of Japanese quail. *BMC Genomics*. 6: 87.
- NAKANE, Y., TSUDZUKI, M. and CLENCH. (1998). A new autosomal recessive mutation in Japanese quail. *The Journal of Heredity*. 89: 347-348.
- SHIMAKURA, K. (1940). Notes on the genetics of the Japanese quail. The simple mendelian autosomal, recessive character, brown-splashed white, of its plumage. *The Japanese Journal of Genetics*. 16: 106-111.
- SITTMANN, K., ABPLANALP, B. AND FRASER, R.A. (1966). Inbreeding depression in Japanese quail. *Genetics*. 54: 371-379.
- YILMAZ, A. and ÇAĞLAYAN, T. (2008). Farklı tüy rengine sahip Japon bıldırcınlarında (*Coturnix coturnix japonica*) yumurta ağırlığı, şekil indeksi ve çıkım ağırlığı ile bu özellikler arası ilişkiler. *Fırat Üniversitesi Sağlık Bilimleri Veteriner Dergisi*. 22: 5-8

## Poultry Breeding from Past to Today

Kübra Melis Sabuncuoğlu<sup>a</sup>, Süleyman Baytur<sup>b</sup> Doğan Narinç<sup>c</sup>

<sup>a</sup>Department of Animal Science, Faculty of Agriculture, Namık Kemal University, Tekirdağ, 59100, Turkey;

<sup>b</sup>Department of Biotechnology, Faculty of Agriculture, Namık Kemal University, Tekirdağ, 59100, Turkey;

<sup>c</sup>Department of Genetics, Faculty of Veterinary Medicine, Namık Kemal University, Tekirdağ, 59100, Turkey

### Abstract

Chicken specie whose wild ancestor is Red Jungle Fowl has been domesticated thousands of years ago. Chickens have been transported for centuries to trade and hobby. As a result of adaptation to the environmental conditions in the continents, different breed lineages; egg-type, game, meat-type and Bantam have occurred. In the 19th century, breeders' associations were established in America and Europe, and these associations began to bring together the best animals according to their morphological characteristics. Thus, artificial selection studies have also begun. In the 20th century, the pedigree information and phenotype records were matched using invention of the trap nest. Genetic variation and breeding value were imparted thank to R. A. Fisher's studies in the first quarter of the 20th century and Henderson's studies in the middle of the century, thus, the genetic selection studies were started. For the first time, in the 1950s, the commercial genotypes were obtained by crossing selected lines. Quantitative trait loci (QTL) and genetic marker studies about major poultry species began in the 1980s. Studies of comparative genomic and candidate gene approaches for poultry have begun in the early 21st century. At the present time, a high density 600K single nucleotide polymorphism (SNP) genotyping array for chicken has been developed for genomic selection, genome-wide association studies, selection signature analyses, fine mapping of QTLs and detection of copy number variants. More than 99 percent of the commercial layers and broilers found in the market today are crosses of long term selected genetically inbred lines. There are few companies that sell commercial genotypes on the global market, and these companies use the latest technologies in poultry breeding. This study was aimed to review of the quantitative and molecular genetics methods introduced until now.

**Keywords:** *Poultry Breeding, Quantitative Genetic, Molecular Genetics, QTL, SNP*

## Dünden Bugüne Kanatlı Islahı

### Özet

Atası kırmızı orman tavuğu olan tavuk türü binlerce yıl önce evcilleştirilmiştir. Tavuklar yüzyıllar boyunca ticaret ve hobi amacıyla kıtalararası taşınmışlardır. Kıtalaradaki çevresel koşullarına adaptasyon sonucunda farklı ırklar meydana gelmiştir. 19. yüzyılda Amerika ve Avrupa'da yetiştirici dernekleri kurulmuş, ve bu dernekler morfolojik özelliklerine göre en iyi hayvanları bir araya getirmeye başlamıştır. Böylece suni seleksiyon çalışmaları da başlamıştır. 20. yüzyılda ise kapanlı follukların icadı ile akrabalık ilişkileri ve fenotipik kayıtlar eşleştirilmiştir. 20. yüzyılın ilk çeyreğinde R. A. Fisher'in çalışmaları ve yüzyılın ortalarında Henderson'un çalışmaları ile genetik varyasyon ve damızlık değer tahmin edilmiş, böylece genetik seleksiyon çalışmaları yapılmaya başlanmıştır. Ticari genotipler ilk kez 1950'lerde seleksiyon yapılmış hatların melezlenmesiyle elde edilmiştir. Major kanatlı türlerine ilişkin kantitatif özellik lokusları (QTL) ve genetik işaretleyici çalışmaları 1980'lerde başlamıştır. Kümes hayvanlarında karşılaştırmalı genomik ve aday gen yaklaşımlarına ilişkin araştırmalar 21. yüzyılın başlarında başlamıştır. Günümüzde, tavuk türü için genomik seleksiyon, genom boyu ilişkilendirme çalışmaları, işaret analizleri, QTL haritalanması ve varyantların saptanması için yüksek yoğunluklu 600K SNP genotiplendirme dizisi geliştirilmiştir. Bugün piyasada bulunan ticari yumurtacı ve etlik piliçlerin % 99'undan fazlası, uzun dönemli seleksiyon uygulanmış hatların melezleridir. Küresel pazarda ticari genotip satışı yapan az sayıda şirket vardır ve bu şirketler kanatlı ıslahı alanındaki son teknolojileri kullanmaktadır. Bu çalışmada bugüne kadar kullanılan kantitatif ve moleküler genetik yöntemlerin derlenmesi hedeflenmiştir.

**Anahtar kelimeler:** *Kanatlı Islahı, Kantitatif Genetik, Moleküler Genetik, QTL, SNP*

### Introduction

The adventure that started with the Red Jungle Fowl is continuing to obtain modern hybrids today, thanks to the success of the quantitative genetic theory and molecular genetics. Taking into account morphological characteristics, traders and hobbyists have created different breeds carrying intercontinental. Some of these breeds were the basis of today's industrial genotypes, such as White Leghorn, Rhode Island, Cornish and Plymouth Rock. More than 99 percent of the commercial layers and broilers found in the market today are crosses of long term selected genetically inbred lines (Muir and Aggrey, 2003). There are few companies that sell commercial

genotypes on the global market, and these companies use the latest technologies in poultry breeding. This study was aimed to review of the quantitative and molecular genetics methods introduced until now.

### **A Historical Perspective**

At the beginning of the 20th century, the relationship records began to be kept by way of the invention of trap nest. Thus, yield and morphological records and parent-offspring registers were brought together for the first time. The other milestone in poultry breeding was the development and application of the theory of quantitative genetics. Heritabilities for characteristics and genetic relationships between economic traits were estimated using pedigree information and yield records of animals. Thus, selection programs were created and successful selection studies were carried out according to breeding values. Thank to R. A. Fisher's studies in the first quarter of the 20th century and Henderson's studies in the middle of the 20th century, the genetic variation of phenotypic variation was explained and BLUP methodology for breeding value estimation was introduced, respectively (Wolc, 2015). Quantitative genetics theory regards the animal as a black box with many genes contributing to the expression of all traits that can be measured (Albers et al., 2006). General target on poultry breeding ranks the birds and breeding value plays key role on ranking the animals with the predicted values (Greonen et al., 1998). It is possible to mass selection by using the phenotypic value of an animal as a breeding value. But the phenotype is not a good predictor of genotype, especially if there is a character with low heritability. The black box has been started to open after the 1980s through the use of genetic markers in poultry breeding. The chicken QTL database has been summarized on the National Animal Genome Research Program (NAGRP) website (<http://www.animalgenome.org/cgi-bin/QTLdb>). This organization has been gathering chicken QTL data published during the past 10 years. Currently, this database contains 8363 QTLs from 277 publications over the world and these data represent 383 different chicken traits. However, QTLs express major genes and many genes have influences on economic characteristics could not have commercial important (Albers et al., 2006). Then the researchers have focused to the candidate gene approach which is also called gene hunting, in this approach the sequence variation is investigated by using the previous information. At the beginning of the 21st century, 24000 genes in chicken genome obtained by the candidate gene approach were predicted within the scope of the project of International Chicken Genome Sequencing Consortium. Then the adventure turned to the beginning, and DNA of the Red Jungle Fowl and contemporary offspring's DNA of the Red Jungle Fowl has been compared for single nucleotide polymorphisms (Wolc et al., 2011). At the present time, a high density 600K single nucleotide polymorphism

(SNP) genotyping array for chicken has been developed for genomic selection, genome-wide association studies, selection signature analyses, fine mapping of QTLs and detection of copy number variants.

### **Global Market**

Today 92% of the world's broiler and layer production is controlled by the industry. Primary breeder companies keep its inbred pure lines, and send the parents to multipliers, providing only male chicken of the sire line and female chicken of the dam line to exclude possibility of breeding by the multipliers. Worldwide sales companies and trademarks are Erich Wesjohann Group (world market leader in poultry genetics; white egg layers, broilers and turkeys, its trademarks are Hy-Line, Aviagen and Lohmann Tierzucht products), Grimaud Group (second in avian genetics; its trademark is Hubbard), Tyson Food (World's largest processor of chicken and red meat; its trademark is Cobb-Vantress), Hendrix Genetics (world's first in brown egg layers, second in turkey, fourth in broilers its trademarks are Isa, Hybrid, Hybro).

### **Conclusion**

Levels of livability, growth performance, feed efficiency, and carcass yield have never been better for broilers, and the same is true for livability, laying performance, and feed efficiency for layers. Despite a reduction in genetic diversity and some anxieties of activist groups and consumers about poultry welfare, there will always be a way to get better for poultry breeding.

### **References**

- ALBERS, G.A.A., RATTINK, A.P. and VEREIJKEN, A.L.J. (2006). The future of molecular genetics in poultry breeding. XII. European Poultry Conference, Verona, Italy.
- GROENEN, M.A.M., CROOIJMANS, R.P.M.A., VEENENDAAL, A., CHENG, H.H., SIWEK, M. and VAN DER POEL, J.J. (1998). A comprehensive microsatellite linkage map of the chicken genome. *Genomics* 49: 265-274.
- INTERNATIONAL CHICKEN GENOME CONSORTIUM (2004a). Sequence and comparative analysis of the chicken genome provide unique perspectives on vertebrate evolution. *Nature* 432: 695-716.
- INTERNATIONAL CHICKEN GENOME CONSORTIUM (2004b). A genetic variation map for chicken with 2.8 million single-nucleotide polymorphisms. *Nature* 432: 717-722.
- MUIR, W.M., AGGREY, S.E. (2003). *Poultry Genetics, Breeding and Biotechnology*. CABI Publishing, CAB International, Wallingford, ISBN: 0851996604.

- WOLC, A., STRICKER, C., ARANGO, J., SETTAR, P., FULTON, J.E., O'SULLIVAN, N.P., PREISINGER, R., HABIER, D., FERNANDO, R., GARRICK, D.J., LAMONT, S.J., DEKKERS, J.C. (2011). Breeding value prediction for production traits in layers using pedigree and marker based methods. *Genetics Selection Evolution* 43:5.
- WOLC, A. (2015). Genomic selection in layer and broiler breeding. *Lohmann Information*, 49: 1-10.

## Bioinformatics and Sequence Alignment: An Example Calpain Gene in Japanese Quails (*Coturnix coturnix japonica*)

Raziye Işık<sup>a</sup>, Hasan Hüseyin İpçak<sup>b</sup>

<sup>a</sup>Namık Kemal University, Faculty of Agriculture, Department of Agricultural Biotechnology  
Tekirdağ, Turkey

<sup>b</sup>Ege University, Faculty of Agriculture, Department of Animal Science, İzmir, Turkey

### Abstract

Calpain is a precious gene that have consistent effects on meat quality and tenderness. But, studies on the effects of that gene on meat quality and carcass composition in quails are very limited. Because nucleotide sequence of Calpain gene are not identified at The International Nucleotide Sequence Databases (NCBI, EMBL, DDBJ). The aim of this study is to identify the calpain gene of Japanese quails by using bioinformatics tools (International Nucleotide Sequence Databases). Bioinformatics is a tool in order to identify genes that encode functional proteins and to develop methods for storing, organizing and analyzing biological outputs. Besides, it helps of the understanding of gene regulation and metabolic pathway reconstruction.

**Key words:** *Bioinformatics, Calpain Gene, Japanese Quails*

## Biyoinformatik ve Sekans Hizalama: Japon Bildircinlarında (*Coturnix coturnix japonica*) Kalpain Geni Örneği

### Özet

Kalpain et kalitesi ve lezzetinin devamlılığı açısından çok önemli bir genidir. Fakat bildircinlarda bu genin et kalitesi ve karkas kompozisyonu üzerine etkileri ile ilgili çalışmalar sınırlı düzeydedir. Çünkü Uluslararası Nükleotid Sekans Veritabanlarında (NCBI, EMBL, DDBJ) kalpain geni tanımlanmamıştır. Bu çalışmanın amacı bildircin kalpain geninin biyoinformatik araçlar yardımıyla tanımlanmasıdır. Biyoinformatik; fonksiyonel proteinleri kodlayan genleri tanımlamada, biyolojik çıktıları depolamada, organize ve analiz etme ile yöntemler geliştirmede kullanılan bir araçtır. Ayrıca, gen düzenlenmesi ve metabolik yolların anlaşılmasına da yardımcı olur.

**Anahtar kelimeler:** *Biyoinformatik, Kalpain Geni, Japon Bildircini*

## Introduction

Bioinformatics is an important application area that develops methods for storing organizing and analyzing biological outputs with helps of semantic web technologies and accessible in different formats. The advances in bioinformatics have in turn made considerable impact on the development and improvements of genomics technologies and structure resources, containing data on protein structures and derived data, pathway and interaction resources, containing information on metabolic pathways, gene expression resources, containing information on microarray and other experiments (Rehm, 2001).

An enormous amount of DNA sequence data is available and even more will be forthcoming in the near future in different databases (NCBI, EMBL, DDBJ). One of this is National Center for Biotechnology Information (NCBI), which is branch of National Library of Medicine (NLM), which is branch of National Institutes of Health (NIH), maintains *GenBank*, a worldwide repository of genetic sequence data (all publicly available DNA sequences). NCBI release incorporates genomic, transcript, and protein data available, as of January 8, 2018 and contains 149,493,466 records, including 102,133,844 proteins, 21,370,778 RNAs and sequences from 75,218 organisms. The number of sequence is increasing every year in NCBI.

## Sequence Alignment: An Example Calpain Gene in Japanese Quails

Sequence information is analyzed to determine genes that encode polypeptides (proteins), RNA genes, regulatory sequences, introns and repetitive sequences. Comparison of sequences can show similarities between sequences or protein functions between species. This similarity is called homology of sequences. For find this similarity generally using BLAST: Basic Local Alignment Search Tool, is an algorithm for comparing primary biological sequence information, such as the amino acid sequences of different proteins or the nucleotides of DNA sequences. Using BLAST, it is possible for scientists to accurately identify a species or find homologous species or sequences among the species (Ogbe et al, 2016).



**Gallus gallus calpain mRNA, complete cds**  
GenBank: EF507731.1  
[FASTA](#) [Graphics](#)  
[Go to:](#)

LOCUS	EF507731	2118 bp	mRNA	linear	VRT 24-APR-2007
DEFINITION	Gallus gallus calpain mRNA, complete cds.				
ACCESSION	EF507731				
VERSION	EF507731.1				
KEYWORDS	.				
SOURCE	Gallus gallus (chicken)				
ORGANISM	<a href="#">Gallus gallus</a> Eukaryota; Metazoa; Chordata; Craniata; Vertebrata; Euteleostomi; Archelosauria; Archosauria; Dinosauria; Saurischia; Theropoda; Coelurosauria; Aves; Neognathae; Galloanserae; Galliformes; Phasianidae; Phasianinae; Gallus.				
REFERENCE	1 (bases 1 to 2118)				

Figure 1. Identification of Calpain gene by bioinformatic tools with helps of

homology



**BLAST** >> blastn suite

blastn | blastp | blastx | tblastn | tblastx

Enter Query Sequence

Enter accession number(s), gi(s), or FASTA sequence(s)  [Clear](#) [Query subrange](#)

From  To

Or, upload file  Dosya seçilmedi

Job Title  Enter a descriptive title for your BLAST search

Align two or more sequences

Choose Search Set

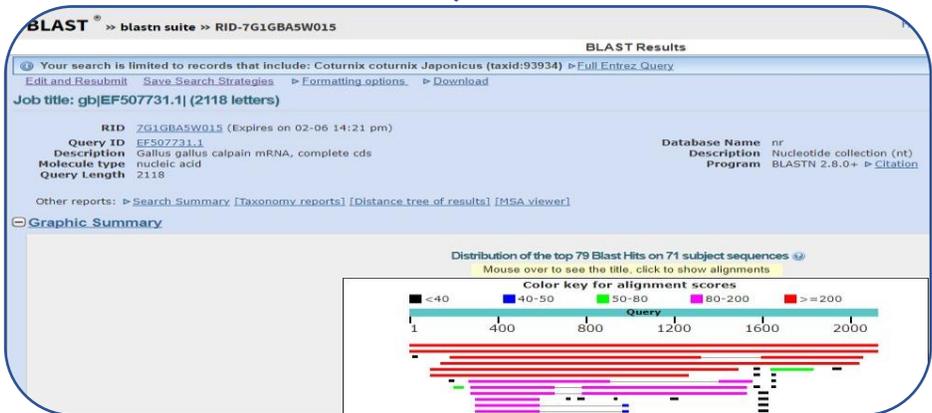
Database  Human genomic + transcript  Mouse genomic + transcript  Others (nr etc.):  
[Nucleotide collection (nr/nt)]

Organism   Exclude   
Enter organism common name, binomial, or tax id. Only 20 top taxa will be shown

Exclude  Models (XM/XP)  Uncultured/environmental sample sequences

Limit to  Sequences from type material

Entrez Query  [You like](#) [Create custom database](#)



Download [GenBank](#) [Graphics](#)

PREDICTED: Coturnix japonica calpain 11 (CAPN11), transcript variant X2, mRNA  
Sequence ID: XM\_015857689.1 Length: 3379 Number of Matches: 1

Range 1: 38 to 2155 [GenBank](#) [Graphics](#) [Next Match](#) [Previous](#)

Score	Expect	Identities	Gaps	Strand
3469 bits(3846)	0.0	2040/2118(96%)	0/2118(0%)	Plus/Plus
Query 1		ATGATGCCCTTTGGGGGGATCGCTGCCCGGGCTGCAGAGGGACCGCCCTGAGAGCCGAGGGG		60
Sbjct 38		ATGATGCCCTTTGGAGGGATCGCTGCCCGGGCTGCAGAGGGACCGCCCTGAGAGCAGAGGGG		97
Query 61		GTCGCGAGCACAAACACGCTGTCAAGTACCTCAACAGGACTATGAAGCCCTCAAGCAA		120
Sbjct 98		GTTGGCAGACAAACACGCTGTCAAGTACCTCAACAGGACTATGAGGCCCTCAAGCAA		157
Query 121		GAGTGCATCGAAGTGGCACCCCTCTCAGGGACCCCGAGTCCAGCTGGCCCCACTGCC		180
Sbjct 158		GCSTGCATTTGAAAGCGGTGCCCTCTCAGGGACCCCGAGTCCAGCTGGTCTACTGCCC		217
Query 181		CTCGGCTTCAAGGAGCTGGGGCCATACTCCAGCAAGACACGGGGCGTGGAGTGGAAAGCGT		240
Sbjct 218		CTTGGCTTCAAGGAGCTGGGGCCACACTCCAGCAAGACACGGGGCGTAGAGTGGAAAGCGT		277
Query 241		CCATCGGAATTAGTGGATGACCCCTCAGTTTCATCGTTGGTGGTGC AACCCGGACAGATATC		300
Sbjct 278		CCATCGGAATTAGTGGATGACCCCTCAGTTTCATTGTTGGTGGTGC AACCCGGACAGATATC		337
Query 301		TGCCAAGGAGCTCTGGGTGACTGCTGGCTGCTGGCTGCCATCGGCTCCCTCACTCTCAAC		360
Sbjct 338		TGCCAGGAGCTCTGGGTGACTGCTGGCTGCTGGCTGCCATTTGGCTCCCTCACTCTCAAC		397
Query 361		GAGGAACTCCGACCCGTGTGGTGCACCCACGGGACAGAGCTTCCAGAGGACTACGCTGGC		420
Sbjct 398		GAGGAACTCCGACCCGTGTGGTGCACCCACGGGACAGAGCTTCCAGGAGGACTACGCTGGC		457

Sequence alignment is remarkably useful method for finding the sequence of an unknown gene. If sequence similarity to one or more database sequences, whose function is already known, these sequences may be homologous. Supposing that the protein sequence is more than 25-30% identical, the sequences are homologous (Rost et al. 1997).

Classical breeding methods are not effective in increasing meat quality of in breeding animals. And progeny test is slow, expensive and generally impractical (Dikeman, 1994). On the other hand, the candidate gene approach is a powerful method used to increase the rate of genetic progress in meat quality characteristics (Zhang et al., 2008). Nowadays, various DNA polymorphisms have been determined as potential selection tools for increase meat quality because some of molecular methods have allow the genotyping of birds at any age and sex for genes related to meat quality and tenderness. Calpain and calpastatin are two genes that are related with meat quality and tenderness (Barendse, 2002; White et al., 2008). It is shown an example about calpain gene in Japanese quails (Figure 1).

If calpain gene sequence for chicken is available on databases,

- Check the complete cDNA in chicken nucleotide database,
- Blast the complete cDNA for finding the sequence in Japanese quails whole genome (if complete cDNA is available),
- Results of the blast, if it is available you can see the options,
- Check that which is the sequence that you search

There is a lot of calpain gene sequences in NCBI database. Henceforward, it is easy to design a primer for any sequence.

## Conclusion

Bioinformatics is a particularly promising area for sequence-based resources, containing DNA and protein sequences and genome sequencing, ontologies are commonly used to assembly and annotations which have several applications in agriculture, pharmaceuticals, biotechnology, research etc. Progress in the field of molecular biology and genetics have allowed the genetic structure of populations and quantitative trait loci (QTL) to be determined. Thus, researchers can have identified remarkable amount of species easily and it will increase in the future.

## References

- BARENDSE, W. (2002). DNA markers for meat tenderness. Patent WO02064820. Bastos, pp. 1–88.
- DIKEMAN, M.E. (1994). Genetics of meat quality. Proceedings of the 5th World Conference on Genetics Applied to Livestock Production, Vol. 19, pp. 437–438.

- WHITE, S.N., CASAS, E., WHEELER, T.L., SHACKELFORD, S.D., KOOHMARAIE, M., RILEY, D.G., CHASE, J.R.C.C., JOHNSON, D.D., KEELE, J.W. and SMITH, T.P.L. (2008). A new single nucleotide polymorphism in CAPN1 extends the current tenderness marker test to include cattle of *Bos indicus*, *Bos taurus*, and crossbred descent. *Journal of Animal Science*, 83: 2001–2008.
- OGBE, R.J., DICKSON, O.O. and OLUMIDE, B.O. (2016). Bioinformatics Advances in Genomics – A Review. *International Journal of Current Pharmaceutical Review and Research. Int J Cur Res Rev.*, 8 (10): 5-11.
- REHM, B. H. A. (2001). Bioinformatic tools for DNA/protein sequence analysis, functional assignment of genes and protein classification *Appl Microbiol Biotechnol*, 57:579–592
- ZHANG, Z.R., LIU, Y.P., JIANG, X., DU, H.R. and ZHU, O. (2008). Study on association of single nucleotide polymorphism of CAPN1 gene with muscle fibre and carcass traits in quality chicken populations. *Journal of Animal Breeding and Genetics*, 125: 258–264.

## **New Approaches in Poultry Production: Candidate Genes Related with Growth and Meat Quality in Japanese Quails**

**Raziye Işık**

Namık Kemal University, Faculty of Agriculture, Department of Agricultural Biotechnology  
Tekirdağ, Turkey

### **Abstract**

Poultry meat production is the second largest sector after the pork production in the world. Selection studies and growth rate and increase in carcass yield have resulted in high meat yield with less feed intake and chicken meat is preferred instead of red meat which is thought to cause various health problems. Quality of meat is a subject that is being studied extensively by researchers, especially in consumer countries in developed countries. Many advances in molecular biology, genetics and biotechnology have identified very limited candidate genes that influence meat quality and growth in poultry. Some of the candidate genes for growth and meat quality are insulin-like growth factor (IGF), calpain 1 (CAPN1), insulin-like growth factor 1 receptor (IGF1R), IGF binding protein (IGFBP)-2,5. The candidate gene is a chromosome region that choose genes from a biochemical pathway known to be involved in QTL or that contain enrolees in which mutations exist that affect the phenotype of interest. In this review, studies on quantitative traits related to meat quality and growth in quails were carried out by candidate gene approach.

**Key Words:** *Candidate genes, meat quality, japanese quails*

## **Kanatlı Üretiminde Yeni Yaklaşımlar: Bildiricilerde Büyüme ve Et Kalitesi ile İlgili Aday Genler**

### **Özet**

Kanatlı eti üretimi, dünyada domuz etinden sonra üreticiliği yapılan en büyük ikinci üretim dalıdır. Seleksiyon çalışmaları ile büyüme hızı ve karkas veriminde sağlanan artışlar, az yem girdisiyle yüksek et verimi sağlarken, çeşitli sağlık sorunlarına yol açtığı düşünülen kırmızı etin yerine kanatlı eti tercih edilmiştir. Et kalitesi, özellikle gelişmiş ülkelerde tüketici talepleri nedeniyle araştırmacılar tarafından üzerinde yoğun olarak çalışılan bir konudur. Moleküler biyoloji, genetik ve biyoteknoloji alanlarındaki gelişmeler ile kanatlılarda et kalitesi ve büyüme üzerine etkili sınırlı sayıda aday gen belirlenmiştir. Büyüme ve et kalitesi ile ilgili bu aday genlerden

bazıları; insulin benzeri büyüme faktör (IGF), kalpain 1 (CAPN1), insulin benzeri büyüme faktör 1 reseptör (IGF1R), IGF bağlanma protein (IGFBP)-2,5 genleridir. Aday gen, QTL olduğu bilinen veya ilgili fenotipi etkileyen mutasyonların bulunduğu üyeleri içeren bir biyokimyasal yoldan genleri seçen bir kromozom bölgesidir. Bu çalışmada, bıldırcınlarda et kalitesi ve büyüme ile ilgili kantitatif özellik lokuslarının aday gen yaklaşımı ile belirlendiği çalışmalar derlenmiştir.

***Anahtar Kelimeler:** Aday genler, et kalitesi, Japon bıldırcını*

### **Introduction**

Parallel to the developments in the science of molecular biology, research in animal genetics and biotechnology has provided the elucidation of the molecular mechanisms of complex quantitative traits such as yield and quality of poultry production. There are two main approaches to determining quantitative traits and genes. The first of these genome wide association approach when there is no functional, physiological or biologic information about quantitative traits to identify the genes of interest (Davis ve Denise, 1998). Genome wide association is that quantitative trait locus is determined by the polymorphic markers of the genetic structure of the chromosomes and to analyze phenotypic and genetic information by means of statistical methods (Sonstegard et al., 2001). The other approach is candidate gene approach using physiological and biological knowledge and phenotypic data related to the trait studied. The candidate gene is a chromosome region that choose genes from a biochemical pathway known to be involved in QTL or that contain enrollees in which mutations exist that affect the phenotype of interest. Candidate gene approach is widely used in gene-disease research, gene association analysis and biomarker research. Genetic progress in selection is quite difficult, as meat quality is a property that is affected by several gene. In animal breeding, marker assisted selection (MAS) studies have been initiated using polymorphic locus information to provide faster genetic progression in the developmental light of selection methods (Mitra et al, 1999). In this review, studies on quantitative traits related to meat quality and growth in quails were carried out by candidate gene approaches.

### **Important Candidate Genes in Poultry Production**

Poultry meat production is the second largest production area in the world. The possible use of MAS in poultry breeding, determination of the quantitative traits responsible for the relevant feature, determination of the genotypes of the animals in the populations in which the genes and markers associated with the quantitative trait loci are present, and concurrent analysis of the phenotypic and genotypic data for the estimation of the breeding

value. For this reason detected several candidate gene in Japanese quail. Fu et al, (2001) investigated that differential regulation of IGFBP-2 and IGFBP-5 gene expression by vitamin A status in Japanese quail. Researchers investigate the effects of vitamin A status on IGF binding protein (IGFBP)-2 and -5 gene expression to viewed the involvement of the insulin-like growth factor (IGF) system in vitamin A (VA)-supported growth in Japanese quail. The result of study show that gene expression of some IGFBPs in vivo are under the control of vitamin A status and suggest a possible involvement of the IGF system in mediating the physiological actions of vitamin A in the growth of Japanese quail. Iranmanesh et al. (2016), was conducted to map quantitative trait loci (QTL) affecting live weight in Japanese quail as an animal model in biological studies and also a commercial bird for eggs and meat production. The results of this study, point out to candidate DNA regions affecting live weight, a trait of great economic relevance to the Japanese quail breeding. Moe et al. (2007), performed single nucleotide polymorphism (SNP) detection in the Japanese quail insulin-like growth factor 1 receptor (IGF1R) coding region and an association study between SNPs and body weight in two lines (SS and LL) selected for large and small body. The result of this study that is significant effect of the SNP genotype was found on 10-week body weight ( $P < 0.01$ ) and on 4- to 10-week and 6- to 10-week average daily gain ( $P < 0.05$ ) in the F2 family obtained from lines LL and SS. Rasouli et al. (2013), were investigated the polymorphisms in two regions of the calpain 1 (CAPN1) gene and their association with breast and thigh meat quality in Japanese quail (ultimate pH (pHu), lightness, redness, yellowness, drip loss, thawing-cooking loss, water holding capacity and shear force, SF). They point out that genotypes of the CAPN1 gene in the first region (217-bp) analyzed were significantly associated with yellowness and SF. One of genotype showed significantly higher yellowness and lower shear force than the other genotypes. Genotypes of the second region of the gene (intron 4, 800-bp) were significantly associated with pHu, redness and SF of the breast meat. The one of genotype showed significantly lower pHu and redness and higher SF (lower tenderness) than other genotypes. Thus, results on polymorphisms of the CAPN1 gene will eventually provide useful information for increasing meat quality of Japanese quail through marker-assisted selection.

## **Conclusion**

The production of poultry meat can be increased by meeting the requirement of animal protein in Turkey. Increasing consumption of poultry meat in comparison to consumption of red meat, and consequently increased production, have led to new developments in the quality criteria of poultry meat. According to consumer preferences, studies on poultry animals are

predicted to improve meat quality. Efforts to identify candidate genes and markers related to meat quality are increasing day by day. It is estimated that candidate gene and marker studies related to meat quality can also be used in the final MAS poultry breeding.

### References

- DAVIS, GP. and DENISE, S.K. (1998). The impact of genetic markers on selection. *J Anim Sci.* 76: 2331-2339.
- SONSTEGARD, T.S., VAN TASSEL, C.P. and ASHWELL, M.S. (2001). Dairy cattle genomics: Tools to accelerate genetic improvement. *J Anim Sci*; 79: 307-315.
- MİTRA, A., YADA, V.B.R. and NAZİR, A. (1999). Molecular markers and their applications in livestock improvement. *Cur Sci*; 77: 1045-1053.
- FU, Z., NOGUCHI, T. and KATO, H. (2001). Differential regulation of IGFBP-2 and IGFBP-5 gene expression by vitamin A status in Japanese quail. *Am J Physiol Endocrinol Metab* 281: E138-E146.
- IRANMANESH, M., ESMAILIZADEH, A., MOHAMMAD ABADI, M.R., ELMİRA ZAND, M., MOKHTARI, S. and WU, D. (2016). A molecular genome scan to identify DNA segments associated with live weight in Japanese quail. *Mol Biol Rep.* 43:1267-1272.
- RASOULI, Z., ZEREHDARAN, S., AZARI, M.A. and SHARGH, M.S. (2013). Genetic polymorphism of the CAPN1 gene is associated with meat quality traits in Japanese quail *British Poultry Science.* 54 (2): 171-175.

## Effect of SNP's on The Secondary Protein Structure of Ghrelin Gene In Long-Term Selected Japanese Quail

Kemal Karabağ<sup>a</sup>, Emel Tüten Sevim<sup>b</sup>, Berkant İsmail Yıldız<sup>b</sup>,  
Emine Toparlan<sup>b</sup>

<sup>a</sup>Akdeniz University, Faculty of Agriculture, Antalya/Turkey

<sup>b</sup>Akdeniz University, Graduate School of Natural and Applied Sciences, Antalya/ Turkey

### Abstract

In this study, secondary protein structure differences of Ghrelin (Ghrl) gene and identification of possible single nucleotide polymorphisms (SNP) were determined in 94 individuals from two Japanese quail genotypes (HBW, LBW), which were selected for 15 generations in reverse direction in terms of body weight, and one control quail genotype. Thus, 313 base at Ghrl gene were sequenced and 6 SNP at Ghrl sequence were detected. It can be said that it has occurred important differences at Ghrl gene coding sequences as a result of SNPs according to selection.

**Keywords:** *Ghrelin, Japanese Quail, Protein Structure, Selection, SNP*

### Uzun Dönem Selekte Edilmiş Japon Bildircinlarında Ghrelin Geninin Sekonder Protein Yapısına SNP'lerin Etkisi

#### Özet

Bu çalışmada, bir kontrol grubu ve canlı ağırlık açısından zıt yönde 15 generasyon selekte edilmiş iki Japon Bildircin genotibinden (YCA, DCA) 94 kişi de Ghrelin (Ghrl) geninin sekonder protein yapısındaki farklılıklar ve muhtemel tek nükleotid polimorfizmleri (SNP) belirlenmiştir. Böylece, Ghrl geninde 313 baz sekanslanmış ve sekansta 6 SNP tespit edilmiştir. SNP'lerin sonucu olarak seleksiyona göre Ghrl geni kodlayan dizilerde önemli farklılıklar oluşturduğu söylenebilir.

**Anahtar Kelimeler:** *Ghrelin, Japon Bildircini, Protein Yapısı, Seleksiyon, SNP*

#### Introduction

Japanese quail is one of the economically important species of poultry. As a result of breeding studies, commercial genotypes with high meat and egg yield were developed. However, undesirable genes can be selected together with the genes expressing the desired characteristics in the studies carried

out with the classical breeding methods. For this reason, Japanese quails need to be investigated by using molecular methods.

Nowadays, molecular genetics develops very fast in terms of method and technology. These developments allow to investigate the identification of genetic variation in various loci and the relationships between yield characteristics. In this context; it was thought that the Ghrelin gene was effective on the phenotypic characteristics in quail lines that were selected in opposite directions along 15 generations in terms of body weight. It is aimed to identify of possible SNPs in the Ghrelin gene and identify relationship with some yields that are economically important.

### **Materials and Methods**

Japanese quails (*Coturnix coturnix japonica*) that were selected in opposite directions along 15 generations in terms of body weight and were not selected a group have been used as animal material.

RNA extraction was made by principle of homogenization of the tissue, disintegration of the cell wall, denaturation of the DNA-protein complex, inactivation of ribonucleases and removal of other molecules. Pcr amplification was performed by using 3 different primers for Ghrelin gene.

### **Results**

313 base at Ghrelin gene were sequenced and 6 SNPs at Ghrelin sequence were detected. It was observed that the SNPs detected did not alter the amino acid and secondary protein structure.

### **Conclusion**

In conclusion, it has been seen that long-term selection leads to both genotypic and phenotypic changes in poultry farm animals and significant changes in the genes that were studied.

### **References**

- BEDNAREK, M.A., FEIGHNER, S.D., PONG, S.S., MCKEE, K.K., HRENIUK, D.L., SILVA, M.V., WARREN, V.A., HAWARD, A.D., VAN DER PLOEG, L.H. and HECK J.V. (2000). Structure-Function Studies on the New Growth Hormone-Releasing Peptide, Ghrelin: Minimal Sequence of Ghrelin Necessary for Activation of Growth Hormonesecretagogue Receptor. *Journal of Medical Chemistry*. 43: 4370-76.
- BAGNASCO, M., DUBE, M.G., KALRA, P.S. and KALRA, S.P. (2002). Evidence for the Existence of Distinct Central Appetite, Energy Expenditure, and Ghrelin Stimulation Pathways As Revealed by Hypothalamic Site-Specific Leptin Gene Therapy, *Endocrinology*. 143: 4409-21.

- CUMMINGS, D.E., PURNELL, J.Q., FRAYO, R.S., SCHMÍDOVA, K., WISSE, B.E. and WEIGLE, D.S., (2001). A Preprandial Rise in Plasma Ghrelin Levels Suggests a Role in Meal Initiation in Humans, *Diabetes*. 50 (8): 1714-9.
- GEELISSEN, S.M., SWENNEN, Q., GEYTEN, S.V., KUHN, E.R., KAIYA, H., KANGAWA, K., DECUYPERE, E., BUYSE, J. and DARRAS, V.M. (2006). Peripheral Ghrelin Reduces Food Intake and Respiratory Quotient in Chicken, *Domestic Animal Endocrinology*. 30: 108-16.
- KAIYA H., DARRAS V.M. and KANGAWA, K. (2007). Ghrelin in Birds: Its Structure, Distribution and Function, *The Journal of Poultry Science*. 44: 1-18,
- LIN, Y., MATSUMURA, K., FUKUHARA, M., KAGIYAMA, S., FUJII, K. and IIDA M. (2004). Ghrelin Acts at the Nucleus of the Solitary Tract to Decrease Arterial Pressure in Rats, *Hypertension*, 43 (5): 977-82.
- MATSUMOTO, M., KITAJIMA, Y., IWANAMI, T., HAYASHI, Y., TANAKA, S., MINAMITAKE, Y., HOSODA, H., KOJIMA, M., MATSUO, H. and KANGAWA, K. (2001). Structural Similarity of Ghrelin Derivatives to Peptidyl Growth Hormone Secretagogues, *Biochemical and Biophysical Research Communications*, 284, 655-9.
- MUNDINGER, T.O., CUMMINGS, D.E. and TABORSKY, G.J. (2006). Direct Stimulation of Ghrelin Secretion by Sympathetic Nerves. *Endocrinology*. 147: 2893-2901.
- NIE, Q., ZENG, H., LEI, M., ISHAG, N.A., FANG, M., SUN, B., YAN, G. and ZHANG, X. (2004). Genomic Organisation of the Chicken Ghrelin Gene and Its Single Nucleotide Polymorphisms Detected by Denaturing High-Performance Liquid Chromatography, *British Poultry Science*, 45 (5): 611-8.
- RICHARDS, M.P., POCH, S.M. and MCMURTRY, J.P. (2006). Characterization of Turkey and Chicken Ghrelin Genes, and Regulation of Ghrelin and Ghrelin Receptor mRNA Levels in Broiler Chickens, *General and Comparative Endocrinology*. 145: 298-310.
- SHOUSA, S., NAKAHARA, K., KOJIMA, M., MIYAZATO, M., HOSODA, H., KANGAWA, K. and MURAKAMI, N. (2005). Different Effects of Peripheral and Central Ghrelin on Regulation of Food Intake in the Japanese Quail. *General and Comparative Endocrinology*. 141: 178-83.
- SUGINO, T., HASEGAWA, Y., KUROSE, Y., KOJIMA, M., KANGAWA, K. and TERASHIMA, Y. (2004). Effects of Ghrelin on Food Intake and Neuroendocrine Function in Sheep. *Animal Reproduction Science*, 82-83: 183-94.
- TSCHOP, M., SMILEY, D.L. and HEIMAN, M.L. (2000). Ghrelin induces adiposity in rodents. *Nature* 407: 6806, 908-13.

# POSTER PRESENTATIONS

## **SESSION 6 INCUBATION**

## Effect of Monochromatic Light Stimuli during Embryogenesis on Hatch Time

Kübra Melis Sabuncuoğlu<sup>a</sup>, Doğan Nariç<sup>b</sup>, Firdevs Korkmaz<sup>a</sup>,  
Hasan Ersin Şamlı<sup>a</sup>

<sup>a</sup>Department of Animal Science, Faculty of Agriculture, Namık Kemal University, Tekirdağ, 59100, Turkey

<sup>b</sup>Department of Genetics, Faculty of Veterinary Medicine, Namık Kemal University, Tekirdağ, 59100, Turkey

### Abstract

Lighting has moliminous task for galliformes and the subjects of intensity, source, period, and wavelength have been discoursed in the studies carried out for many years. Major studies on monochromatic lighting with LED lamps at different wavelengths have been performed in the recent years. This study aimed to reveal the effects of providing Japanese quail eggs with the dark, green and blue monochromatic lighting throughout the entire incubation period on hatch time. As a result, there is no statistical difference in hatch time was observed ( $P>0.05$ ) among the treatment groups.

**Keywords:** LED, Hatch time, Monochromatic lighting, Quail

### Özet

Aydınlatma, kanatlı hayvanlar için büyük bir öneme sahiptir ve ışığın yoğunluğu, kaynağı, süresi ve dalga boyu konuları uzun yıllar süren çalışmalarda tartışılmıştır. Farklı dalga boylarındaki LED lambalar ile monokromatik aydınlatma üzerine yapılan başlıca çalışmalar son yıllarda gerçekleştirilmiştir. Bu çalışma Japon bildircin yumurtalarına tüm inkübasyon süresince sağlanan karanlık, yeşil ve mavi monokromatik aydınlatma uygulamasının embriyonik ölüm ve kuluçka süresine etkilerini ortaya koymayı amaçlamıştır. Sonuç olarak gruplar arasında kuluçka süresi bakımından istatistiksel olarak bir fark görülmemiştir ( $P>0.05$ ).

**Anahtar kelimeler:** LED, Kuluçka Süresi, Monokromatik Aydınlatma, Bildircin

### Introduction

The hatching eggs are usually incubated in the dark setting in most hatcheries. Uncommonly some lighting equipments are used in incubators. There are some studies on the effects of lighting during incubation on embryonic development, hatchability, and post-hatch performance. Most

scientists assessed that the conventional lighting during incubation has increased the weight of embryos (Cooper, 1972). There are also assertions that the exposure conventional lighting during embryogenesis positively affects hatchability and shortens the incubation period, it have identified that some conventional lighting equipments emit additional heat into the incubator (Rosenboim et al. 2003). The light-emitting diode lamp that does not emit ambient heat and can use different light wavelengths has recently been preferred for incubation lighting. This study aimed to reveal the effects of providing Japanese quail eggs with the dark (control group) as well as with green (560 nm) and blue (480 nm) monochromatic lighting throughout the entire incubation period on hatch time.

### **Materials and Methods**

The experiment was conducted in the Faculty of Agriculture and the Faculty of Veterinary Medicine at Namık Kemal University and approved by the Ethical Committee of Namık Kemal University (Decision Number 02/04-10.27.2015). The study was carried out by using three homogeneous automatic incubators. The lighting in these incubators was provided through the LED lights assembled to the two lateral walls and the back wall of the incubators and 560 nm of wavelengths and 480 nm of wavelengths were used for green and blue lights, respectively. The conditions in the incubators were kept constant except for lighting. In the three incubators, a thermal environment was created to attain a temperature of  $37.5 \pm 0.1^\circ\text{C}$  and 60% relative humidity and automatic rotation was applied hourly. In the last three days of incubation, the eggs were taken to the hatching trays and a temperature of  $37.2 \pm 0.10^\circ\text{C}$  and 70% relative humidity were provided in the incubators. The animal material of the research was comprised of the hatching eggs simultaneously obtained from a randombred and nonselected breeder flock at 48 weeks of age. To calculate embryonic mortalities and hatchability, macroscopic examinations were made on 328 hatching eggs in the control group, 204 hatching eggs treated with blue LED lighting, and 204 hatching eggs treated with green LED lighting that remained after eliminating the unfertilized eggs. The generalized linear mixed effect model with logit functions was employed at the 0.05 significance level in the statistical analysis of the binomial and non Gaussian distributed data about the embryonic mortalities and hatch time observed in the treatment groups and the differences among the groups were analyzed with the Tukey-Kramer method – a multiple comparison test suitable for this method.

### **Results and Discussion**

The effects of the monochromatic lighting programs at different wavelengths applied in incubation on the hatch times of the chicks are presented in Figure 1. The rates of hatched quails in the blue light, green light, and control

groups at the 400<sup>th</sup> hour of incubation were found as 0.76%, 13.91%, and 6.54%, respectively, whereas these rates were discovered to be 17.56%, 63.48%, and 81.78% at the 410<sup>th</sup> hour.

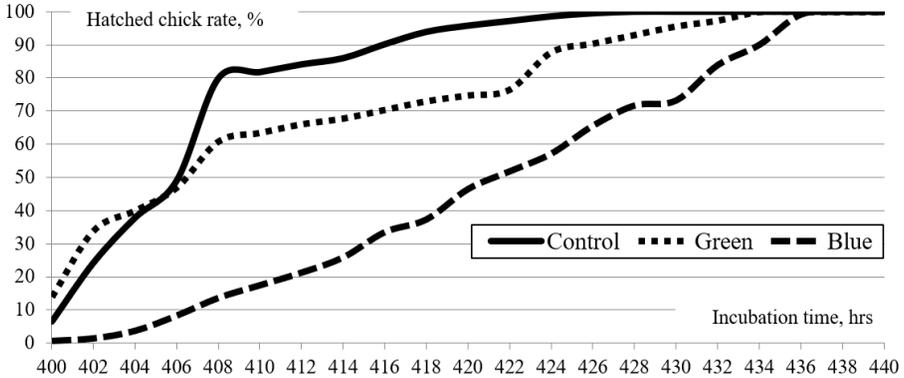


Figure 1. Distribution of hatched chick rates by treatment group in the last 40 hours of incubation

All hatched chicks were obtained at the 428<sup>th</sup> hour in the control group, at the 434<sup>th</sup> hour in the green light group, and at the 438<sup>th</sup> hour in the blue light group ( $P>0.05$ ). Some researchers reported that the lighting applied in incubation enhanced embryonic activity, that the development of the respiratory system particularly increased, and that the incubation times of the embryos were shortened (Wu et al., 2001). Nevertheless, it is known that the conventional lighting equipment used in these studies emitted additional heat into the incubator and that the incubation time was shortened accordingly. Having applied fluorescent lighting to broiler breeder eggs in incubation, Özkan et al. (2012) reported that there was no difference between the hatch times of the embryos treated with the dark and light in the study, where the eggshell temperatures were not different either.

### Conclusion

There is no study on alternate green and blue LED lighting in the incubation period is available in the literature. It may be recommended to investigate the effect of applying green light in the first half of the period of embryogenesis of Japanese quails and blue light in the second half of it on some economic traits in the following studies.

### References

COOPER, J.B. (1972) Effect of light during incubation on hatchability of turkey eggs. *Poult. Sci.* 51:1105–1108.

- FARGHLY, M.F.A., MAHROSE, K.M.A., and ABOU-KASSEM, D.E. (2015) Pre and post hatch performance of different Japanese quail egg colors incubated under photostimulation. *Asian. Poult. Sci.* 9:19-30.
- ROZENBOIM, I., HUISINGA, R., HALEVY, O., and EL HALAWANI, M. (2003) Effect of embryonic photostimulation on the posthatch growth of turkey poults. *Poult. Sci.* 82:1181–1187.
- ÖZKAN, S., YALÇIN, S., BABACANOĞLU, E., KOZANOĞLU, H., KARADAŞ, F., and UYSAL, S. (2012) Photoperiodic Lighting (16 h light: 8 h dark) Programs during incubation: 1. Effects on growth and circadian physiological traits of embryos and early stress response of broiler chickens. *Poult. Sci.* 91:2911-2921.

## Strain Differences and Egg Weight Affected Leg Bones Development of Broiler Embryos and Chicks

Serhat Yıldırım Aydın, Neslihan Kalkan, Tahir Shah,  
Mojtaba Vafaenia, Servet Yalçın

Ege University Faculty of Agriculture Department of Animal Science, Bornova, İzmir,  
Turkey

### Abstract

This study was aimed to examine the effect of strain and egg weight on leg bone development of embryos and chicks. Eggs obtained from fast- and slow-growing broiler breeders were used. To evaluate egg weight effect, eggs were classified as lighter (LE) and heavier (HE) than average egg weight of the flock. The results showed that there was no interaction between strain and egg weight for leg bone traits measured. Fast-growing chicks had significantly heavier relative leg bone weights compared to slow-growing counterparts, on d 21. Lower ash content obtained for chicks from LE indicated that those chicks probably would have an increased potential for leg disorders.

**Keywords:** *Broiler, Egg Weight, Embryo, Leg Bone, Strain*

### Özet

Bu çalışmada, genotip ve yumurta ağırlığının etlik piliç embriyolarında ve bir günlük civcivlerde bacak kemiklerinin gelişimine etkisinin araştırılması amaçlanmıştır. Hızlı ve yavaş gelişen etlik damızlıklardan alınan yumurtalar kullanılmıştır. Yumurta ağırlığının etkisini araştırmak için, yumurtalar sürünün ortalama yumurta ağırlığından daha hafif (HY) ve daha ağır (AY) olarak sınıflandırılmıştır. Sonuçlar, bacak kemiklerinin gelişimi açısından yumurta ağırlığı ve genotip arasında interaksiyon olmadığını göstermiştir. Hızlı gelişen damızlıklara ait civcivlerde yavaş gelişenlere göre bacak kemikleri daha ağır bulunmuştur. HY'de saptanan düşük tibia kül içeriği, ortalama yumurta ağırlığından daha hafif yumurtalarda gelişen civcivlerde bacak problemleri oluşma potansiyelinin yüksek olduğuna işaret edebilir.

**Anahtar kelimeler:** *bacak kemiği, embriyo, etlik piliç, genotip, yumurta ağırlığı*

## Introduction

The fast-growing broiler chickens have been selected to reduce the time required to reach target BW and feed efficiency (Havestein et al., 1994). Due to selection for fast growth, breast muscle weight has been increased, whilst resulting changes in leg bone anatomy and mineralization, broilers have had poor walking ability (Yalçın et al., 2001). Tibia ash is one of the sensitive indicators of bone mineralization which affects bone breaking strength (Hall et al., 2003; Shim et al., 2012). Yalcin et al. (2001) reported that on d of hatch, tibia ash content was affected by maternal age, however the extent of this effect depended on the strain. Previous studies showed that fast-growing broilers had reduced bone ash content than those from the slow-growing broilers (Williams et al., 2003; Shim et al., 2012). Yair et al. (2017) also reported inferior bone properties in chicks from fast-growing line compared to slow-growing line. This result was relevant especially those that hatched from small eggs (Yair et al., 2017). Therefore, the present study aimed to evaluate the effect of strain and egg weight on leg bone development and ash of broiler embryos and chicks.

## Material and Method

Eggs obtained from fast-growing (Ross 308) and slow-growing (Hubbard, JA) broiler breeder strains were used. All eggs from each strain were numbered, weighed, a total of 192 eggs were selected (96 from each strain) and classified as lighter (LE,  $64 \pm 1$  g) or heavier (HE,  $72 \pm 1$  g) than average egg weight of the flock. All eggs were incubated at the same standard incubation conditions after 3 d of storage at 18°C and 75% of relative humidity. Ten eggs from each group were randomly weighed at ED 18 and embryos were removed from eggs. Weights of shank, tibia, femur were obtained. Relative weights were calculated by dividing the absolute weight by embryo weight. Tibias were dried at 110°C and ashed at 500°C to determine tibia dry matter content and ash, respectively. The same procedure was repeated on d of hatch. The General Linear Models (GLM) procedure of JMP 5.0.1 software was used to analyze the data. When differences were significant, means were compared by using student's t tests.

## Results

There was no significant effect of strain on relative shank, tibia and femur weight on d 18. By d 21, the heaviest shank, tibia and femur were obtained for fast-growing broilers (Figure 1 A, B, C).

Egg weight was not significant for relative shank and tibia weight, however, embryos from LE had heavier femur weight on d 18. On d 21, weights of shank, tibia and femur were heavier for LE than HE chicks (Figure 1D, E, F).

On d 18 and 21, tibia dry matter (%) of slow-growing broilers was higher than those from fast-growing broilers (Figure 2A). There was no effect of strain on ash content of tibia on d 18 and 21 (Figure 2B).

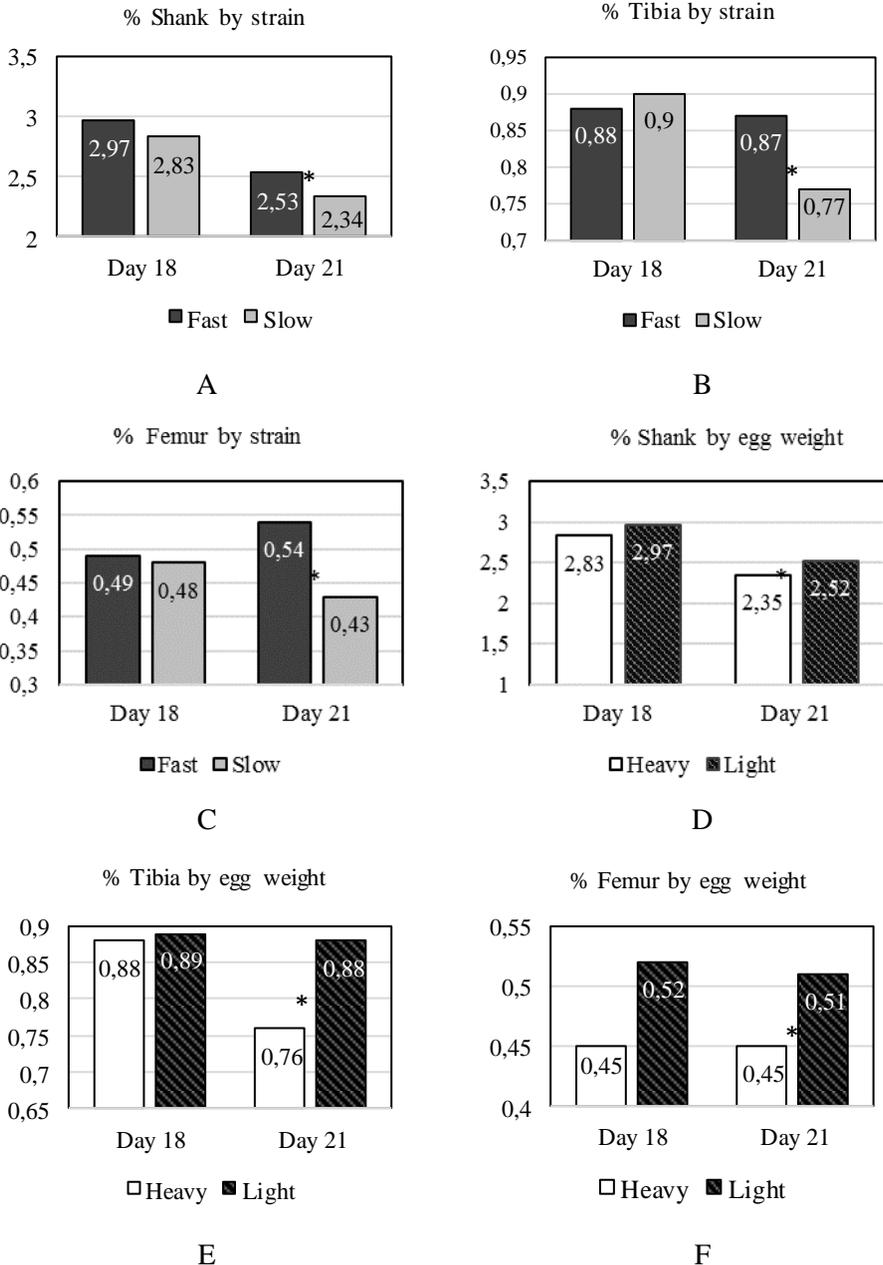


Figure 1. Effect of strain and egg weight on shank, tibia and femur on d 18 and 21

\* P < 0.05

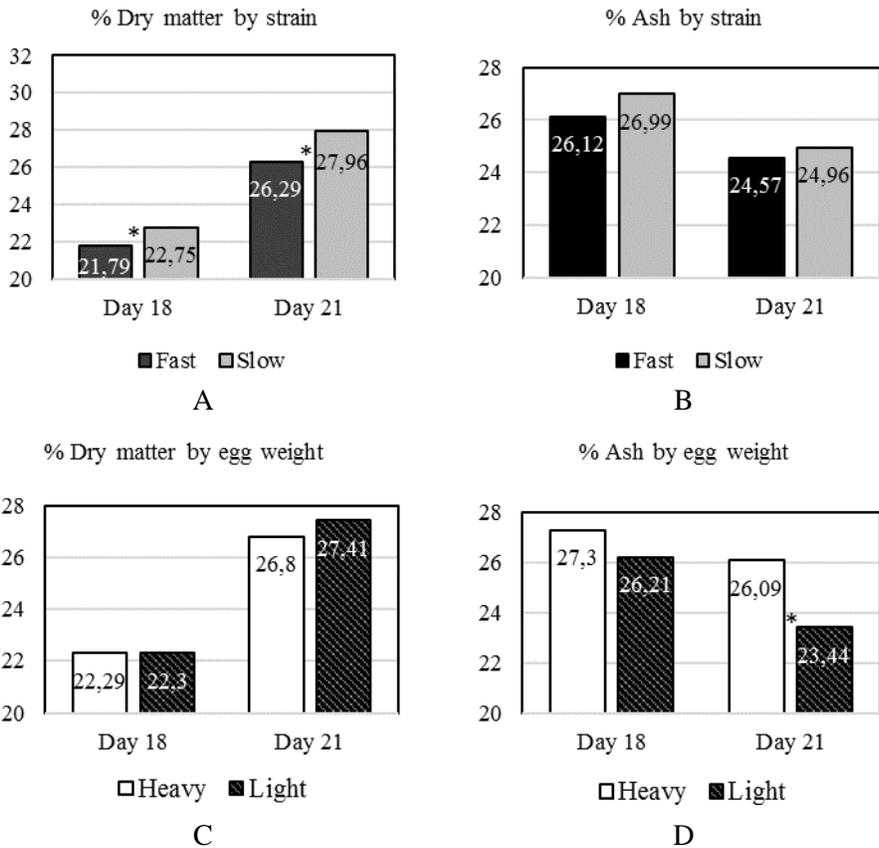


Figure 2. Effect of the strain and egg weight on dry matter and ash of tibia on d 18 and 21 \* P < 0.05

Egg weight effect was not significant for dry matter content of tibia on d 18 and 21 (Figure 2C) and ash weight on d 18 (Figure 2D). On d 21, tibia ash content was higher in HE chicks than those from LE (Figure 2D).

### Conclusion

The present results showed that chicks from lighter eggs had heavier leg bones compared to chicks from heavier eggs. This result was probably due to their lower chick weight. On the other hand, tibia ash content of chicks from lighter eggs was found to be lower than those from heavier eggs. These results may suggest that the chicks in lighter eggs than average egg weight of the flock, probably would have an increased potential for leg disorders.

## References

- HALL, L. E., SHIRLEY, R. B., BAKALLI, R. I., AGGREY, S. E., PESTI, G. M., EDWARDS, Jr H. M.. (2003) Power of two methods for the estimation of bone ash of broilers. *Poultry Science* 82:414–418.
- HAVENSTEIN, G. B., FERKET, P.R., SCHEIDLER, S. E., RIVES, D. V. (1994) Carcass composition and yield of 1991 vs 1957 broilers when fed “typical 1957 and 1991 broiler diets”. *Poultry science* 73: 1795-1804.
- SHIM, M. Y., KARNUAH, A. B., MITCHELL, A. D., ANTHONY, N. B., PESTI, G. M. and AGGREY, S. E. (2012) The effects of growth rate on leg morphology and tibia breaking strength, mineral density, mineral content, and bone ash in broilers *Poultry Science* 91 :1790–1795.
- WILLIAMS, B. D., WADDINGTON, D., MURRAY, H., FARQUHARSON, C. (2003) Bone strength during growth: influence of growth rate on cortical porosity and mineralization. *Calcified Tissue International* 74: 236–245.
- YAIR, R., CAHANER, A., UNI, Z., and SHAHAR, R. (2017) Maternal and genetic effects on broiler bone properties during incubation period. *Poultry Science* 0:1–11.
- YALÇIN, S., ÖZKAN, S., COSKUNER, E., BILGEN, G., DELEN, Y., KURTULMUS, Y., TANYALÇIN, T. (2001) Effects of strain, maternal age and sex on morphological characteristics and composition of tibial bone in broilers. *British Poultry Science* 42: 184–190.

## Egg and Hatchability Traits in Pekin Ducks

Turgut Kırmızıbayrak<sup>a</sup>, Buket Boğa Kuru<sup>a\*</sup>, Mahir Murat Cengiz<sup>b</sup>, Serpil Adıgüzel Işık<sup>a</sup>

<sup>a</sup> Kafkas University, Faculty of Veterinary Medicine, Department of Animal Breeding and Husbandry, Kars, Turkey

<sup>b</sup> Atatürk University, Erzurum Technical Vocational School, Erzurum, Turkey

\*Corresponding: [buket\\_vetfak@hotmail.com](mailto:buket_vetfak@hotmail.com)

### Abstract

In this study, it was aimed to investigate the egg and hatchability traits of Pekin ducks. A total of 751 Pekin duck eggs was kept in the incubator. Egg length  $62.79 \pm 0.09$  mm, egg width  $45.94 \pm 0.08$  mm, egg weight  $73.97 \pm 0.22$  mm and shape index  $72.99 \pm 0.11$  were found in the study. The fertility rate, hatchability, hatchability of fertile eggs and embryonic mortality rate were determined as 70.04%, 60.19%, 85.93%, 14.07%, respectively. In conclusion, hatchability in Pekin duck eggs in commercial farm were similar to the literature, but some preventions must be taken to improve the fertility rates.

**Key words:** *Egg traits, Hatchability traits, Pekin ducks*

## Pekin Ördeklerinde Yumurta ve Kuluçka Özellikleri

### Özet

Bu çalışmada, Pekin ördeklerinin yumurta ve kuluçka özelliklerinin araştırılması amaçlanmıştır. Kuluçkalanmak üzere 751 adet Pekin ördeği yumurtası kuluçka makinesine konulmuştur. Çalışmada, yumurta uzunluğu  $62,79 \pm 0,09$  mm, yumurta genişliği  $45,94 \pm 0,08$  mm ve yumurta ağırlığı  $73,97 \pm 0,22$  mm olarak belirlenmiştir. Döllülük oranı, kuluçka randımanı, çıkım oranı ve embriyonal ölüm oranı sırasıyla %70.04, %60.19, %85.93, %14.07 olarak tespit edildi. Sonuç olarak; özel ticari işletme koşullarındaki Pekin ördeği yumurtalarındaki kuluçka randımanı düzeyi literatür bildirimlerine benzer olduğu, fertilitte düzeyini iyileştirici için bazı önlemler alınmalıdır.

**Anahtar kelimeler:** *Yumurta özellikleri, Kuluçka özellikleri, Pekin ördeği*

## Introduction

With increasing world population, white meat tendency is increasing because it is a cheaper protein source than red meat. Duck breeding has increased in our country in recent years. Again, because of the short production period of duck is an alternative to breeding of chicken and turkey (Demir *et al.*, 2010). Pekin duck growth rate and feed utilization is high, maintenance and feeding is easy, the risk of disease is lower than chickens. At the same time high prices can be sold in luxury restaurants. The Pekin duck has a significant advantage in terms of providing new jobs and employment opportunities (Rashid *et al.*, 2009; Demir *et al.*, 2010). According to the data of the year 2016, about 2.25% of Turkey's ducks presence is in the province of Kars (TUİK, 2016). In this study, it was aimed to investigate the egg and hatchability traits of Pekin ducks.

## Materials and Methods

The study was conducted in a hatchery of a commercial farm in Kars province where Pekin ducks farming was carried out in the free range system. A total of 751 Pekin duck eggs was kept waiting for 3-10 days were placed in the incubator immediately after their characteristics were determined. The length, width and weight values of the eggs were recorded prior to placement in the incubator. On the 10th day of the incubation, the fertility of the eggs was checked and the hatchability traits were determined at the end of the incubation. Statistical analysis of the data was performed using the SPSS® 18.0 software (Chicago, IL, USA) program. Obtained values were expressed as mean  $\pm$  standard error of mean (SEM).

## Results and Discussion

Egg length average  $62.79 \pm 0.09$  mm, egg width average  $45.94 \pm 0.08$  mm, egg weight average  $73.97 \pm 0.22$  mm and shape index  $72.99 \pm 0.11$  were determined in the study. The fertility rate, hatchability, hatchability of fertile eggs and embryonic mortality rate were determined as 70.04%, 60.19%, 85.93%, 14.07%, respectively. The death in shell rate, early embryonic mortality and late embryonic mortality in incubated fertile eggs were determined as 4.56%, 2.66% and 6.84%, respectively.

## Conclusion

In conclusion, hatchability in Pekin duck eggs in commercial farm were similar to the literature, but some preventions must be taken to improve the fertility rates.

### References

- DEMİR, P., ERIŞİR, Z., POYRAZ, Ö., ONBAŞILAR, E.E. and ERDEM, E. (2010) Cost-benefit analyses of Pekin duck fattening according to various housing systems and slaughter age. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi* **16**: 493-496.
- RASHID, M.A., KAWSAR, M.H., RASHID, M.A., MIAH, M.Y. and HOWLIDER, M.A.R. (2009) Fertility and hatchability of Pekin and Muscovy duck eggs and performance of their ducklings. *Progressive Agriculture* **20**: 93-98.
- TUİK (2016) Hayvancılık istatistikleri veri tabanı, Yıllık hayvan sayısı ve hayvansal üretim. <http://rapory.tuik.gov.tr/14-01-2018-23:05:33-143087590518830048831081550330.html>. Access date: 12.01.2018.

## Effect of breeder age on hatching traits under long term storage conditions

Umut Sami Yamak, Kadir Erensoy, Elif Cilavdarođlu, Elvan Ergin, Musa Sarıca

<sup>a</sup>Ondokuz Mayıs University, Agricultural Faculty, Department of Animal Science Samsun/ Turkey

### Abstract

Hatching eggs have been stored for different durations before incubation with different reasons. Fertility and hatchability decrease according to storage conditions. 2400 eggs from three different flocks with different ages (27,48 and 65 weeks) and were stored for 11 days in storage machines. Eggs were individually numbered and weighed before storage. Eggs were placed to incubation machine after weighing again. At day 18, eggs were weighed and transferred to hatching machine. Middle aged flock's eggs had higher total weight loss (11.30%) than young (10.12%) and old (10.17%) flocks. Fertility was higher in middle aged flock (94.88%) than young (87.85%) and old (59.80%) flock. Highest hatching rate was determined in young flock eggs (74.22%), while was lowest in old flock (53.57%).

**Keywords:** *Breeder Age, Incubation, Storage, Fertility, Hatching Rate*

### Özet

Kuluçkalık yumurtalar kuluçka işleminde önce çeşitli nedenlerden dolayı farklı sürelerde depolanmaktadır. Depolama koşullarına bađlı olarak döllülük ve çıkış gücü düşmektedir. Farklı yaşlardaki (27, 48 ve 65 haftalık) üç sürüden alınan 2400 yumurta 11 gün süre ile bir depolama makinasında depolanmıştır. Yumurtalar depolanmadan önce bireysel olarak numaralandırılıp tartılmıştır. Yumurtalar tekrar tartılarak kuluçka makinasına yerleştirilmiştir. 18. Günde yumurtalar tekrar tartılarak çıkım makinasına transfer edilmiştir. Orta yaşlı sürü yumurtaları (%11.30), genç (%10.12) ve yaşlı (%10.17) sürü yumurtalarına göre daha fazla toplam ağırlık kaybetmişlerdir. Döllülük oranı orta yaşlı sürü yumurtalarında (%94.88) genç (%87.85) ve yaşlı (%59.80) sürülerden daha fazla bulunmuştur. En yüksek çıkış gücü genç sürüde (%74.22) tespit edilirken en düşük ise yaşlı sürüde (%53.57) tespit edilmiştir.

**Anahtar Kelimeler:** *Ebeveyn Yaşı, Kuluçka, Depolama, Döllülük, Çıkış Gücü*

## **Introduction**

Eggs are mainly stored for two reasons. One is to fill the incubation capacity, and the other is the demand on products (Fasenko *et al.*, 2001). If the demand on chicken meat is lower, companies store hatching eggs for a while. The effects of pre-incubational egg storage on embryonic viability depend on storage time, environmental conditions, hen age and strain (Brake *et al.*, 1997). During storage, eggs lose weight; fertility and hatchability decreases. It is reported that hatchability decreases 1% for every day after 10 days of storage (Bakst and Akuffo, 2002). Breeder age is another factor on the hatchability of eggs. Butler (1991) indicated that parental age can influence the extent of embryonic development at oviposition. Older hens lay bigger eggs and had a greater weight loss during incubation period than lighter ones (Lourens *et al.*, 2006). On the other hand, Islam *et al.* (2008) observed the best egg fertilization and hatchability in hens aged between 41 and 60 weeks. In this study, we executed the effect of egg shell thickness on hatching traits of breeders at different ages under long term storage conditions.

## **Material and methods**

The study was conducted with Ross commercial hybrid eggs. 800 eggs from each flock at the ages of 27, 48 and 65 weeks (total 2400 eggs) were bought from a commercial breeding company. The eggs were brought to Ondokuz Mayıs University hatchery after the day collected. All Eggs were numbered and weighed. Eggs were placed to storage machines each has a capacity of 1600 eggs. After 11 days of storage at 18°C temperature and 70-78% relative humidity, all eggs were placed to incubation machine after eggs were individually weighed. Eggs were kept in incubation machine at 37.7 °C and 60% relative humidity for 18 days and transferred to hatching machine after individually weighed. Storage egg weight loss, incubation weight loss and total weight loss was calculated from these data and given as percentage to total egg weight for thickness groups. After completing incubation, all unhatched eggs were broken open to identify fertility. The rate of fertilized eggs to total eggs was given as fertility. The rate of hatched eggs to fertilized eggs was given as hatchability. Hatched chicks rate to all eggs was determined as incubation yield.

## **Results and Discussion**

Mean egg shell thickness values were found 0.42 mm, 0.40 mm and 0.37 mm for young, medium and old breeders, respectively (Table 1,  $P < 0.05$ ). Shell thickness significantly decreased at older ages. Reversely, egg weight increased at older ages. These were expected results. Lourens *et al.*, (2006) reported that older hens lay bigger eggs with thinner shells. Eggs obtained

from young and old aged flocks lost similar weight during storage (0.79% vs 0.80%), but eggs of middle aged flock significantly lost higher weight during storage (0.85%). Despite the difference between weight losses of flocks, all eggs lost lower weight than reported values during long term storage. Khan et al., (2014), reported that eggs lost 2.5% of their weight during 9 days of storage. It was reported that 10–12% weight loss from the eggs is necessary during incubation for a successful result in stored and non-stored eggs (Deeming, 1995). Middle aged flock's eggs lost significantly more weight during incubation. Various results present in the literature on this subject. Jabbar and Ditta (2017) found that old flock's eggs lost higher weight (12.13%) than middle aged (11.77%) and young (11.29%) flocks' eggs. On the other hand, Iqbal et al., (2016), found totally opposite results that older flock had the lowest egg weight lost (60 weeks, 11.08%) than middle aged (45 weeks, 11.22%) and young (30 weeks, 11.45%) flocks during incubation. Fertility was 87.85 % in young flock's eggs and increased to 94.88% in middle aged flocks eggs and then decreased to 59.80% in old flock's eggs. Similar results were reported by Nowaczewski et al., (2016) and Iqbal et al., (2016). Hatching results were found as 74.22%, 63.75% and 32.14% for young, middle aged and old flocks, respectively.

Table 1. Egg Shell thickness, egg weight, egg weight losses and some hatching results of breeder eggs of three different flocks

BA	MST	MEW	SWL	IWL	TWL	F	HR	IY
Y	0.42 <sup>a</sup>	56.15 <sup>c</sup>	0.79 <sup>b</sup>	9.42 <sup>b</sup>	10.12 <sup>b</sup>	87.85 <sup>b</sup>	74.22 <sup>a</sup>	64.95 <sup>a</sup>
M	0.40 <sup>b</sup>	68.39 <sup>b</sup>	0.85 <sup>a</sup>	10.54 <sup>a</sup>	11.30 <sup>a</sup>	94.88 <sup>a</sup>	63.75 <sup>ab</sup>	60.5 <sup>a</sup>
O	0.37 <sup>c</sup>	72.12 <sup>a</sup>	0.80 <sup>b</sup>	9.46 <sup>b</sup>	10.17 <sup>b</sup>	59.80 <sup>c</sup>	53.57 <sup>b</sup>	32.14 <sup>b</sup>

BA: Breeder Age, Y: Young (27 weeks), M: Middle aged (48 weeks), O: Old (65 weeks), MST: Mean shell thickness (mm), MEW: Mean egg weight (g), SWL: Storage weight loss (%), IWL: Incubation weight loss (%), TWL: Total weight loss (%), F: Fertility (%), HR: Hatching rate (%), IY: Incubation yield (%)

## Conclusion

Storage of the eggs is common in commercial broiler industry. Fertility, hatchability and incubation yield decrease during storage. Breeder age is also has effect on hatching results. Results of this study showed that hatching results were found lower for the old breeders in long storage conditions.

## References

- BAKST, M.R., AKUFFO, V.,(2002) Impact of egg storage on embryo development. *Avian Poult. Biol. Rev.* 13, 125-131.
- BRAKE, J., WALSH, T.J., BENTON, C.E., PETITTE, J.N., MEIJERHOF, R. & PENALVA, G., (1997) Egg handling and storage. *Poult. Sci.* 76, 144-151.

- BUTTLER, D.E.,(1991) Egg handling and storage at the farm and hatchery. In: Avian Incubation. Ed. Tullett, S.G., Butterworth-Heinemann Ltd. Surrey, UK. pp. 195-204.
- DEEMING, D.C. (1995) Factors affecting hatchability during commercial incubation of ostrich (*Struthio camelus*) eggs.Br Poult Sci. 36:51–65.
- FASENKO, G.M., CHRISTENSEN, V.L., WINELAND, M.J., PETITTE, J.N.,(2001) Examining the effects of pre-storage incubation of turkey breeder eggs on embryonic development and hatchability of eggs stored for four or fourteen days. Poult. Sci. 80, 132-138.
- IQBAL, J., KHAN, S.H., MUKHTAR, N., AHMED, T., PASHA, R. A.,(2016) Effects of egg size (weight) and age on hatching performance and chick quality of broiler breeder. Journal of Applied Animal Research. Vol. 44, No. 1, 54–64.
- JABBAR, A., DITTA, A.,(2017) Effect of broiler breeders age on hatchability, candling, water loss, chick yield and dead in shell. World Vet J, 7(2): 40-46.
- KHAN, M.J.A., KHAN, S.H., BUKHSH, A., AMIN, M.,(2014) The effect of storage time on egg quality and hatchability characteristics of Rhode Island Red (RIR) hens. Veterinarski Arhiv 84 (3), 291-303.s
- LOURENS A., MOLENAAR, R., VAN DEN BRAND, H., HEETKAMP M.J.W., MEIJERHOF R., KEMP B. (2006) Effect of egg size on heat production and the transition of energy from egg to hatchling. Poultry Sci., 85: 770–776.

## Some Egg and Hatching Traits of Linda Geese Reared under Local Breeder Conditions

Mehmet Sarı<sup>a</sup>, Aykut Asım Akbaş<sup>b</sup>, Kadir Emre Buğdaycı<sup>c</sup>, Mustafa Saatçı<sup>d</sup>

<sup>a</sup>Ahi Evran University, Agriculture Faculty, Department of Animal Science, Kırşehir, Turkey

<sup>b</sup>Mehmet Akif Ersoy University, Veterinary Medicine Faculty, Department of Animal Science, Burdur, Turkey

<sup>c</sup>Mehmet Akif Ersoy University, Veterinary Medicine Faculty, Department of Animal Nutrition and Nutritional Disease, Burdur, Turkey

<sup>d</sup>Muğla Sıtkı Koçman University, Agriculture Faculty, Department of Animal Science, Muğla, Turkey

### Abstract

Study was conducted to determine some egg and hatching traits of Linda geese reared under local breeder conditions. All the studied geese were at the 24<sup>th</sup> months of age. The mean egg production for per goose was 21.46 and average mean laying period was determined as 90 days. The mean weight of eggs was 132.64 g and the shape index was detected as 65.01%. The eggs were stored for 7 days in an 18 °C cool room before the hatching process. Hatchability of eggs was found as 59.17%. These findings are the first records about the Linda goose in Turkey. There were no serious problems of raising, hatching and after the hatching process of Linda geese reared under local breeder conditions. Those findings indicated that Linda geese, which have better productive and reproductive traits, could be easily reared under the condition of West Mediterranean region in Turkey. Also, this breed can be recommended to goose breeders.

**Keywords:** *Linda goose, egg, hatching, gosling*

### Halk Elinde Yetiştirilen Linda Kazlarının Bazı Yumurta ve Kuluçka Özellikleri

#### Özet

Araştırma halk elinde yetiştirilen Linda kazlarının bazı yumurta ve kuluçka özelliklerini belirlemek amacıyla yapılmıştır. Araştırmadaki kazların yaşı 24 ay, kaz başına yumurta verimi 21.46 adet, yumurtlama süresi 90 gün olarak tespit edilmiştir. Kuluçkalık yumurtaların ağırlığı 132.64 g ve şekil indeksi % 65.01 olarak belirlenmiştir. Kuluçka periyodundan önce yumurtalar 18°C'lik odada 7 gün depolanmıştır. Kuluçka randımanı % 59.17 olarak tespit edilmiştir. Bu bulgular Türkiye'de yetiştirilen Linda kazları için ilk verilerdir. Halk elinde yetiştirilen Linda kazlarının yetiştirme, kuluçka ve kuluçka sonrasında ciddi sorunlarla karşılaşılmanmıştır. Daha verimli ve üretken özelliklere sahip olduğu belirlenen Linda kazlarının, Türkiye'nin Batı Akdeniz bölgesi şartlarında yetiştiriciliğinin kolay bir şekilde yapılabileceği kanaatine varılmıştır. Bundan dolayı, bu kaz ırkı yetiştiricilere tavsiye edilebilir.

**Anahtar Kelimeler:** *Linda kazı, yumurta, kuluçka, palaz*

## Introduction

According to the data of year 2016, there are 380 620 000 and 933 353 geese in the world and Turkey, respectively (FAO 2018; TSI 2017). Goose breeding having important sub-regional and cultural influences is not a very common livestock activity in Turkey and also it is maintained with native goose breeds in general. On the other hand, in recent years, ones of the best goose breeds, Emden, Toulouse and Chinese geese were introduced to Turkey's avian sector. In addition to the mentioned goose breeds, Linda goose breeding had also been tested within last few years in Turkey.

Linda geese, which had an effect composing more than 60% of the number of geese in Russia (Royter *et al.*, 2017), obtained via combining the native goose breeds of Nizhny Novgorod region in Russia with the Chinese, Adler, Solnechnogorsk and Gorky geese. The feather color of Linda geese is usually white. These geese have a cone-shaped protrusion on their forehead, called as a knop. This protrusion is bigger in males than in females. There is a slight swelling in their neck, called as a dewlap. Their bodies are deep, wide and long. Their average live weights are 6-7 kg for adults and also males are heavier than females. Their annual egg productions are 40-50, egg weights are between 140-170 g (Anonymous, 2017).

In Turkey, there have been a lot of researches about the various goose breeds. However, no research on Linda geese has been completed yet. This study is the first one, conducted to determine some egg and hatching traits of Linda geese reared under local breeder conditions.

## Materials and Methods

Study was carried out in a private goose farm in province of Burdur-Ağlasun-Kibritli. The data were obtained from the 24 months old Linda geese in the years of 2015-2017. Animals were fed with stale bread, factory by-products, wheat and rye mixtures as well as the grass around the farm. The temperatures of the embryo development and hatching machine were set at 37.7 ° C and 37.2 ° C, respectively and their humidity rates were set at 55% and 75%, respectively. There was no gender definition in the herd, and male and female ratios were close to each other.

## Results and Discussion

The obtained data related to some egg and hatching traits of Linda geese were presented as mean value in Table 1. While, the total number of studs used in the study was 1025, the number of eggs was 22000. The numbers of eggs obtained per goose were determined as 40 and 27 eggs in 2015 and 2016, respectively. Due to some troubles in management process of geese in the year 2017, the mean egg production per goose for nearly 36<sup>th</sup> months of age was determined as 21.46. While this value was found to be higher than the findings reported by Onk (2009) as 12.66 in native geese; it was also was found to be lower than the value (45-50) reported by Royter *et al.* (2017) in Linda geese. In this study, the laying period of Linda geese was defined to be 90 days. This value was higher than the values reported by Tilki and İnal (2004) in Armutlu, Baskuyu and Tatlicak geese as 75, 60 and 73 days, respectively. While the egg weight determined in this study (132.64 g) was lower

than values reported by Tilki and Inal (2004), and Onk (2009) in native geese, the shape index values were in agreement with the findings.

Table 1. Some egg and hatching traits of Linda geese

<i>Traits</i>	
The number of female studs	1025
Total number of eggs obtained	22000
Egg production	21.46
The age of female studs, month	24
Laying period, day	90
Egg weight, g	132.64
Shape index, %	65.01
Feeding	Stale bread, factory by-products, wheat, rye
Cleaning the eggs	Steel wool
The storage period of the eggs, day	7
Storage temperature of the eggs, °C	18
Processes applied to incubation eggs	10 min cooling for 7-14 days 22 min cooling for 15-22 days 45 min cooling for 23-27 days Irrigate at incubation water temperature after cooling.
Temperature of embryo development machine, °C	37.7
Temperature of embryo hatching machine, °C	37.2
Humidity of embryo development machine, %	55
Humidity of embryo hatching machine, %	75
Number of hatching eggs, number	18000
Hatchability, %	59.17
Number of goslings obtained, number	10650

In the study, eggs were stored for 7 days in an 18°C cool room before the hatching process. Tilki and Saatci (2013) reported that the hatchability of eggs stored more than 6-7 days might decrease. The number of hatching eggs was 18000, the hatchability was 59.17% and the numbers of goslings obtained were calculated as 10650. Royter *et al.* (2017) reported that the hatchability of Linda geese was between 70-75 %. In another study, the egg production were found as 40.7, 41.4 and 40.5, egg weights were found as 154.7, 157.1 and 158.4 g, in the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> generations of the sire line of Linda geese respectively. Hatchability was also determined as 59.3%, 65.6% and 66.9% in the same study (Soloviev, 2012). The hatchability values of study (59.17%) was found to be higher than the values reported by Tilki and Inal (2004) as 56.90, 54.72 and 57.14 in native goose breeds. In this study, the egg production and laying period of Linda geese were found to be

higher than ones of reports related to native goose breed, and it was thought that the most important reason of this fact is the breed factor.

The findings of study indicated that Linda geese could be easily reared under local condition of West Mediterranean region in Turkey because of their better egg production and laying periods and higher hatchability. Those defined traits may also be used to motivate the goose breeders to rear the Linda geese in Turkey.

## References

- ANONYMUS, (2017) <https://yaroslavskaya.all.biz/en/lindovskiyes-geeseg1862330#.WddCeWi0PIV>. Date of access: 06.10.2017.
- FAO, (2018) <http://www.fao.org/faostat/en/#data/QA>. Date of access: 04.02.2018
- ONK, K. (2009) The egg production, growth, slaughter, and carcass characteristics of native geese (*Anser anser*) raised under local breeding conditions in Kars. *PhD Thesis*. Kafkas University, Health Sciences Institute.
- ROYTER, Y., SOLOVYOV, V. and MAKULIN, A. (2017) Linda goose: Maintenance of the stock herd (Линдовские гуси: содержание племенного стада). *Livestock of Russia Thematic Issue (ЖИВОТНОВОДСТВО РОССИИ ТЕМАТИЧЕСКИЙ ВЫПУСК)*, 23.
- SOLOVEV, V. YU. (2014) Evaluation and selection of geese on reproductive indicators (Оценка И Отбор Гусей По Воспроизводительным Показателям), *Thesis*, Sergiyev Posad.
- TILKI, M. and SAATCI, M. (2013) Goose breeding in every direction. Salmat Packaging Industry and Trade Limited Company. First edition. ISBN: 978-9944-729-10-9. Ankara.
- TILKI, M. and INAL, Ş. (2014) Yield traits of geese of different origins reared in Turkey. I. Hatching traits. *Turkish Journal of Veterinary and Animal Sciences* 28: 149-155.
- TSI, (2017) <http://rapory.tuik.gov.tr/26-09-2017-11:09:52-186244893396410499084823747.html?> Date of access: 26.09.2017.

## The effect of injection of zinc-glycine on hatchability, hatching weight and some organs weight some in quail hatching eggs

Abbas Fadhil Abdulqader, Osman Olgun

Department of Animal Science, Faculty of Agriculture, Selcuk University, 42130 Konya, Turkey

### Abstract

The purpose of this study was to determine the effect of in-ovo injection of zinc-glycine on hatchability of set eggs, hatchability of fertile eggs, hatching weight, and yolk sac and liver weights of quails. On day 14 of incubation, eggs from group-1 was not injected, group-2 was injected with physiological water, group-3 was injected with 20 µg/egg zinc and group-4 was injected with 40 µg/egg zinc in amniotic sac. The results of this study demonstrated that in-ovo injection of zinc-glycine, especially at dose of 20 µg/egg, had positive effects on hatching and yolk sac weights without detrimental effects on hatchability.

**Keywords:** Hatchability, In-ovo, Quail, Yolk sac, Zinc

### Kuluçkalık bildircin yumurtalarına çinko-glisin enjeksiyonunun kuluçka, çıkış ağırlığı ve bazı organ ağırlıklarına etkisi

### Özet

Bu çalışmanın amacı in ovo çinko-glisin enjeksiyonunun kuluçka randımanına, çıkış gücüne, çıkış ağırlığına ve bildircinlerin sarı kesesi ve karaciğer ağırlıklarına etkisini araştırmaktır. Kuluçkanın 14. günü yumurtalara grup-1 enjeksiyon yapılmayan, grup-2 fizyolojik su, grup-3 20 µg/yumurta çinko ve grup-4 40 µg/yumurta çinko enjeksiyonu yapılmıştır. Bu çalışmanın sonuçları çinko-glisinin özellikle 20 µg/yumurta seviyesinde in-ovo enjeksiyonu kuluçka sonuçlarını olumsuz etkilememek için çıkış ve sarı kesesi ağırlığına pozitif etkisi olmuştur.

**Anahtar kelimeler:** Bildircin, Çinko, In ovo, Kuluçka, Sarı Kesesi

### Introduction

In recent years, studies on feeding with in ovo technique, which is one of the early feeding methods, are increasing day by day. The use of in ovo feeding can lead to significant improvement in the efficiency and profitability of poultry by increasing the hatchability, the digestive capacity and improving the intestine development of chickens. Zinc is an essential element necessary

for growth, immune, reproductive and many biochemical processes (Jose et al. 2018). It has been reported that zinc deficiency in breeder eggs results in decreased hatchability, and increased abnormal embryo development (Zhu et al., 2017). It is aimed to help the development of the embryo during incubation and post hatching by increasing the mineral consumption of the embryo by the addition of minerals such as zinc with the ovo technique (Yair and Uni 2011).

### **Materials and Methods**

A total of 400 quail eggs with similar weights were randomly allotted to 4 treatments with 4 replicates per treatment and 25 eggs per replicate in a completely randomized design. The eggs were injected with 0.2 mL physiological water at 14 embryonic day of incubation. These were, group-1 was not injected, group-2 was injected with physiological water, group-3 was injected with 20 µg/egg zinc and group-4 was injected with 40 µg/egg zinc in amniotic sac. In ovo injection procedure was carried out according to the description by Oliveira et al. (2015). The randomly selected birds were weighed, and their yolk sac and liver were weighted. A completely randomized design was applied, and data were analyzed using the least-square methodology.

### **Results and Discussion**

There were no significant hatchability of set eggs, hatchability of fertile eggs, or liver weight differences among treatments. Hatching weight in the group 3 (20 µg/egg of zinc) and group 4 (40 µg/egg of zinc) treatment groups were significantly ( $P < 0.05$ ) higher compared with the group 1, but no significant differences were observed between the group 1 and group 2. It was determined that injection of zinc of 20 µg/egg level statistically increased yolk sac weight according to the group 1 ( $P < 0.01$ ), but yolk sac weight negatively affected by injection of 40 µg/egg of zinc in quail chicks. Chen et al. (2009) reported that the injection of glutamine and carbohydrates to breeder duck eggs reduced the weight of the yolk sac. Similarly, Zhai et al. (2011) reported that the injection of carbohydrate mixture to breeder broiler eggs increased the yolk sac weight. However, Zhai et al. (2008) reported that the injection of L-carnitine to breeder Leghorn eggs had no effect on the yolk sac weight.

Table 1. Effect of injection of zinc of quail eggs on hatchability and some organs weights

Parameters	Groups*			
	1	2	3	4
Fertility	97.00±1.92	90.00±2.58	92.00±2.31	91.00±5.26
Hatchability of set eggs	87.00±4.43	83.00±4.73	83.00±3.00	84.00±5.90
Hatchability of fertile eggs	89.61±3.55	92.04±2.87	90.44±4.28	92.11±1.38
Yolk sac	9.61±0.53 <sup>B</sup>	10.67±0.21 <sup>AB</sup>	12.07±0.26 <sup>A</sup>	7.95±0.34 <sup>C</sup>
Liver, %	2.29±0.23	2.85±0.07	2.34±0.13	2.48±0.12

\* Group 1: non-injection; Group 2: 0.2 ml of physiological water injected; Group 3: 20 µg/egg zinc injected; Group 4: 40 µg/egg zinc injected. <sup>A,B</sup>Means within rows with different superscripts differ at P<0.01.

### Conclusion

It could be concluded that in-ovo injection of 20 µg/egg levels of zinc can to be positively affect chick performance by increasing yellow sac weight.

### References

- CHEN W., WANG R., WAN H.F., XIONG X.L., PENG P. AND PENG J. (2009) Influence of in ovo injection of glutamine and carbohydrates on digestive organs and pectoralis muscle mass in the duck. *Brit Poult Sci.* 50:436-442.
- JOSE N., ELANGOVA A.V., AWACHAT V.B., SHET D., GHOSH J. AND DAVID C.G. (2018). Response of in ovo administration of zinc on egg hatchability and immune response of commercial broiler chicken. *J Anim Physiol Anim Nutr.* 102:591–595.
- OLIVEIRA T.F.B., BERTECHINI A.G., BRICKA R.M., KIM E.J., GERARD P.D. AND PEEBLES E.D. (2015) Effects of in ovo injection of organic zinc, manganese, and copper on the hatchability and bone parameters of broiler hatchlings. *Poult Sci.* 94:2488–2494.
- YAIR R. AND UNI Z. (2011) Content and uptake of minerals in the yolk of broiler embryos during incubation and effect of nutrient enrichment *Poult Sci.* 90:1523-1531.
- ZHAI W., NEUMAN S., LATOUR M.A. AND HESTER P.Y. (2008). The Effect of In Ovo Injection of L-Carnitine on Hatchability of White Leghorns. *Poult Sci.* 87:569–572.
- ZHAI W., GERARD P.D., PULIKANTI R. AND PEEBLES E.D. (2011) Effects of in ovo injection of carbohydrates on embryonic metabolism, hatchability, and subsequent somatic characteristics of broiler hatchlings. *Poult Sci.* 90:2134-2143.
- ZHU Y.W., LI W.X., LU L., ZHANG L.Y., JI C., LIN X., LIU H.C., ODLE J. AND LUO X.G. (2017) Impact of maternal heat stress in conjunction with dietary zinc supplementation on hatchability, embryonic development, and growth performance in offspring broilers. *Poult Sci.* 96: 2351–2359.

## Effect of egg shell thickness and storage period on hatching traits of chicken eggs

Umut Sami Yamak<sup>a</sup>, Mehmet Akif Boz<sup>b</sup>, Kadir Erensoy<sup>a</sup>, Musa Sarica<sup>a</sup>

<sup>a</sup>Ondokuz Mayıs University Agricultural Faculty Department of Animal Science SAMSUN

<sup>b</sup>Bozok University Agricultural Faculty Department of Animal Science YOZGAT

### Abstract

This study was conducted to determine the effect of egg shell thickness and storage period on some hatching traits of broiler eggs. 3200 eggs were collected from a flock at the age of 65 weeks. All eggs were stored for 3 and 11 days after individually numbered, weighed and shell thicknesses determined. After storage, eggs were weighed and incubated for 21 days. At day 18, eggs were weighed before transfer to hatching machine. Storage weight loss, incubation weight loss and total weight loss was calculated with these data. Storage weight loss was affected by shell thickness groups and storage periods ( $P<0.05$ ). Incubation weight loss was not affected by both of them. Fertility, hatchability and incubation yield was determined as hatching traits. Storage period significantly affect all these traits. The rates of fertility, hatchability and incubation yield significantly decreased at 11 days of storage compared to 3 days ( $P<0.05$ ). Hatching traits were not affected by egg shell thickness groups.

**Keywords:** *Egg shell thickness, storage, hatching, incubation, ultrasound*

### Özet

Bu çalışma kabuk kalınlığının ve depolama süresinin etlik piliç yumurtalarında bazı kuluçka özellikleri üzerine etkisini araştırmak için yürütülmüştür. Toplam 3200 yumurta 65 haftalık yaştaki sürüden toplanmıştır. Tüm yumurtalar bireysel olarak numaralandırılıp, tartıldıktan sonra kabuk kalınlıkları belirlenmiş ve 3 ile 11 gün süre depolanmıştır. Depolamadan sonra yumurtalar tekrar tartılıp 21 gün kuluçkaya tabi tutulmuştur. 18. Günde çıkış makinesine transfer edilmeden önce tekrar ağırlık tartımları yapılmıştır. Elde edilen verilerden depolama kaybı, kuluçka kaybı ve toplam ağırlık kaybı hesaplanmıştır. Kabuk kalınlığı ve depolama süresi depolamadaki ağırlık kayıplarını önemli derecede etkilemiştir ( $P<0.05$ ). Kuluçka kayıpları ikisinden de etkilenmemiştir. Kuluçka özellikleri olarak döllülük, çıkış gücü ve kuluçka randımanı belirlenmiştir. Depolama süresi tüm bu özellikleri önemli derecede etkilemiştir. Döllülük oranı, çıkış gücü ve kuluçka randımanı 11 günlük depolamada 3 günlük

depolamaya göre önemli derecede azalmıştır ( $P<0.05$ ). Kuluçka özellikleri kabuk kalınlığı gruplarına göre değişiklik göstermemiştir.

**Anahtar Kelimeler:** *Yumurta kabuk kalınlığı, depolama, çıkış, kuluçka, ultrason*

## **Introduction**

Storage of hatching eggs is common in practice. Duration of storage changes according to demand on broilers. Duration shortens if demand is high or extends if demand is low (Rocha et al., 2013). The pH of albumen increases during storage and fastest increase occurs in first four days. Newly laid egg albumen substantially contains bicarbonate and carbon dioxide. Egg loses CO<sub>2</sub> during storage and pH of albumen increases from 7.6 to 9.2-9.7 (Rocha et al., 2013; Silversides and Budgell, 2004). This increase is fastest in first four days (Rocha et al., 2013). Also, hatchability is higher in the eggs incubated after four days of storage compare to incubated at oviposition day (Asmundson and MacIlraith, 1948). But hatchability significantly decreases if storage period extends to 7 days or longer (Reijrink et al., 2008). The gas exchanges from the egg via pores; and the depth of the pores change according to shell thickness.

The effect of shell thickness on hatchability of eggs was previously investigated in different studies. Some of these studies found that shell thickness affected hatchability (Andrews, 1972; Bennet, 1992; Shafey, 2002). All of these studies determined the shell thickness indirectly. But in recent years, it is possible to determine shell thickness directly by ultrasound gauge without breaking the egg. The shell thickness of different poultry species' eggs was determined by this method and contrary to previous studies no relation found between shell thickness and hatchability (Ergun and Yamak, 2017; Yamak et al., 2015, 2016a,b). But the relation between shell thickness and incubation is not clear. Therefore, egg weight losses and hatching traits of eggs at different storage periods were determined for eggs with different shell thickness groups, in this study.

## **Material and Methods**

A total of 3200 eggs were bought from a commercial breeding company. The flock was at 65 weeks of age and all eggs were collected at same day. The eggs were brought to Ondokuz Mayıs University hatchery after the day collected. All Eggs were numbered and weighed, and shell thicknesses were measured with an Eggshell Thickness Gauge (ORKA Tech. Ltd., Israel) that uses precision ultrasound to gauge thickness without breaking the egg and is accurate to within 0.01 mm. Eggs were grouped as thin, medium and thick shelled according to method described by Yamak et al., (2015). The thinnest and thickest eggshell thickness values were also recorded. The difference

between the thickest and thinnest eggshell values were determined using the formula  $X_{\max}-X_{\min} /3$ , and this value was added to the mean eggshell thickness value and recorded as the range of eggshell thickness for the thick-shell group and deducted from the mean eggshell thickness value and recorded as the range of eggshell thickness for the thin-shell group. Eggs were placed to 2 storage machines each has a capacity of 1600 eggs. After 3 days of storage at 18°C temperature and 70-78% relative humidity, 1200 eggs were placed to incubation machine after eggs were individually weighed. Eggs were kept in incubation machine at 37.7 °C and 60% relative humidity for 18 days and transferred to hatching machine after individually weighed. The incubation completed after 3 days in hatching machine at 37.5 °C and 70% relative humidity. Same procedures were applied to other 1200 eggs after 10 days of storage. Storage egg weight loss, incubation weight loss and total weight loss was calculated from these data and given as percentage to total egg weight for thickness groups. After completing incubation, all unhatched eggs were broken open to identify fertility. The rate of fertilized eggs to total eggs was given as fertility. The rate of hatched eggs to fertilized eggs was given as hatchability. Hatched chicks rate to all eggs was determined as incubation yield.

### Results and Discussion

Mean egg shell thickness was 0.38 mm in the study. Eggshell thicknesses ranged between 0.25-0.48 mm and included thin ( $\leq 0.30$  mm), medium (0.31-0.45 mm) and thick ( $\geq 0.46$ ) -shelled eggs. 75 eggs were classified as thin-shelled, 1105 as medium-shelled and 20 as thick-shelled for 3 days storage. These numbers were 100, 1009 and 36 for thin, medium and thick shelled groups, respectively. Egg weight was significantly differed between thickness groups and thin shelled group had significantly higher egg weight than medium and thick shelled group ( $P < 0.01$ , Table 1). Eggs lost 0.59% of their weight at 3 days of storage and 1.59% at 11 days of storage ( $P < 0.01$ ). This was an expected result. Similarly, Egbeyale et al., (2013), reported the weight loss of pre-incubated eggs 0.52% at 3 days of storage and 1.97% at 12 days of storage. Thin and thick shelled eggs lost more weight than medium group ( $P < 0.05$ ). Incubation weight losses were ranged between 9.51% and 10.16% and did not significantly differ between egg shell thickness groups or storage periods. It is normal for eggs to loose %12 of weight during first 18 days of incubation (Tullet, 1990). Total weight losses of eggs did not differ between shell thickness groups, but 11 days stored eggs lost significantly higher weight than 3 days stored eggs (11.30% vs 10.31%,  $P < 0.05$ , Table 1). Conditions in the storage machine caused these weight loss rates not to be more different.

Table 1. Mean shell thickness and weight losses of egg shell thickness groups at different storage periods.

Shell Thickness Group	Storage Period (days)	Shell Thickness (mm)	Egg Weight (g)	Storage Weight Loss (%)	Incubation Weight Loss (%)	Total weight Loss (%)
Thin	3	0.284	65.32	0.62	10.08	10.63
	11	0.284	65.05	1.49	9.94	11.27
Medium	3	0.386	63.60	0.59	9.61	10.15
	11	0.389	63.32	1.46	9.91	11.22
Thick	3	0.461	63.41	0.56	9.66	10.17
	11	0.464	63.27	1.43	10.16	11.43
SEM		0.001	0.138	0.009	0.056	0.060
<b>EFFECTS</b>						
Shell Thickness		**	**	*	NS	NS
Thin		0.284 <sup>c</sup>	65.16 <sup>a</sup>	1.16 <sup>a</sup>	10.00	10.99
Medium		0.388 <sup>b</sup>	63.47 <sup>b</sup>	1.00 <sup>b</sup>	9.75	10.65
Thick		0.463 <sup>a</sup>	63.32 <sup>b</sup>	1.17 <sup>a</sup>	9.98	10.98
Storage Period		NS	NS	**	NS	**
3		0.377	64.11	0.59	9.78	10.31
11		0.379	63.88	1.46	10.00	11.30

\*: P<0.05; \*\*: P<0.01, SEM: Standard Error of Means, NS: Insignificant; a, b, c: Differences in superscript letters within columns represent significant differences between groups

Fertility, hatchability and incubation of egg shell thickness groups at different storage periods were given in Table 2. The rate of these traits did not significantly change between egg shell thickness groups. Similarly, Yamak et al., (2015) found that egg shell thickness groups did not affect hatching traits of broiler eggs. Fertility, hatchability and incubation yield was significantly affected by storage period (P<0.01; P<0.05, Table 2). Mean fertility was 94.7% at 3 days stored eggs, but decreased to 88.1% at 11 days of storage. Hatchability was 89.6% at 3 days stored eggs and decreased to 75.3% when eggs stored for 11 days. Based on fertility and hatchability, incubation yield decreased at 11 days storage compared to 3 days storage (84.9 % vs 66.5%). These findings were in line with the results of Egbeyale et al., (2013) who found that all hatching traits decreased at longer storage periods.

### **Conclusion**

Egg shell thicknesses of eggs were determined with an ultrasound gauge and the results of this study showed that egg shell thickness groups did not affect total weight loss and hatching traits of eggs. These findings were in contrast with the results of some previous studies. Using new technology and methods is an important factor on these findings. Storage period had significant effect on fertility, hatchability and incubation yield of eggs.

Table 2. Some hatching traits of egg shell thickness groups at different storage periods.

Shell Thickness Group	Storage Period (days)	Fertility (%)	Hatchability (%)	Incubation Yield (%)
Thin	3	95.0	93.1	88.4
	11	93.5	74.2	69.5
Medium	3	94.2	90.3	85.0
	11	89.5	79.5	71.2
Thick	3	95.0	85.5	81.3
	11	81.3	72.3	58.8
SEM		1.25	1.56	1.84
<b>EFFECTS</b>				
Shell Thickness		NS	NS	NS
Thin		94.3	83.6	78.9
Medium		91.9	84.9	78.1
Thick		88.2	78.9	70.1
Storage Period		*	**	**
3		94.7	89.6	84.9
11		88.1	75.3	66.5

\*: P<0.05; \*\*: P<0.01, SEM: Standard Error of Means, NS: Insignificant;

a, b, c: Differences in superscript letters within columns represent significant differences between groups

## References

- ASMUNDSON, V.S. AND MACILRAITH, J.J. (1948) Preincubation tests with turkey eggs. *Poultry Science* 27: 394-401.
- EGBEYALE, L.T., BOSHA, M.K., SOGUNLE, O.M., and ADELEYE, O.O., (2013) Effect of Pre-Incubation Storage Periods on Weight Loss, Embryonic Development, and Hatchability of Pullet Eggs. *The Pacific Journal of Science and Technology*.14(2): 416-424.
- ERGUN, O.F., YAMAK, U.S. (2017) The effect of eggshell thickness on hatchability of quail eggs, *Veterinary World*, 10(9): 1114-1117.
- ROCHA, J.S.R., BAIAO, N.C., BARBOSA, V.M., POMPEU, M.A., FERNANDES, M.N.S., LARA, L.J.C., MATIAS, C.F.Q., and BATISTA, J.V.M.S.P., (2013) Negative effects of fertile egg storage on the egg and the embryo and suggested hatchery management to minimize such problems. *World's Poultry Science Journal*, 69: 35-44.
- TULLET, S.G., (1990) Science and art of incubation. *Poultry Science*, 69: 1-15.
- YAMAK, U.S., SARICA, M., BOZ, M.A., ONDER, H., (2015) The effect of egg shell thickness on some hatching traits of broiler breeders. *Kafkas Univ. Vet. Fak. Derg.* 21 (3):421-424.

YAMAK, U.S., BOZ, M.A., UCAR, A., SARICA, M.,and ONDER, H., (2016) The effect of eggshell thickness on hatchability of guinea fowl and pheasants. Brazilian Poultry Science. Oct-Dec, Special Issue 2, Incubation, 53-58.

YAMAK, U.S., SARICA, M., BOZ, M.A.,and UCAR, A., (2016) The effect of eggshell thickness on hatching traits of partridges. Brazilian Poultry Science. July-Sep, Special Issue, Quails, 13-18.

## Effects of Dietary Replacement of Organic Minerals, Fish Oil and Hydrolyzed Collagen on Tibia Characteristics of Broiler Chickens

Bahadır Can Güz<sup>a</sup>, Roos Molenaar<sup>a</sup>, Ingrid de Jong<sup>b</sup>, Bas Kemp<sup>a</sup>,  
Henry van den Brand<sup>a</sup>, Marinus van Krimpen<sup>b</sup>

<sup>a</sup>Adaptation Physiology Group, Wageningen University & Research, The Netherlands

<sup>b</sup>Wageningen Livestock Research, Wageningen University & Research, The Netherlands

### Abstract

Nutrition is one of the most important factors for growth and bone development in broiler chickens. Alterations and replacements in broiler diets might affect bone development; it might contribute to locomotion related problems. This study was designed to evaluate effects of dietary replacement of organic minerals (OTM), fish oil (FISH) and hydrolyzed collagen (COL) on tibia characteristics of broiler chickens. A total of 384 one-day-old Ross 308 male broilers were used in a completely randomized pen design with 4 diet treatments and 8 replicates per treatment. In the OTM diet, the inorganic calcium, phosphorus and trace elements were replaced by their organic varieties. In the FISH diet, palm oil and soybean oil were partly (%91) replaced by fish oil. In the COL diet, soybean meal was partly (%14) replaced by hydrolyzed collagen. On day 28, 35 and 42, tibia length (TL), thickness (TT), head thickness (THT), mineral content (TMC), mineral density (TMD), breaking strength (TBS), stiffness (TSF) and energy to fracture (TEF) were measured (n=3/replicate). Tibia parameters were corrected for differences in BW. Birds of the OTM treatment had the longest TL at day 42; the longest THT at day 28; the highest TMC at day 42; the highest TMD at day 28, 35 and 42; the highest TBS at day 42; the highest TSF at day 35 and 42; and the highest TEF at day 42 compared to the other treatments. All tibia parameters of the FISH treatment showed a general tendency to lowest values. All tibia parameters of the COL and control treatments were ranked between OTM and FISH treatments throughout the experiment. It can be concluded that replacing inorganic Ca, P and trace elements in broiler diets by organic Ca, P and trace elements might stimulate tibia development.

**Key words:** Organic minerals, fish oil, collagen, broiler, tibia characteristics

# POSTER PRESENTATIONS

## SESSION-7

### MANAGEMENT

## Investigation of Growth Curves of Live Weight with Some Nonlinear Models in Broiler Chickens

Turgay Şengül<sup>a</sup>, Şenol Çelik<sup>a</sup>, Bünyamin Söğüt<sup>a</sup>, Hakan İnci<sup>a</sup>, Ömer Şengül<sup>b</sup>

<sup>a</sup>Bingol University, Faculty of Agriculture, Depart. of Anim. Sci., Bingol-TURKEY

<sup>b</sup>Uludag University, Faculty of Agriculture, Depart. of Anim. Sci., Bursa-TURKEY

### Abstract

This study was conducted to determine the live weight model of the broiler chicks by using the most appropriate mathematical growth curves. Live weights were used in broiler chicks grown for 0-6 weeks. Gompertz, Verhulst and Gauss models were used to define the live weights of the birds. In the comparison of the models, the determination coefficient ( $R^2$ ), mean square error (MSE) and model effectiveness (ME) values were used. As a result of the study, it is seen that Gompertz model is the best model to define live weight of the broilers in the Gompertz model,  $R^2$ , MSE, ME and growth rates for male broiler were 0.9998, 1880.228, 0.9995 and 0.241, respectively.

**Key words:** *Broiler, live weight, growth, nonlinear model*

### Introduction

Growth is a change in the weight and body size of a living organism that occurs during a certain period of time and is a characteristic of great economic importance in animal breeding (Akçapınar and Özbeyaz, 1999). The age-related change in the growth of living organism is called the growth curve (Malhado *et al.*, 2008, Agudelo-Gomez, 2009; Bayram and Akbulut, 2009; Prestes, 2012). In the course of reaching the adult weight, which grows to the end of the animal, biological parameters that have an important role in explaining the physiological growth with the growth curve models can be estimated (Behr *et al.*, 2001).

This study was conducted to investigate growth curves of live weight in broiler chickens with some nonlinear models.

### Material and Method

This study was carried out for 6 weeks in a poultry farm of Bingol University Faculty of Agriculture, Department of Animal Science. Forty eight male broiler chicks were used as animal material in the experiment. The chicks weighed weekly from the beginning to the sixth week of age. In the study, Gompertz, Verhulst and Gaussian models were used to estimate live weights of broiler chickens. The models used in this study were calculated as following;

The Gompertz growth model (Winsor, 1932)

$$Y_t = A * \exp(-b * \exp(-kt))$$

Verhulst growth model (Motulsky and Christopoulos, 2003),

$$Y_t = \frac{A}{1 - b * \exp(-k * t)}$$

Gauss growth model (Norusis, 2005),

$$Y_t = A * (1 - k * \exp(-kt^2))$$

In these models; A, B, k are growth curve parameters and,

A: Asymptotic size or weight, b: A measure of the starting size of the living (fixed), k: Growth constant, t, Time (age), Y: Live weight, A, B, k = Growth curve parameters. In order to determine the best model, goodness of fit criteria such as mean square errors (MSE), determination coefficient ( $R^2$ ) and model effectiveness (ME) were used. The mean error squares is obtained by dividing the error squares by the degree of freedom of the sum of squares. For the most appropriate model, the smallest MSE value is preferred (Bergerud and Sit, 1994; Nasri *et al.*, 2006).

Shortly, the equations are;

$$MSE = \frac{1}{n} \sum_{t=1}^n (Y_t - \hat{Y}_t)^2$$

determination coefficient ( $R^2$ ),

$$R^2 = \frac{\sum_{t=1}^n (\hat{Y}_t - \bar{Y})^2}{\sum_{t=1}^n (Y_t - \bar{Y})^2} = 1 - \frac{\sum_{t=1}^n (Y_t - \hat{Y}_t)^2}{\sum_{t=1}^n (Y_t - \bar{Y})^2}$$

(Lopez *et al.*, 2004; Şahin, 2009), model effectiveness (ME),

$$ME = \frac{\sum_{t=1}^n (\hat{Y}_t - Y_t)^2}{\sum_{t=1}^n (Y_t - \bar{Y})^2}$$

The model effectiveness value must be above 90% for the model to be effective (Mohanty and Painuli, 2004). Where n: number of observations,  $Y_t$ : observation value,  $\hat{Y}_t$ : estimate value.

## Results

The live weight values of broiler were compared with the Gompertz, Verhulst and Gauss models and the results are given in Table 1.

Table 1. Growth model parameters and fitness for goodness criteria for live weight in broiler chickens

Parameters	Gompertz	Verhulst	Gauss
A	6854.354	3136.722	9404.129
b	4.882	-37.106	0.993
k	0.241	0.736	0.007
R <sup>2</sup>	0.9998	0.9997	0.9996
MSE	1880.228	2517.308	3299.762
ME	0.9995	0.9993	0.9991

As shown in Table 1, the mean square error (MSE) in the Gompertz model was 1880.228, the coefficient of determination (R<sup>2</sup>) was 0.9998, the model effectiveness (ME) was 0.9995, and the growth rate was k = 0.241 in the broiler. In the Verhulst model, MSE was found as 2517.308, R<sup>2</sup> = 0.9997, model effectiveness (ME) = 0.9993 and growth rate k = 0.736. In the Gaussian model, MSE was found to be 3299.762, R<sup>2</sup> = 0.9996, ME = 0.9991 and growth rate k = 0.007.

## Conclusion

In this study, the growth rate of male broiler chickens from the beginning to the experiment to the age of 6 weeks was compared. The 3 models examined were found suitable for live weight data of chickens. The R<sup>2</sup> and ME values of all models are very high. Models have been shown to be effective because the models' efficiency values were above 0.90 in all models. As a result, it was determined that the best model explaining the weight-age variation of broiler chickens was the Gompertz model.

## References

- AGUDELO-GÓMEZ D, HURTADO-LUGO N, and CERÓN-MUÑOZ MF. (2009) Growth curves and genetic parameters in Colombian buffaloes (*Bubalus bubalis artiodactyla*, *Bovidae*). *Rev Colomb Cienc Pecu*, 22, 178-188.
- AKÇAPINAR H, ÖZBEYAZ C. (1999) Hayvan Yetiştiriciliği Temel İlkeleri. Kariyer Matbaacılık Ltd. Şti. Ankara.
- BEHR V, HORNICK JL, CABARAUX JF, ALVAREZ A, and ISTASSE L. (2001) Growth patterns of Belgian Blue replacement heifers and growing males in commercial faMSR. *Livest Prod Sci*, 71, 121-130.

- BAYRAM, B., AKBULUT, Ö. (2009) Esmer ve Siyah Alaca sığırlarda büyüme eğrilerinin doğrusal ve doğrusal olmayan modellerle analizi. *Hayvansal Üretim* 50(2): 33-40.
- Bergerud, W., Sit, V. 1994. *Catalog of curves for curve fitting*. Crown Publication Inc. Victoria, B.C., p110.
- LOPEZ, S., PRIETO, M., DIJKSTRA, J., DHANOA, M. S., and FRANCE, J. (2004) Statistical evaluation of mathematical models for microbial growth. *International Journal of Food Microbiology*, 96: 289-300.
- MALHADO, CHM, RAMOS AA, CARNEIRO PLS, SOUZA JC, WECHSLER FS, ELER JP, AZEVEDOY DMMR, and SERENO JRB. (2008) Nonlinear models to describe the growth of the buffaloes of Murrah breed. *Arch Zootec*, 57(220): 497-503.
- MOHANTY M., PAINULI, D. K. (2004) Modelling rice seedling emergence growth and under tillage and residue management in a rice-wheat system on vertisol in Central India. *Soil and Tillage Research* 76: 167-174.
- MOTULSKY, H. J., CHRISTOPOULOS, A. (2003) Fitting models to biological data using linear and nonlinear regression. In: *A Practical Guide to Curve Fitting*. Graphpad Software Inc, San Diego, Ca, USA. p351.
- NASRI, M. H. F., MESGARAN, M. D., FRANCE, J., CANT, J. P., and KEBREAB, E. (2006) Evaluation of models to describe ruminal degradation kinetics from in situ ruminal incubation of whole soybeans. *American Dairy Science Association*, 89:3087-3095.
- NORUSIS, M. J., (2005) *SPSS 14.0 Advanced Statistical Procedures Companion*. Prentice Hall, A division of Pearson Education, Upper Saddle River, NJ 07458.
- PRESTES AM, GARNERO ADV, MARCONDES CR, DAMÉ MC, JANNER EA, and RORATO PRN. (2012) Estudo da curva de crescimento de bubalinos da raça Murrah criados no estado do Rio Grande do Sul. IX Simpósio Brasileiro de Melhoramento Animal João Pessoa. PB-20 22 de junho de 2012 SBMA.
- ŞAHİN, M. (2009) Parçalı regresyonlar ve tarımsal alanlarda kullanımı. KSÜ Fen Bilimleri Enstitüsü. Yüksek Lisans Tezi. Kahramanmaraş.
- WINSOR, C. P. (1932) The Gompertz curve as a growth curve. *Proc. National Academy of Science*. Vol. 18: No.1.

## Relations Between Welfare and Health of Laying Hens in Cage System

Kadir Erensoy, Musa Sarıca, Umut Sami Yamak

Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science,  
Samsun, Turkey

### Abstract

The evaluation of animal welfare requires information on all aspects of the animal's health status. Many factors such as disease, skeletal and foot health, harmful and parasitic load, behavior, stress, emotional state, nutrition and genetics affect the level of laying hens welfare. Assessment of animal health can be classified as infectious diseases, parasitic infestations, production diseases, physical damage, and air quality, mortality. This paper reviews infectious, parasitic and production diseases classifications related to welfare of laying hens in cage system. It is aimed to deal with the relation between welfare and health parameters in this study.

**Key words:** *Cage, Health, Laying Hen, Welfare*

### Kafes Sisteminde Barındırılan Yumurta Tavuklarında Refah ve Sağlık İlişkileri

#### Özet

Hayvan refahının değerlendirilmesi hayvanın sağlık durumunun tüm yönleri hakkında bilgi gerektirir. Hastalık, iskelet ve ayak sağlığı, zararlı ve parazit yükü, davranış, stres, duygusal durum, beslenme ve genetik yapı gibi çok sayıda faktör yumurtacı tavukların refahını etkiler. Hayvan sağlığı ile refah ilişkisinin ortaya koyulmasında bulaşıcı hastalıklar, parazit enfestasyonları, üretim hastalıkları, fiziksel yaralanmalar, hava kalitesi ve ölüm oranı gibi parametreler ele alınmaktadır. Bu çalışmada kafes sisteminde barındırılan yumurta tavuklarının sağlık parametreleri ile refah durumları arasındaki ilişkiler irdelenmiştir.

**Anahtar kelimeler:** *Kafes, Sağlık, Yumurta Tavuğu, Refah*

#### Introduction

The welfare of laying hens is a big concern in developed countries, especially in EU and egg industry (EFSA, 2005; EC, 2007). Cage space per layer is limited in conventional cage systems. Social concerns about animal welfare have played a major role in the development of alternative systems at the point of improving the welfare of layings in cage systems. It is aimed

to improve welfare of laying hens and especially to display behavioral traits (nesting, dust-bath, perching, wing flapping, mobility), however transition to non-cage systems can increase risk of some welfare problems such as infectious diseases and parasitic load as well as improvement of behavioral repertoire (EFSA, 2005).

Welfare is the ability to overcome the conditions in which a layer is found. A combination of adequate nutrition, a favorable environment, optimal health, exhibiting normal behavior, and positive mental experience are indicators for good welfare in laying hens (Hartcher and Jones, 2017). The evaluation of animal welfare requires information on all aspects of the animal's health status. Many factors such as disease, skeletal and foot health, parasitic load, behavior, stress, emotional state, nutrition and genetics affect the level of laying hens' welfare (Lay et al., 2011). Assessment of the effects of housing systems on animal health can be classified as infectious and parasitic diseases, production diseases, physical damage, air quality and mortality (EFSA, 2005). Here, we review infectious diseases (bacterial and viral diseases), parasitic load (ectoparasites) and production diseases (reproductive organs diseases, fatty liver haemorrhagic syndrome (FLSH), osteoporosis) related to welfare of laying hens in cage system (Table 1).

**Table 1. Welfare and health status of laying hens in different housing systems\***

Welfare Indicators	Conventional Cages	Non-cages	Outdoor
Health			
Infectious diseases	Low	Low (variable)	Low (very variable)
Parasitic load	Low	Moderate (variable)	Very high
Skeletal quality and foot health			
Skeletal quality	Low	Low/Moderate	Low/Moderate
Osteoporosis	Very high	Low	Low
Foot pad dermatitis/ Bumblefoot/ Hyperkeratosis	Moderate	Low	Low
Claws	Low	High	High

\*This table revised from EFSA (2005) and Lay et al. (2011).

### **Infectious and Parasitic Diseases**

Prevention and control of diseases and parasites are considered as the basis for animal welfare. Escherichia coli peritonitis, coccidiosis, necrotic enteritis, mycoplasma gallisepticum, calcium depletion-tetany and infectious bronchitis have been listed as common diseases for poultry (United States Animal Health Association, 2007). Generally, bacterial and viral diseases, coccidiosis and red mites are more common in litter-based and free range systems than cage systems (Rodenburg et al., 2008; Fossum et al., 2009;

Widowski et al., 2013). Access to free range area increases the transmission risk of dangerous infectious diseases such as avian influenza, newcastle and parasitic load such as ectoparasites from wild birds (Lay et al., 2011; Widowski et al., 2013). Kreienbrock et al. (2003) reported that the incidence of bacterial infection and external parasites were found high in the litter area and free range system. Related to this, use of antibiotics and acaricides was higher laying hens in these systems. It is understood that these problems have not been experienced more laying hens in cages that are not accessible to the litter material and free range area.

Bacterial and protozoan infections such as erysipelas, *E. coli*, pasteurellosis and ascaridia show a considerable increase in prevalence laying hens in floor-based compared with cages (Hane et al., 2000; Hafez, 2001; Hafez et al. 2001; Permin, et al., 2002; Esquenet et al., 2003; SVA, 2004); this is because wild birds are a source of many infections for domestic poultry (Halvorson et al., 1982). Free range laying hens are very vulnerable to the hazards and infectious diseases that may arise from wild birds. However, these risks are lower in layers housed in closed systems such as the cage system (SANCO, 2003). Hens in litter-based and free-range systems had greater mortality associated with viral disease (lymphoid leukosis, Marek's disease, and Newcastle disease), coccidiosis, and red mites (*Dermanyssus gallinae*) compared with hens in conventional cages which are relatively sterile systems, are not suitable environments for ectoparasites (Lay et al., 2011). Therefore, it is understood that the ectoparasitic risk is lower in conventional cage systems than non-cage systems.

Free range systems increase microbial contamination from soil, direct contact with parasites and increased risk of infectious disease. Precautions such as vaccination, disinfection and biosecurity are common procedures applied to all housing systems for the least risk of disease.

### **Production Diseases**

Reproductive disorders are often diagnosed during the necropsy of laying hens. These disorders include salpingitis, ovarian obstruction, prolapse and usually followed by peritonitis and other abdominal changes (EFSA, 2005). Abrahamsson and Tauson (1997) reported that mortality due to salpingitis to be less than 1% in conventional cages. Reproductive disorders do not appear to be associated with a particular housing system. Salpingitis and peritonitis may be caused by pecking around the cloaca in non-cage systems (Engström and Schaller, 1993; Ekstrand et al., 1996; Abrahamsson et al., 1998) and in aviaries, when birds were not beak trimmed (Michel and Pol, 2001) than in conventional cages.

The fatty liver Hemorrhagic Syndrome (FLHS) is a typical production disease encountered laying hens in conventional cage systems. Kaufmann-Bartand and Hoop (2009) reported an increase in fatty liver in cage systems compared with those on litter-based and free-range systems, and also similar signs were reported by Weitzenbürger et al. (2005).

Osteoporosis is widespread in today's commercial laying hens and contributes to approximately 20 to 35% of all mortalities during the egg production cycle of caged hens (Anderson, 2002). Laying hens in conventional cages are increasingly susceptible to osteoporosis which a major skeletal health problem resulting from lack of exercise compared to litter-based systems (Fleming et al., 1994; Whitehead and Fleming, 2000; Jendral et al., 2008). It is generally accepted that the main cause of bone fragility is the general restriction of movement in laying hens (Michel and Huonnic, 2003), although mineral deficiencies in the feed as well as high egg production, primarily lead to weakening of the leg and wing bones. Increased opportunities for movement can improve bone strength to a certain extent.

### Conclusions

It is seen that alternative systems are not sufficient to improve the welfare of animals completely compare with cage systems. Particularly, it is understood that the risk of contracting infectious diseases and parasitic infection is more prevalent in free range systems, but the limited mobility affects skeletal quality in cage systems.

### References

- ABRAHAMSON, P., FOSSUM, O. and TAUSON, R. (1998) Health of laying hens in an aviary system over five batches of birds. *Acta veterinaria scandinavica*, 39: 367-379.
- ABRAHAMSSON, P. and TAUSON, R. (1997) Effects of group size on performance, health and birds' use of facilities in FCs for laying hens. *Acta Agriculture Scandinavica*, Sect. A.
- ANDERSON, K.E. (2002) Final report of the thirty fourth North Carolina layer performance and management test. *Cooperative Extension Service*, North Carolina State University, Raleigh.
- EKSTRAND, C., ALGERS, B., GEISMAR, J., GUNNARSSON, S., ODÉN, K., ONILA, M. and SVEDBERG, J. (1996) Utvärdering av inhysningssystemet Oli-voletage för frigående värphöns. *Svensk Veterinärtidning*, 48(6): 286-294.
- ENGSTROM, B. and SCHALLER, G. (1993) Experimental studies of the health of laying hens in relation to housing system. *Proc. 4th European Symposium on Poultry Welfare*, Eds. C.J. Savory and B.O. Hughes, Universities federation of Animal Welfare, Potters Bar, 87-96.
- ESQUENET, C., DE HERT, P., DE BOSSCHERE, H., RONSMANS, S., DUCATELLE, R. and VAN ERUM, J. (2003) An outbreak of histomoniasis in free-range layer hens. *Avian Pathology*, 32(3):305-308.
- EUROPEAN COMMISSION. (2007) Attitudes of EU citizens towards the welfare of farmed animals. Available online: [http://ec.europa.eu/food/animal/welfare/survey/sp\\_barometer\\_aw\\_en.pdf](http://ec.europa.eu/food/animal/welfare/survey/sp_barometer_aw_en.pdf) (accessed on 26 Dec 2017).

- EUROPEAN FOOD SAFETY AUTHORITY. (2005) Opinion of the Scientific Panel on Animal Health and Welfare on a request from the Commission related to the welfare aspects of various systems of keeping laying hens: 4.2. Animal Health Affected by Systems (Chapter 4 of the Report). *The EFSA Journal*, Vol. 197, 1-23, <http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2005.197/epdf> Accessed Dec. 2017.
- FLEMING, R.H., WHITEHAED, C.C., ALVEY, GREGORY, N.G. and WILKINS, L.J. (1994) Bone structure and breaking strength in laying hens housed in different husbandry systems. *Br. Poult. Sci.* 35: 651-662.
- FOSSUM, O., JANSSON, D.S., ETTERLIN, P.E. and VÅGSHOLM, I. (2009) Causes of mortality in laying hens in different housing systems in 2001 to 2004. *Acta Veterinaria Scandinavica* 51: 1-9.
- HAFEZ, M. (2001) Emerging and re-emerging bacterial infections in poultry and their significance to the poultry industry. In Proceedings XII International Congress of the World Veterinarian Poultry Association, Cairo-Egypt, *The Egyptian Branch of the World Veterinary Poultry Association*. Pp. 67-76.
- HAFEZ, M., MAZAHERI, A., PRUSAS, C., BOHLAND, K., POPPEL, M. and SCHULZE, D. (2001) Aktuelle Geflügelkrankheiten bei Legehennen im Zusammenhang mit alternativen Haltungssystemen. *Tierärztl. Prax.* 29(G):168-74.
- HALVORSON, D., KARUNAKARAN, D., SENNE, D., KELLEHER, C., BAILEY, C., ABRAHAM, A., HINSHAW, V. and NEWMAN, J. (1982) Epizootiology of avian influenza simultaneous monitoring of sentinel ducks and turkeys in Minnesota. *Avian Dis.* 27:77-85.
- HANE, M., HUBEREICHER, B. and FROHLICH, E. (2000) Survey of laying hen husbandry in Switzerland. *World's Poultry Science Journal*, 56: 21-31.
- HARTCHER, K. and JONES, B. (2017) The welfare of layer hens in cage and cage-free housing systems. *World's Poultry Science Journal*, 73(4), 767-782.
- JENDRAL, M.J., KORVER, D.R., CHURCH, J.S. and FEDDES, J.J.R. (2008) Bone mineral density and breaking strength of White Leghorns housed in conventional, modified, and commercially available colony battery cages. *Poult. Sci.*, 87: 828-837.
- KAUFMANN-BART, M. and HOOP., R.K. (2009) Diseases in chicks and laying hens during the first 12 years after battery cages were banned. *Vet. Rec.* 164:203-207.
- KREIENBROCK, L., SCHNEIDER, B., SCHAL, J. and GLASER, S. (2003) Epileg-Orientierende epidemiologische Untersuchung zum Leistungsniveau und Gesundheitsstatus in Legehennenhaltungen verschiedener Haltungssysteme. Zwischenbericht: Deskriptive Auswertung. 1. Institut für Biometrie, Epidemiologie und Informationsverarbeitung (IBEI), Hannover, Germany.

- LAY, D.C., FULTON, R.M., HESTER, P.Y., KARCHER, D.M., KJAER, J.B., MENCH, J.A., MULLENS, B.A., NEWBERRY, R.C., NICOL, C.J., O'SULLIVAN, N.P., and PORTER, R.E. (2011) Hen welfare in different housing systems, *Poultry Science*, 90(1):278-294.
- MICHEL, V. and HUONNIC, D. (2003) A comparison of welfare, health and production performance of laying hens reared in cages or aviaries. *Br. Poult Sci.*, 43:775-776.
- MICHEL, V. and POL, F. (2001) Comparaison de l'élevage de poules pondeuses, avant et pendant la période de ponte, dans un système alternatif de type volière et dans un système classique de cages en batteries. Première étude. *Final report for french ministry of agriculture*.
- PERMIN, A., AMBROSEN, T., MAGG EIGAARD, N., FOLDEN FLENSBURG, M., BOJESEN, M., CHRISTENSEN, J.P. and BISGAARD, M. (2002) Sygdomme och velfærd – iökologiske og fritgående h nsehold. *Dansk Veterinærtidsskrift*, 85(6): 12-16.
- RODENBURG, T.B., TUYTTENS, F.A.M., DE REU, K., HERMAN, L., ZOONS, J. and SONCK, B. (2008) Welfare assessment of laying hens in furnished cages and non-cage systems: An on-farm comparison. *Anim. Welf.*, 17:363–373.
- SANCO. (2003) *Control strategies for Avian influenza*. 10612/2003. Directorate E.
- SVA. (2004) National Veterinary Institute of Sweden, Personal communication. 751 89 Uppsala, Sweden.
- UNITED STATES ANIMAL HEALTH ASSOCIATION. (2007) Report of the Committee on Transmissible Diseases of Poultry and Other Avian Species. Available online: <http://www.usaha.org/committees/reports/2007/report-pad-2007.pdf>, Accessed.: Dec. 2017.
- WEITZENBURGER, D., VITS, A., HAMANN, H. and DISTL, O. (2005) Effect of furnished small group housing systems and furnished cages on mortality and causes of death in two layer strains. *Br. Poult. Sci.*, 46: 553-559.
- WHITEHEAD, C.C., and FLEMING, R.H. (2000) Osteoporosis in cage layers. *Poult. Sci.* 79:1033–1041.
- WIDOWSKI, T.M., CLASSEN, H., NEWBERRY, R.C., PETRIK, M., SCHWEAN-LARDNER, K., COTTEE, S. and COX, B. (2013) Code of practice for the care and handling of pullets, layers, and spent fowl: poultry (layers): Review of scientific research on priority issues. Poultry (Layer) Code of Practice Scientific Committee, National Farm Animal Care Council, Canada. Available at: [https://www.nfacc.ca/resources/codes-of-practice/poultry-layers/Layer\\_SCReport\\_2013.pdf](https://www.nfacc.ca/resources/codes-of-practice/poultry-layers/Layer_SCReport_2013.pdf).

## The Effect of Altitude on Some Performance and Structural Features of The Village Chicken Production: Artvin Province Example

Eren Bayraktar<sup>a</sup>, Ahmet Şekeroğlu<sup>b</sup>, Mustafa Duman<sup>c</sup>

<sup>a</sup>Gaziosmanpaşa University, Graduate School of Natural and Applied Sciences, Tokat-Turkey

<sup>b</sup>Niğde Ömer Halisdemir University, Ayhan Sahenk Faculty of Agricultural Sciences and Technologies, Department of Animal Production and Technologies, Niğde –Turkey

<sup>c</sup>Niğde Ömer Halisdemir University, Bor Vocational, School, Department of Laboratory and Veterinary Health, Bor, Niğde – Turkey

### Abstract

It was aimed to investigate the poultry farming in Artvin region with this study. In this study, Artvin is divided into three zones according to the province heights as 0 - 500 m (Zone 1), 501 m - 1000 m (Zone 2) and >1001 m (Zone 3). In order to determine the performance characteristics of chickens, 3 enterprises from 3 villages were determined from each zone. At the beginning of the experiment, average live weights of chickens were determined. The number of incubating chicken, the number of eggs for natural incubation for each incubating chicken, the number of healthy chicks from each natural incubation and the daily egg production were recorded for nine months (from April to November in 2010). Egg weights were determined by weighing the eggs obtained in one day each month. A survey was conducted in face-to-face interviews with totally 23 villages and 223 enterprises for the purpose of determine the structural characteristics of village chicken production in Artvin. There was a significant difference between zones in terms of educational status of family members, number of individuals in the families, number of poultry species, preference of chicken genotype, the number of eggs placed under the incubating chickens, egg weight. In this study, which investigated Artvin village chicken production, it was determined that there was no commercial purpose of the village chicken farms, farmers mostly prefer native chicken and no modern techniques were used in production. In terms of these characteristics, village chicken production system in Artvin carries the characteristics of traditional village chicken production systems.

**Key words:** Artvin, Altitude, Village Chicken

### Rakımın Köy Tavukçuluğundaki Bazı Performans ve Yapısal Özellikler Üzerine Etkisi: Artvin İli Örneği

#### Özet

Bu çalışma ile Artvin ili köy tavukçuluğunun incelenmesi amaçlanmıştır. Bu çalışmada Artvin, ili yüksekliklerine göre 0-500 m (Bölge 1), 501 m - 1000

m (Bölge 2) ve >1001 m (Bölge 3) olmak üzere üç bölgeye ayrılmıştır. Tavukların performans özelliklerini belirlemek amacıyla, her bölgede 3 köyden 3 işletme tespit edilmiştir. Araştırmanın başlangıcında tavukların ortalama canlı ağırlıkları belirlenmiştir. Kuluçkaya yatan tavuk sayısı, kuluçkaya konulan yumurta sayısı, doğal kuluçkadan çıkan sağlıklı civciv sayısı ve günlük yumurta verimi dokuz ay boyunca (Nisan-Kasım 2010 arasında) kaydedildi. Yumurta ağırlıkları, her ayın bir gününde elde edilen yumurtaların tartılması ile belirlenmiştir. Artvin'de köy tavuğu üretiminin yapısal özelliklerini belirlemek amacıyla toplam 23 köy ve 223 işletme ile yüz yüze görüşmeler yapıldı. Bölgeler arasında, aile üyelerinin eğitim durumu, ailedeki bireylerin sayısı, çiftlikteki kanatlı sayısı, genotip tercihi, kuluçkadaki tavukların altına yerleştirilen yumurta sayısı ve yumurta ağırlığı açısından istatistiki farklılık tespit edilmiştir. Artvin köy tavukçuluğunun incelendiği bu çalışmada işletmelerin ticari bir amacının olmadığı, çiftçilerin çoğunlukla yerli tavuğu tercih ettiği ve üretimde modern teknikler kullanılmadığı tespit edildi. Bu özellikler açısından, Artvin'deki köy tavuğu üretim sistemi, geleneksel köy tavuğu üretim sistemlerinin özelliklerini taşımaktadır.

*Anahtar kelimeler:* Artvin, Rakım, Köy Tavukçuluğu

## Introduction

Healthy and quality products can be produced at extremely low cost in intensive production systems, However, in some countries it is not possible to establish and maintain commercial enterprises that can use advanced technology. For this reason, despite the intensive production system developments, traditional production at village conditions has not been affected by these developments (Aksoy et al., 2007).

Village chicken production in Turkey aims to meet the needs of family and to offer visitors some egg and chicken meat. If production surplus occurs, the product is sold in small local markets (Türkoğlu and Eleroğlu, 1999). With this study, it was aimed to investigate the poultry farming in Artvin region and to help the work to be done in this area.

## Material and methods

Artvin is located in Eastern Black Sea Region of Turkey with an area of 7367 km<sup>2</sup>. In this study, Artvin is divided into three zones according to the province heights as 0 - 500 m (Zone 1), 501 m - 1000 m (Zone 2) and >1001 m (Zone 3). 10% of the total villages were randomly selected from each zone and 10 families were randomly selected from the determined villages.

In order to determine the performance characteristics of chickens before the survey study, 3 enterprises from 3 villages were determined in each zone. At the beginning of the experiment, average live weights of chickens were

determined. The number of incubating chicken, the number of eggs for natural incubation for each incubating chicken, the number of healthy chicks from each natural incubation and the daily egg production were recorded for nine months (from April to November in 2010). The incubation yield was calculated from these records. Egg weights were determined by weighing the eggs obtained in one day each month.

A survey was conducted in face-to-face interviews with 5 villages and 47 enterprises from Zone 1, 6 villages and 60 enterprises from Zone 2 and, 12 villages and 116 enterprises from Zone 3 (Totally 23 villages and 223 enterprises). Careful attention has been paid to the presence of two people in each family in order to answer the questions correctly. The characteristics such as the educational status of the individuals, the number of family members, the animal species in enterprise, the poultry species in enterprise, the genotype of the chickens, the type of feed used, the frequency of feeding and the type of follicle were questioned in survey for the determination of the structural features of the enterprises.

Variance analysis method was applied to data after performing angular transformation to the data expressed as % in this study. A comparison of the means was made using the Duncan multiple range test (Bek and Efe, 1988).

## **Results and Discussion**

### ***Structural Features***

It was determined that 20,17% of the family members in the study area were primary school graduates, 43,75% were middle school graduates, 31,53% were high school graduates and 2,17% were college graduates ( $P<0,05$ ). In the 1st, 2nd and 3rd zones, the number of individuals in the families is 3,91; 4,29 and 4,80 persons respectively ( $P<0,01$ ) and an average of 4.33 persons. The number of individuals in the families increases with the increase in the altitude.

When the average of the animal species in the enterprises are taken into account, the number of cattle, sheep, goat and poultry are 1.78; 2.33; 0.61 and 14.74, respectively. In this study, the results obtained for the animal species found in the enterprises were found to be higher than the number of sheep and poultry indicated by Sekeroglu and Aksimsek (2009) and less than that of cattle. By the number of poultry species owned by the enterprises, the amount of chicken, goose, turkey and duck was 13.94; 0.11; 0.34 and 0.36, respectively ( $P<0,01$ ). In this study, the amount of poultry in enterprises was found to be lower than the value (18,8) of Khalafalla et al. (2002) but more than the amount (8,69) of Sekeroglu and Aksimsek (2009). There was statistically significant difference ( $P<0,01$ ) between preference of native genotypes (83.76%), commercial hybrids (12.12%) and mixed genotypes (4.11%) in Artvin region. Sekeroglu and Aksimsek (2009) reported that

native genotypes were preferred at 95,5% in village chicken poultry in Tokat. The use of wheat, corn, barley, mixed and concentrated feed in the study area was 25,11%; 20.71%; 22.50%; 19.57% and 12.11% respectively. It can be said that considering the feeds given by the enterprises in the research area, they have the characteristics of traditional and developed village poultry. The average daily feeding frequency of the poultry farms in the zone 1, 2 and 3 were 16.63%; 79.98% and 3.40% ( $P>0.01$ ) respectively. It has been determined that farmers mostly prefer wooden-basket (%46,12) as a nesting-box.

### ***Performance Features***

According to the data obtained in the study area, the average live weights of chickens were 2.56 kg, 2.31 kg and 2.27 kg in the Zone 1, Zone 2 and Zone 3; respectively. As the altitude increased in the study area, the decrease in live weights of chickens did not make statistical difference ( $P> 0,05$ ). The annual number of incubation of chickens in Zone 1, Zone 2 and Zone 3 was 1.5, 2.17 and 1.33, respectively ( $P> 0.05$ ). The number of eggs placed under the incubating chickens were 13,31; 13,31 and 10,22 in Zone 1, Zone 2 and Zone 3, respectively ( $P<0,05$ ). These results are consistent with results of Benabdeljelil et al. (2001) (13-14), Mwalusya et al. (2002) (11,8) and Sekeroglu and Aksimsek (2009) (11,39 - 12,42). The mean number of healthy chicks from each incubation was determined as 9,98 in Zone 1; 8,00 in Zone 2 and 7,36 in Zone 3 ( $P>0,05$ ). The incubation yields in the Zone 1, Zone 2 and Zone 3 regions were 74.98%; 73.77% and 72.02% respectively ( $P>0.05$ ). This incubation yield was in harmony with the results that reported by Abdelqader et al. (2007) (71.2% - 85.5%) and Sonaiya et al. (2002) (71% - 79%).

Egg weights were 55.69 g, 57.74 g and 56.17 in the 1st, 2nd and 3rd zones respectively. It was found that the eggs in the Zone 2 were heavier than the eggs in the Zone 1 and Zone 3 ( $P<0.01$ ). Egg yields in the Zone 1, Zone 2 and Zone 3 were 139,38; 142,01 and 130,53 pcs/year, respectively ( $P>0,05$ ). These values are showing affinity with the results of previous researches such as Yurt (2002) (80 – 170 pcs/year), Şekeroğlu and Sarıca (2005) (158,6 - 162,1 pcs/year) and Güngördü (2008) (100 – 149 pcs/year).

### **Conclusion**

In this study, which investigated Artvin village chicken production, it was determined that there was no commercial purpose of the village chicken farms, farmers mostly prefer native chicken and no modern techniques were used in production. In terms of these characteristics, village chicken production system in Artvin carries the characteristics of traditional village chicken production systems.

## References

- AKSOY, T., YURT, Z., İLASLAN Ç. D. and YAPICI, N. (2007) Dünyada ve ülkemizde köy tavukçuluğu. 5. *Ulusal Zootekni Bilim Kongresi*, Van, pp. 56.
- ABDELQADER, A., WOLLNY C.B.A. and GAULY, M. (2007). Characterization of local chicken production systems and their potential under different levels of management practice in Jordan. *Tropical Animal Health and Production* 39: 155–164.
- BENABDELJELİL, K., ARFAOUİ, T. and JOHNSTON, P. (2001) Traditional poultry farming in morocco. *Livestock Community ve Environment Proceedings of the 10th Conference of the Association of Institutions for Tropical Veterinary Medicine*, Copenhagen, pp.7.
- GÜNGÖRDÜ, S. (2009) Batman ili köy tavukçuluğunun durumu. Ph.D. Thesis, Van Yüzüncü Yıl University, Institute of Science and Technology.
- KHALAFALLA, A.I., AWAD, S. and HASS, W. (2002) Village poultry production in the Sudan Characteristics ve parameters of family poultry production in Africa. *International Atomic Energy Agency (IAEA)*, pp. 87-94
- MWALUSANYA, N.A., KATULE, A.M. MUTAYOBA, S.K. MTAMBO, M.M.A. OLSEN, J.E. and MINGA, U.M. (2002) Productivity of local chickens under village management conditions. *Tropical Animal Health ve Production*, 34: 405–416.
- PANDEY, V.S. (1992) Epidemiology ve economics of villages poultry production in Africa. ( Editors Pandey, V.S. ve Demey, F.) *Overview Conference Proceedings, Village Poultry Production In Africa*, Rabat, pp.124–128
- TÜRKOĞLU, M. and ELEROĞLU, H. (1999) Serbest broiler yetiştiriciliği. *VIV Poultry Yutav'99. Uluslararası Tavukçuluk Fuarı ve Konferansı*, İstanbul, pp. 110-122.
- SONAİYA, E. B., DAZOGBO, J. S. and OLUKOSI, O. A. (2002) Further assessment of scavengable feed resource base. In: Characteristics ve Parameters Of Family Poultry Production in Africa, pp. 193-200.
- ŞEKEROĞLU, A. and AKŞİMŞEK, Ş.D. (2009) Some characteristics of village poultry in Tokat province. *Anadolu Journal of Agricultural Sciences*, 24:108-113.
- ŞEKEROĞLU, A. and SARICA, M. (2005) The effects of free range system on egg productions and egg quality of brown and white layer genotypes. *Journal of Poultry Research*, 6: 10-16.

## A Comparative Morphometric Study On Os Hyoideum Of Female And Male Geese Growing In Kars

Gülseren Kırbaş\*, İsmet Takcı

Kafkas University, Faculty of Veterinary Medicine, Department of Anatomy, Kars, Turkey

\*Corresponding: glsrn36@gmail.com

### Abstract

Domestic goose (*Anser anser domesticus*) is found in the Anserinae subfamily of the Anatidae family of the Anseriformes family. The aim of this study is to compare morphometrically the os hyoideum of female and male geese. A total of 20 goose cadavers, weighing 3-5 kg, 10 female and 10 male, were used in this study. It was seen that os entoglossum was flattened and ended with a cartilaginous tip. Length of os entoglossum (EGU)  $33.07 \pm 1.1$  mm in female geese,  $38.05 \pm 0.6$  mm in male geese, Urohyale's height (UB)  $2.3 \pm 0.8$  mm in female geese, and  $14.5 \pm 0.5$  mm in male geese. In conclusion, the os entoglossum is more prolonged in male geese than the female.

**Key words:** *Anatomy, Goose, Os hyoideum*

### Kars Yöresinde Yetiştirilen Dişi Ve Erkek Kazların Os Hyoideum'ları Üzerinde Karşılaştırmalı Morfometrik Bir Çalışma

#### Özet

Evcil kaz (*Anser anser domesticus*), Anseriformes takımının Anatidae familyasının Anserinae alt familyasında bulunur. Bu çalışmanın amacı, dişi ve erkek kazların os hyoideum'larının morfometrik olarak karşılaştırmaktır. Bu çalışmada 3-5 kg ağırlığında, 10 dişi ve 10 erkek olmak üzere toplam 20 kaz kadavrası kullanıldı. Os entoglossum'un yassılaştığı olduğu ve kıkırdak bir uçla sonlandığı görüldü. Os entoglossum uzunluğu (EGU); dişi kazlarda  $33,07 \pm 1,1$  mm, erkek kazlarda  $38,05 \pm 0,6$  mm, Urohyale'nin boyu (UB); dişi kazlarda  $2,3 \pm 0,8$  mm, erkek kazlarda  $14,5 \pm 0,5$  mm olarak ölçüldü. Sonuç olarak, os entoglossum'un erkek kazda dişi kazlara göre daha uzun olduğu belirlendi.

**Anahtar kelimeler:** *Anatomi, Kaz, Os hyoideum*

## Introduction

Domestic goose (*Anser anser domesticus*) is found in the Anserinae subfamily of the Anatidae family of the Anseriformes family. There are differences in poultry tongues and tongue bones compared to domestic mammals. There have also been reported to be species differences between the birds. Os hyoideum consist of; (corpus) in the middle, ramus hyoideum connecting to the corpus on both sides, urohyale (carina) extending to the caudal, and os entoglossum on the front end of the corpus (Gültekin, 1966; Nickel *et al.*, 1977). The aim of this study is to compare morphometrically the os hyoideum of female and male geese breeding in Kars region, Turkey.

## Materials and Methods

A total of 20 goose carcasses weighing 3-5 kg, 10 females and 10 males at 1 year of age were used in the study. The tongue muscles of the geese to be worked on are dissected. After boiling and drying, measurements were taken with the aid of digital calipers from each animal of each bones. It was displayed with a photographed. Terminological expressions were used based on Nomina Anatomica Avium (Baumel *et al.*, 1993). The data accumulated have been evaluated by SPSS (20.0) software packet program.

## Results and Discussion

It was seen that larynx cranialis was found at the beginning of the joint of Ramus hyoideus with basihyoideum. Os entoglossum was flattened and ended with a cartilaginous tip. Length of os entoglossum;  $33.07 \pm 1.1$  mm in female geese,  $38.05 \pm 0.6$  mm in male geese, Urohyale's height;  $2.3 \pm 0.8$  mm in female geese, and  $14.5 \pm 0.5$  mm in male geese.

It has been reported that this area is convexly shaped in budgies whose ventral face of basihyoideum has a certain fossa in parrots (Özkan, 2002). There was also a certain fossa in the female and male geese. In the parrots, two outcrops on the basihyoideum were found to have an average length of 3.6 mm and open ends, while budgerigars had a triangular shape with edges joined together with an average edge length of 3.8 mm (Özkan, 2002). In our study, it was seen that this outcome was unique in female and male geese. The length of the protrusion was found to be  $17.7 \pm 0.4$  mm in female geese and  $16.23 \pm 0.3$  mm in male geese. The length of os entoglossum was determined to be 5.7 mm in the parrot, 3.6 mm in the budgerigar (Özkan, 2002),  $3.60 \pm 0.40$  in the loin,  $6.65 \pm 0.31$  mm in the turkey (İlgün *et al.*, 2015). In our study, it was found that os entoglossum was  $33.07 \pm 1.1$ mm in female and  $38.05 \pm 0.6$  mm in male.

## Conclusion

In conclusion, the os entoglossum is more prolonged in male geese than the female geese in Kars region, Turkey.

## References

- NİCKEL, R., SCHUMMER A., SEİFERLE E.(1977) Anatomy of the domestic birds. Berlin: *Verlag Paul Parey*, 1-25.
- GÜLTEKİN, M. (1966) Evcil memeli ve kanatlıların karşılaştırmalı osteologia'sı. *Ankara Üniversitesi Basımevi*, 288-306.
- ÖZKAN, Z.E. (2002) Papağan (*Agapornis personata*) ve muhabbet kuşlarında (*Melopsittacus undulatus*) Os hyoideum üzerinde karşılaştırmalı makro-anatomik incelemeler. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*, **8(2)**: 143-145.
- İLGÜN, R., KURU, N., ÖZKAN, Z.E. (2015) Beç tavuğu (*Numida meleagris*) ve hindi (*Meleagris gallapova*) Os hyoideum'u üzerinde karşılaştırmalı makro-anatomik incelemeler. *Erciyes Üniversitesi Veteriner Fakültesi Dergisi*, **12(3)**: 191-194.
- BAUMEL, J.J., KING, S.A., BREAZİLE, J.E., EVANS, H.E., BERGE, J.C.V. (1993) Handbook of Avian Anatomy: Nomina Anatomica Avium. *Second edition, Published by the Nuttall Ornithological Club*. Cambridge, pp. 257-299.

## Effect Of Different Breeding Systems On Growth Performance, Carcass And Meat Quality Of Japanese Quails

Burak Gözet<sup>a</sup>, Mikail Baylan<sup>b</sup>, Ayşen Bulancak<sup>c</sup>, Kadriye Kurşun<sup>b</sup>

<sup>a</sup>Tarım İl Müdürlüğü, Adana

<sup>b</sup>Çukurova Üniversitesi Ziraat Fakültesi Zootekni Bölümü, Adana

<sup>c</sup>Uluslararası Kıbrıs Üniversitesi Tarım Bilimleri ve Teknolojileri Fakültesi, Kıbrıs

### Abstract

This study was conducted to investigate the effects of housing at different raising conditions on growth performance, carcass and meat quality parameters of Japanese quails. Three different breeding systems applied at this study; first group at cage system, second group at cage+ground system (0-2 week at cage, 3-6 week at ground) and third group at ground system. At the end of study the best results at live weight, feed consumption and feed conversion ratio were obtained from quails reared at cage system. Carcass and meat quality parameters were determined during the 5<sup>th</sup> and 6<sup>th</sup> week of trial. There were no significant difference between groups at 6<sup>th</sup> week whereas highest results at carcass and meat quality parameters obtained from group raised at cage system at 5<sup>th</sup> week of trial. Highest values at 5<sup>th</sup> week obtained from ground raised group in terms of leg weight ratio and cage raised group in terms of breast main part ratio which were main parts of carcass. Only differences in breast weight ratio were obtained from carcass main parts at 6<sup>th</sup> week. Difference at pH values determined only for 6<sup>th</sup> week, difference between cooking loss(%) values determined for 5<sup>th</sup> and 6<sup>th</sup> week. Generally it was found that there were no effects of raising systems on L, a, b (L: Lightness, a: redness, and b: yellowness) values of breast meat for 5<sup>th</sup> and 6<sup>th</sup> week. As a result, it was concluded that raising of Japanese quails at cage systems give better results in terms of carcass and performance parameters.

**Keywords:** *Japanese quails, Different Breeding Systems, Growth Performance, Carcass and Meat Quality.*

### Introduction

Poultry meat production in Turkey, chicken, turkey, quail, duck, goose and ostrich meat is composed of. Japanese quails (*Coturnix coturnix Japonica*) are preferred by breeders and researchers, with their biological superiority such as reproductive power and shortened generations, as well as intensive production. Growing quail farming is becoming more and more popular because of its high yield in a short time without requiring large investment in the narrow area. Quails have been well adapted to the environment in natural

life. However, since intensive aquaculture restricts the freedom of movement of quails, they are dependent on the environment. The shelter environment plays a very important role in the case of breeding in the field or in the cage system, or in the case of co-cultivation of both breeding systems, greatly affecting the financial return of the investment. In this study, fattening performance, carcass characteristics and meat quality will be examined in quails grown in different breeding systems.

### **Materials and Methods**

The animal material of the study, Ç.Ü. Agricultural Faculty Research and Implementation Farm In the poultry unit grown in the poultry unit, 450 hatching chicks were formed as a result of incubation activities. Three different breeding systems applied at this study; first group at cage system, second group at cage+ground system (0-2 week at cage, 3-6 week at ground) and third group at ground system.

### **Results and Discussion**

As a result, it was concluded that raising of Japanese quails at cage systems give better results in terms of carcass and performance parameters.

### **Referans**

- ALTAN A, BAYRAKTAR H and ÖNENÇ A, (2001) Etlik piliçlerde sıcak stresinin et rengi ve pH'sı üzerine etkileri. Hay Ür Derg, 42 (2): 1-8
- AHUJA, S. D., BANDYOPADHYAY, U.K., and KUNDU, R., (1992) Influence of Stocking Density and System of Housing on Growth Characteristic in Japanese Quail. Indian Journal of Poultry Science, 27(4):193-197.
- AKRAM, M., SHAH, A.H., and KHAN, M.I., (2000) Effect of Varying Floor Space on Productive Performance of Japanese Quail Breeders Maintained Under Litter Floor and Cage Housing Systems . Pakistan Journal of Agricultural Science, 37(1-2): 42-46.
- ALKAN, S., KARSLI, T., KARABAĞ, K., and GALIÇ, A., (2013) Farklı Hatlardaki Japon Bildircinlarında (Coturnix coturnix Japonica) Farklı Kesim Yaşı ve Cinsiyetin Karkas Özelliklerine Etkisi. Süleyman Demirel Üniversitesi Ziraat Fakültesi Dergisi, 8 (1):12-18.
- AOAC. (1990) Official methods of analysis of the Association of Official Analytical Chemists. 15th edition. Washington, DC, Association of Official Analytical Chemists
- AYSÖNDÜ., M.H., ÖZBEY., O., and ESEN, F., (2013) Effect of Different Breeding Systems on the Growth Performance of Pheasants (*Phasianus Colchicus*) Under Intensive Conditions. Akdeniz Üniversitesi Ziraat Fakültesi Dergisi, 26(2):131-135.

- BAYLAN, M., CANOĞULLARI, S., ÇOPUR, G., and ÖNEL, S.E., (2010) Japon Bildircinlarında (*Coturnix Coturnix Japonica*) Yaşın Besi Performansı, Kesim ve Karkas Özelliklerine Etkisi. Kümes Hayvanları Kongresi, Kayseri.
- CASTELLINI, C., DAL BOSCO, A., BERNARDINI, M., and CYRIL, H.W., (1998) Effect of dietary vitamin E on the oxidative stability of raw and cooked meat. *Meat Science*, 50(2): 153-161
- CASTELLINI, C., MUGNAI, C., and DAL BOSCO, A., (2002) Effect of Organic Production System on Broiler Carcass and Meat Quality. *Meat Science*, 60:219-225.
- CHIDANADA, B.D., PRATHAPKUMAR, K.S., SREENIVASIAH, V., LOKNATH, G.R., AND RAMAPPA, B.S., (1995) Comparative Performance of Japanese Quail Reared in Cages and on Deep Litter. (1) Body Weight, Feed Efficiency and Mortality. *Indian Journal of Animal Production and Management*, 6 (1): 38-42.
- ÇELİK, Ş., İNCİ, H., VE KAYAOKAY, A., (2014) Japon Bildircinlarında Canlı Ağırlığın Yetiştirme Sistemleri ve Cinsiyete Göre İncelenmesi . *Türk Tarım ve Doğa Bilimleri Dergisi*, 1(3): 384-389.
- ELEROĞLU, H., DEVELİ, I., TÜRKOĞLU, M., OKUR, N., UÇAR, A., ÖZLÜ, S., (2016) Farklı Yetiştirme Sistemlerinin Etlik Piliçlerde Fiziksel ve Duyusal Özelliklere Etkisi. *Tavukçuluk Araştırma Dergisi* 13 (1): 16-21
- FERRANTE, V., LOLLI, S., VEZZOLI, G., AND CAVALCHINI, L.G., (2009) Effects of Two Different Rearing Systems (Organic And Barn) on Production Performance, Animal Welfare Traits and Egg Quality Characteristics in Laying Hens. *Italian Journal of Animal Science*, 8: 165-174.
- FOUZDER S.K., ALI M.L., HOWLIDER M.A.R. AND KHAN N.R.M.Z. (1999) Performance of growing Japanese quails in cages, on slatted floor and on littered floor. *Indian Journal of Animal Science*, 69(12):1059-1062.
- GRASHORN, M.A., (2006) Aspects of Nutrition And Management of Meat Quality. Xvııth European Symposium on The Quality of Poultry Meat Doorwerth, The Netherlands, 23-26 May (2005)
- Hunt, M.C., Acton J.C., Benedict R.C., Calkins C.R., Cornforth , D.P., Jeremiah L.E., Olson D.G., Salm C.P., SAVELL J.W., AND SHIWAS S.D. (1991) Guidelines for meat color evaluation. Chicago: American Meat Sci. Assoc. and National Live Stock and Meat Board .
- İNCİ, H., ŞENGÜL, Y., DAŞ, A., KARAKAYA, E., VE KARAOKAY, A., (2015) Kafes ve Yer Sisteminde Yetiştirilen Bildircinların Besi Performansı ve Karkas Özellikleri Bakımından Karşılaştırılması. *Türk Tarım ve Doğa Bilimleri Dergisi* 2(1):119-125.

- İPEK, A., ŞAHAN, Ü., VE YILMAZ, B., (2002) Japon Bildircinlarında (*Coturnix Coturnix Japonica*) Yetiştirme Sistemleri ve Yerleşim Sıklığının Gelişme Performansları Üzerine Etkisi. Tavukçuluk Araştırma Dergisi, 4:29-34.
- KARTALKANAT, A., (2014) Organik ve Yoğun Koşullarda Yetiştirilen Etlik Piliçlerin Besi Performansı ve Et Kalitesinin Karşılaştırılması. Sütçü İmam Üniversitesi, Fen Bilimleri Enstitüsü, Doktora Tezi.
- KOÇAK, Ç., Ö SEZEN., (2000) Bildircin, Sülün ve Keklik yetiştiriciliği. Ege Üniversitesi Ziraat Fakültesi Zootečni Bölümü Yardımcı Ders Kitabı. Sayfa:11.
- LAÇIN, E., ÇOBAN, Ö., AKSU, M. İ SABUNCUOĞLU ÇOBAN, N., VE DAŞ, H., (2012) Farklı Yetiştirme Metotlarının Etlik Piliçlerde Besi Performansı, Kesim, Karkas ve Bazı Et Kalite Parametreleri Üzerine ETKİSİ. INTERNATIONAL ANIMAL SCIENCE CONGRESS OF TURKISH AND RELATIVES COMMUNITIES (2012), Poster Abstracts, sf 112
- LIN, C.Y., KUO, H.Y., AND WAN, T.C., (2014) Effect of Free-Range Rearing on Meat Composition, Physical Properties and Sensory Evaluation in Taiwan Game Hens. Asian-Australasian Journal of Animal Sciences, 27(6): 880-885
- RAACH-MOUJAHED, A., HADDAD, B., MOUJAHED, N., AND BOUALLEGUE, M., (2011) Evaluation of Growth Performances and Meat Quality of Tunisian Local Poultry Raised in Outdoor Access. International Journal of Poultry Science, 10(7):552-559,
- NARAHARI, D., RAMAMURTHY, N., VISWANATHAN, S., THANGAVEL, A., MURUGANADAM, B., SUNDARASU, V., AND MAJUR, K.A., (1986) The Effect of Rearing System and Marketing Age on the Performance of Japanese Quail. Cherion, 15:160-163.
- OLAWUMI, S.O., (2015) Carcass Characteristics of Coturnix Quail as Affected by Sex and Housing System. International Journal of Agriculture, Forestry and Fisheries, 3(3): 76-79.
- ÖZDEMİR, G., (2007) Kaya Kekliklerinin (*Alectoris Graeca*) Yer ve Kafes Sistemlerinde Büyüme, Besi Performansı ve Karkas Özellikleri. Fırat Üniversitesi Sağlık Bilimleri Enstitüsü Zootečni Anabilim Dalı Doktora Tezi.
- PADMAKUMAR, B., REGHUNATHAN, N.G., RAMAKRISHNAN, A., UNNI G., A.K.K., AND RAVINDRANATHAN, N., (2000) Effect of Floor Density on Production Performance of Japanese Quails Reared in Cages and Deep Litter. Journal of Veterinary and Animal Sciences, 31: 37-39
- RAZEE, A., MAHBUB, A.S.M., MİAH, M.Y., HASNATH, M.R., HASAN, M.K., UDDİN M.N., AND BELAL, S.A., (2016) Performance of Japanese Quails (*Coturnix coturnix Japonica*) on Floor and Cage Rearing System in Sylhet, Bangladesh: Comparative Study. Iranian Journal of Applied Animal Science, 6(4):931-936

- ROSHDY, M., KHALIL, H.A., HANAFYA. M., AND MADY, M. E., (2010) Productive and Reproductive Traits of Japanese Quail As Affected By Two Housing System, Egyptian Poultry Science, (30) (I): (55-67)
- SARICA, M., SEKEROGLU, A., DEMIR, E., SUICMEZ, M., AND DINCER, F., (2004) The Comparisons of Deep Litter, Cage and Free Sitemsin in Broiler Production Under Welfare Conditions. XXII World's Poultry Congress Book Of Abstracts, S. 354.
- ŞEKEROĞLU, A., VE DIKTAŞ, M., (2012) Yavaş Gelişen Etlik Piliçlerin Karkas Özelliklerine Ve Et Kalitesine Serbest Yetiştirme Sisteminin Etkisi. Ulusal Kümes Hayvanları Kongresi, 3-5 Ekim 2012, İzmir.
- ŞENGÜL, T., VE YILDIZ, A., (1997) Bildircinlarda Farklı Yetiştirme Sistemlerinin Bazı Verim Özelliklerine Etkisi. Harran Üniversitesi Ziraat Fakültesi Dergisi, 1(2):49-58.
- T. M. EL-SHEIKH, T.M., ESSA, N. M., ABDEL-KAREEM, A. A. A., AND ELSAGHEER, M. A., (2016) Evaluation of Productive and Reproductive Performance of Japanese Quails in Floor Pens and Conventional Cages With Different Stocking Densities. Egyptian Poultry Science Journal, (36) (III): 669 -683
- TESTİK, A., ULUOCAK, N., VE SARICA, M., (1993) Değişik Genotiplerdeki Japon Bildircinlarının (*Coturnix Coturnix Japonica*) Bazı Verim Özellikleri. Türk Veteriner ve Hayvancılık Dergisi,17(2):167-173.
- TSERVENI-GOUSHI, A.S., YANNAKOPOULOS, A.L. (1986) Carcass Characteristics of Japanese Quail at 42 Days of Age. British Poultry Science, 27: 123-127.
- TOELLE V. D., HAVENSTEIN G. B., NESTOR K. E., HARVEY W. R.(1991)Genetic and phenotypic relationships in Japanese quail,body weight, carcass and organ measurements. PoultryScience 70: 1679-1688.
- ULUOCAK, (1991) Çukurova'da Yeni Bir Hayvansal Protein Kaynağı Olarak Bildircin. I. Tarım Kongresi, ADANA
- WILSON, W.O., ABBOTT, U.K. AND ABLANALP, H. (1961) Evaluation of Coturnix (Japanese Quail) As Pilot Animal for Poultry. Poultry Science, 40:651-657.

## Assessment of *Chlamydiaceae* contamination on litter and water in free-range chicken flocks

Quilicot, A.M.M.<sup>a,b</sup>, Horvatek Tomić, D.<sup>a</sup>,  
Gottstein, Ž.<sup>a</sup>, Prukner-Radovčić, E.<sup>a</sup>

<sup>1</sup> Department of Poultry Diseases with Clinic, Faculty of Veterinary Medicine, University of Zagreb, Croatia

<sup>2</sup> College of Veterinary Medicine, Visayas State University, ViSCA, Baybay City, Leyte, Philippines

### Abstract

Three chlamydial agents (*Chlamydia psittaci*, *C. gallinacea* and *C. avium*) are associated with avian species, with *C. psittaci* and *C. gallinacea* being detected in chicken flocks. This study detects *Chlamydiaceae* in environmental samples (litter and water), in areas where free-range poultry flocks are raised, in Croatia and in the province of Bohol, Philippines. Litter and water samples were collected from thirty farms from Croatia (n=14) and Bohol island, Philippines (n=16). A sample was considered positive when the quantification cycle (Cq) value is  $\leq 40$  upon *Chlamydiaceae* detection through real-time polymerase chain reaction (qPCR) assay by targeting the *23S rRNA* gene. Twenty-five out of 30 (83.33%) litter samples and 20 out of 30 (66.67%) water samples were positive for *Chlamydiaceae*. The results showed that *Chlamydiaceae* are present in the environment where the free-range flocks are raised. The Cq value of litter samples was significantly higher than in water samples ( $p=0.002$ ) indicating that the examined flocks were possibly chronically harboring chlamydiae. With these findings, it is highly important that farmworkers are aware of the zoonotic potential of the organism and that strict biosecurity and hygienic measures should be implemented on the farm.

**Keywords:** *Chlamydiaceae*, free-range chickens, contamination

### Introduction

Avian chlamydiosis is considered recently as an emerging disease associated with one or a combination of chlamydial species. At present, three chlamydial species were found to be associated with avian species, namely, *Chlamydia psittaci*, *C. gallinacea* and *C. avium* (SACHSE et al., 2015). *C. psittaci* and *C. gallinacea*, particularly, were isolated from domestic poultry such as chickens, turkey and ducks. Other chlamydial agents such as *C. abortus*, *C. suis*, *C. muridarum*, *C. pecorum* and *C. trachomatis* were also isolated from birds (PANTCHEV et al., 2009; SACHSE et al., 2012; GUO et

al., 2016). Studies were conducted to evaluate the involvement of the environment in the persistence of *Chlamydia* in a flock considering that chlamydiae stay in the gastrointestinal tract in apparently healthy birds. HULIN et al. (2016) demonstrated the positive correlation between positive water and soil samples with the presence of *C. psittaci*-positive ducks. DICKX and VANROMPAY (2011) also showed that *C. psittaci* concentration in confined houses rises in the air during hatching periods that could infect day-old poultry. In the present study, the flocks are raised in an open area, however, the risk of contamination is possibly present considering that these flocks are in an organic farming system, that is, the use of antimicrobials is reduced. Moreover, chlamydiae are capable of surviving in the environment for a longer time (MITSCHERLICH and MARTH, 1984) and in the host despite antimicrobial therapy due to its ability to undergo persistent state (SACHSE et al., 2015).

It is important to detect environmental contamination to assess risk of transmission both to susceptible birds and humans and to be able to minimize transmission and infection by implementing efficient biosecurity and management procedures. This study aims to detect *Chlamydiaceae* in environmental samples (litter and water), in areas where free-range poultry flocks are raised.

### Materials and Methods

Litter and water samples were collected from thirty farms raising free-range chicken flocks from Croatia (n=14) and Bohol island, Philippines (n=16). Real-time polymerase chain reaction (qPCR) assay of the *23S rRNA* gene was used to detect *Chlamydiaceae* in litter and water samples. A sample is considered positive when quantification cycle (C<sub>q</sub>) value is  $\leq 40$ .

### Results

Twenty-five out of 30 (83.33%) litter samples and 20 out of 30 (66.67%) water samples were positive with *Chlamydiaceae* (Table 1). Detection rates between the two samples is insignificantly different. However, the mean C<sub>q</sub> value of litter samples is significantly higher than in water samples ( $p=0.002$ ). The higher C<sub>q</sub> mean value in litter samples than in water may indicate that the flock has been chronically harboring the organism. High shedding of chlamydiae in the cloaca into the feces is high in chronic infection while shedding in the pharynx is associated with acute infection (ANDERSEN, 1996). The possibility of litter contamination is high when there is high number of *Chlamydiaceae* in the feces.

**Table 1.** Number and Cq values of *Chlamydiaceae*-positive litter and water samples.

Sample	Chlamydiaceae-positive (n, %)	Cq Values		
		Mean (SD)	Minimum	Maximum
Litter (n=30)	25, 83.33 <sup>a</sup>	31.33 ± 4.21 <sup>a</sup>	24.73	38.74
Water (n=30)	20, 66.67 <sup>a</sup>	33.80 ± 6.12 <sup>b</sup>	25.78	39.82

## Conclusions

Environmental contamination with *Chlamydiaceae* in areas where free-range chicken flocks are raised is present. The individuals working closely with the flock should be aware of the zoonotic potential of *Chlamydiaceae* and should ensure that hygienic measures are performed properly. Efficient biosecurity measures should be implemented to minimize, if not, eliminate the bacterial load in the environment.

## References

- ANDERSEN, A. A. (1996) Comparison of pharyngeal, fecal, and cloacal samples for the isolation of *Chlamydia psittaci* from experimentally infected cockatiels and turkeys. *J. Vet. Diagn. Invest.* 8, 448–450.
- DICKX, V. and D. VANROMPAY (2011) Zoonotic transmission of *Chlamydia psittaci* in a chicken and turkey hatchery. *J. Med. Microbiol.* 60, 775–779.
- GUO, W., J. LI, B. KALTENBOECK, J. GONG, W. FAN and C. WANG (2016) *Chlamydia gallinacea*, not *C. psittaci*, is the endemic chlamydial species in chicken (*Gallus gallus*). *Sci. Rep.* 6, 19638.
- HULIN, V., P. BERNARD, F. VORIMORE, R. AAZIZ, D. CLÉVA, J. ROBINEAU, B. DURAND, L. ANGELIS, V. I. SIARKOU and K. LAROUCAU (2016) Assessment of *Chlamydia psittaci* Shedding and Environmental Contamination as Potential Sources of Worker Exposure throughout the Mule Duck Breeding Process In: GOODRICH-BLAIR, H. (ed.): *Appl. Environ. Microbiol.* 82, 1504–1518.
- MITSCHERLICH, E. and E. H. MARTH (1984) *Microbial survival in the environment: Bacteria and Rickettsiae important in human and animal health.* Berlin, Springer-Verlag.
- PANTCHEV, A., R. STING, R. BAUERFEIND, J. TYCZKA and K. SACHSE (2009) New real-time PCR tests for species-specific detection of *Chlamydia psittaci* and *Chlamydia abortus* from tissue samples. *Vet. J.* 181, 145–150.
- SACHSE, K., S. KUEHLEWIND, A. RUETTGER, E. SCHUBERT and G. ROHDE (2012) More than classical *Chlamydia psittaci* in urban pigeons. *Vet. Microbiol.* 157, 476–480.
- SACHSE, K., K. LAROUCAU and D. VANROMPAY (2015) Avian Chlamydiosis. *Curr. Clin. Microbiol. Rep.* 2, 10–21.

## Effect of Litter Type and Gender on Some Temperature Parameters in Broiler

Ahmet Şekeroğlu<sup>a</sup>, Mustafa Duman<sup>b</sup>, Sedat Karaman<sup>c</sup>

<sup>a</sup>Niğde Ömer Halisdemir University, Ayhan Sahenk Faculty of Agricultural Sciences and Technologies, Department of Animal Production and Technologies, Niğde –Turkey

<sup>b</sup>Niğde Ömer Halisdemir University, Bor Vocational, School, Department of Laboratory and Veterinary Health, Bor, Niğde – Turkey

<sup>c</sup>Gaziosmanpaşa University, Faculty of Agriculture, Department of Biosystems Engineering, Tokat- Turkey

### Abstract

In this study, the effects of litter type and gender of poultry on body temperature in broilers were investigated. In the experiment, 750 chickens of mixed gender (ROSS 308) were used. Broilers was placed into 15 pens (dimensions, 2×2 m) according to research design. The Rectal, footpad and breast 6 (3 male, 3 female) randomly selected chicken and litter temperature was determined weekly. While the effect of the litter type on the footpad temperature, the breast temperature and the litter temperature was statistically significant ( $P<0.05$ ), the rectal temperature effect was not significant ( $P>0.05$ ). The effect of gender on rectal temperature footpad temperature, and the breast temperature was not statically significant ( $P>0.05$ ). As a result, it can be said that the litter type has no effect on the body temperature but it is effective on some body surface temperatures and litter temperature. At the same time, gender has no effect on body temperatures and body surface temperatures. The results show that further works are needed in this regard.

**Key words:** Broiler, Litter Type, Gender, Temperature

## Etlik Piliçlerde Altlık Tipi ve Cinsiyetin Bazı Sıcaklık Parametreleri Üzerine Etkisi

### Özet

Bu çalışmada, etlik piliçlerde altlık türünün ve cinsiyetin bazı vücut sıcaklıkları üzerine etkisi araştırılmıştır. Denemede, karışık cinsiyetteki 750 etlik piliç (ROSS 308) kullanılmıştır. Etlik piliçler deneme planına göre 15 ünitelerde (2×2 m) yetiştirmeye alınmıştır. Rasgele seçilmiş 6 (3 erkek, 3 dişi) tavuktan Rektum, footpad ve göğüs sıcaklıkları ile altlık sıcaklığı haftalık olarak belirlendi. Altlık tipinin footpad, göğüs ve altlık sıcaklıkları üzerine etkisi istatistiksel olarak önemli iken ( $P<0,05$ ), rektal sıcaklık üzerine etkisi

anlamli deęildir ( $P > 0,05$ ). Cinsiyetin rektal sıcaklık ayak tabanı sıcaklığı ve göęüs sıcaklığı üzerine etkisi istatistiksel olarak önemli deęildir ( $P > 0,05$ ). Sonuç olarak, altlık tipinin vücut sıcaklığı üzerinde herhangi bir etkisi olmadığı ancak bazı vücut yüzey sıcaklıklarında ve altlık sıcaklığını etkiledięi söylenebilir. Aynı zamanda, cinsiyetin vücut sıcaklığı ve bazı vücut yüzey sıcaklıkları üzerinde bir etkisi yoktur. Sonuçlar, bu konuda daha fazla çalışmaya ihtiyaç duyulduęunu göstermektedir.

**Anahtar kelimeler:** *Etlik Piliç, Altlık Tipi, Cinsiyet, Sıcaklık*

### **Introduction**

As in other husbandry fields, the aim in chicken production is to obtain the yield in a desirable level at the lowest cost. As the chickens have spent their life in poultry houses, in order for the chicken to be able to perform their yield capacities entirely, they should be kept in a good environment conditions with a good care as well as genetic features. An adequate environment within poultry houses is a very important requirement for success in the poultry industry. In poultry houses environmental conditions mean physical (heat, humidity and air movement) and chemical factors (ammonia and carbon dioxide) (Kocaman et al., 2006).

The environmental temperature range within which poultry are able to keep a constant body temperature with minimum effort ('thermo neutral zone' or 'comfort zone') is ranges from 16-26°C. In case of reduction of environmental temperature, they consume much feed in order to maintain their body heat and likewise the environmental temperature increases feed consumption falls (Diarra and Tabuaciri, 2014). Broiler producers have used pine shavings (PS) as a primary bedding source for rearing broilers for decades. Increased expansion of the poultry industry, new wood by-product markets, and new lumber milling techniques are causing a decrease in supply and increase in cost of PS and sawdust in many poultry-producing regions (Bowers et al., 2003).

In this study, the effects of litter type and gender of poultry on body temperature in broilers were investigated.

### **Material and Methods**

In the experiment, 750 chickens of mixed gender (ROSS 308) were obtained from a private commercial breeding center as animal material. The experiment area has natural ventilation, tube feeders and automatic water systems. Heating of the poultry was done with electrical heaters. The experiment was conducted during the winter season (December-February). Number of animal material for experiment was 750 mix-sexed broiler that obtained from a private commercial breeder enterprise. Broilers was placed into 15 pens (dimensions, 2×2 m) according to research design.

In the experiments, wood shavings (WS), acidic pumice stone (APS), basic pumice stone (BPS), 50% wood shavings + 50% acidic pumice stone (WS+APS), 50% wood shavings + 50% basic pumice stone (WS+BPS), were used as litter material.

The Litter temperature was determined weekly by the average of the values obtained from 5 different places (4 corners and center), 3 times in a day (Morning (7.00), noon (14.00) and evening (21.00)). The litter surface temperature was determined by infrared thermometer (Bilgili et al., 1999).

Rectal, footpad and breast temperatures of 6 (3 male, 3 female) randomly selected chicken from all replicate were determined weekly from 2<sup>nd</sup> week to 6<sup>th</sup> week. The rectal temperature was measured with a digital thermometer inserted about 3 cm into the cloaca. The footpad and chest temperatures were determined by taking the average of the values measured by the infrared thermometer from 3 different parts of the organs. In the following weeks temperature measurements were always taken from the same animals and from the same places.

The data were evaluated according to the Variance Analysis Method. Duncan multiple comparison test was applied to the mean of the groups that were significant in the analysis of variance (Bek and Efe, 1989).

### **Results and Discussion**

Effect of litter type and gender on rectal temperature, footpad temperature, breast temperature and litter temperature are given in Table 1.

Table 1. Effect of litter type and gender on rectal temperature, footpad temperature, breast temperature and litter temperature (°C)

Litter Type	Rectal Temperature	Footpad Temperature	Breast Temperature	Litter Temperature
WS	41.10	30.32 <sup>B</sup>	30.33 <sup>A</sup>	28.55 <sup>B</sup>
APS	41.13	28.99 <sup>A</sup>	32.77 <sup>AB</sup>	27.82 <sup>A</sup>
BPS	41.12	29.68 <sup>AB</sup>	33.55 <sup>B</sup>	27.81 <sup>A</sup>
WS+APS	41.18	30.51 <sup>B</sup>	33.28 <sup>B</sup>	28.23 <sup>AB</sup>
WS+BPS	41.19	30.37 <sup>B</sup>	33.43 <sup>B</sup>	28.26 <sup>AB</sup>
P	NS	*	*	*
Gender				
Male	41.14	30.08	33.11	-
Female	41.15	29.88	33.04	-
P	NS	NS	NS	-
Mean	41.15	29.98	33.07	28.13

NS: Nonsignificant (P>0.05); \*: P<0.05; Within each column, means followed by different letters are significantly different according to Duncan multiple range test.

While the effect of the litter type on the footpad temperature, the breast temperature and the litter temperature was statistically significant (P<0.05), the rectal temperature effect was not significant (P>0.05). Chickens, like all

homeothermic animals, maintain a constant body temperature (BT) over a wide range of ambient temperatures (Deeb and Cahaner, 1999). So the chickens can keep body heat in balance while some surface temperatures can be affected by ambient temperatures. Likewise, the type of litter material affects the litter surface temperature. This difference is mostly related to the heat transfer ability of the litter material. The effect of gender on rectal temperature, footpad temperature, the breast temperature and the litter temperature were not statically significant ( $P>0.05$ ).

### **Conclusion**

As a result, it can be said that the litter type has no effect on the body temperature, but it is effective on some body surface temperatures and litter temperature. At the same time, gender has no effect on body temperatures and body surface temperatures. The results show that further works are needed in this regard.

### **References**

- BEK, Y. and EFE, E. (1989) Araştırma Deneme Metotları I. Çukurova Üniversitesi Ziraat Fakültesi. Ders Kitabı. No: 71. Adana.
- BILGILI, S.E., MONTENEGRO, G.I., HESS, J. B. and ECKMAN, M.K. (1999) Sand as Litter for Rearing Broiler Chickens. The Journal of Applied Poultry Research 8: 345-351.
- DEEB, N.A.D.E.R. and CAHANER, A.V.I.G.D.O.R. (1999) The effects of naked neck genotypes, ambient temperature, and feeding status and their interactions on body temperature and performance of broilers. Poultry Science 78: 1341-1346.
- DIARRA, S.S. and TABUACIRI, P. (2014) Feeding management of poultry in high environmental temperatures. International Journal of Poultry Science 13: 657-661.
- KOCAMAN, B., ESENBUGA, N., YILDIZ, A., LAÇIN, E. and MACIT, M. (2006) Effect of environmental conditions in poultry houses on the performance of laying hens. International Journal of Poultry Science 5: 26-30.
- BOWERS, B.D., HESS, J. B., BILGILI, S.F., BLAKE, J.P. AND ECKMAN, M.K. (2003) Sand Litter Temperatures During Brooding. The Journal

## Application of Fuzzy Nonlinear Regression for Egg Production Curve Fitting

Ozkan Gorgulu<sup>a</sup>, Asli Akilli<sup>b</sup>

<sup>a</sup>Department of Biostatistics and Medical Informatics, Faculty of Medicine, Ahi Evran University, Kirsehir, Turkey - ogorgulu@ahievran.edu.tr,

<sup>b</sup>Department of Biometry and Genetic, Faculty of Agriculture, Ahi Evran University, Kirsehir, Turkey asliakilli@ahievran.edu.tr.

### Abstract

Nonlinear fuzzy regression (NFR) is one of the tools used as an alternative to classical regression for the biological interpretation of egg production in poultry. In this study, the use of NFR based on least squares support vector machines (LSSVM) is aimed to ensure compatibility of egg performance curves. In the analysis, Radial Basis Function (RBF), Polynomial and Linear Kernel functions for LSSVM training were considered in different parameter combinations to determine optimal values of model parameters, and RBF was found to be successful. The results of analysis show that nonlinear fuzzy regression is very successful in modelling egg performance curves and can be predicted with low errors.

**Key words:** *Egg Performance, Kernel Function, Fuzzy Least Square Support Vector Machine, Fuzzy Nonlinear Regression.*

## The Effect of Lightening of Strip Led in Different Colors in Japan Quails (*Coturnix Coturnix Japonica*) on Performance Parameters

Ömer Görgülü, Tülin Çiçek Rathert

Kahramanmaraş Sutcu Imam University, Department of Animal Science, Kahramanmaraş / Turkey

### Abstract

In the experimentation, continuous lighting of in-cage of different light sources on performance parametrs in Japanese (*Coturnix coturnix japonica*) were examined. The weights of entry to cage of quails were determined by weighing and averages of live weight in the group were distributed randomly as close to each other to cage sections. Scales of live weight were recorded weekly, the amounts of feed they have consumed were recorded daily. The quails used in the experiment are ten days.

In the experimentation, different colors of lighting sources were used, including White, yellow, red and blue strip led. Performance parameters of quails were examined by these light sources. Parameters related to quails growth, viability, feed consumption, egg yield and gain of live weight were analyzed.

At the end of the experimentation, cannibalism occurred at least in the red color and the most in the yellow color. Among the groups of treatment during the experimentat period; the survival rate, the average of live weight, the sum of the first ten egg weights, the average egg weight, the data at the age to start ovulation were found to bestatiscally insignificant ( $P>0.05$ ). The weekly consumption of feed was found to be statistically significant in the second week ( $P<0.05$ ) while the data in the other weeks were found to be insignificant ( $P>0.05$ ).

**Key Words:** *Quail, Strip Led, Source of Light, Live Weight, Egg Yield*

## Rearing Factors Affecting the Immune System in Poultry

Özlem Varol Avcılar<sup>a</sup>, Esin Ebru Onbaşlar<sup>b</sup>

<sup>a</sup> Osmaniye Korkut Ata University School of Health, Department of Nutrition and Dietetics, Osmaniye

<sup>b</sup> Ankara University, Faculty of Veterinary, Department of Animal Science, Ankara.

### Abstract

Increased production in poultry farming will be possible with healthy animals. The management conditions for the animal's immune system and healthy animal breeding should be good. The reply of the body to foreign factors is called the immune response. The immune system consists of innate (natural, non - specific) and later acquired (specific) systems. The main cell responsible for the immune response in the body is lymphocytes. Most lymphocytes are found in lymphoid tissues and organs. According to their functional structures and functions, lymphocytes are divided into T and B lymphocytes. Several factors can cause stress in the poultry, leading to suppression of immune levels. These factors are temperature, quality of air and litter, ration, stocking density, lighting programs etc. The negativity in these management conditions can cause poultry to become more vulnerable to microbial agents. Depending on the suppression of the immune system in poultry can observed inadequate growth and inadequate development of lymphoid organs.

In this review, it is aimed to evaluate stocking density, temperature applications, genetic structure, feed applications and lighting programs affecting the immunity of the poultry.

**Key words:** *Poultry, immune system, rearing factors.*

## **The Influence of Stocking Density on The Productive Performance in Cage-Housed Broiler Breeder Flock**

**Saleeva I.P., Ivanov A.V., Andrianova E.N.**

All-Russian Research and Technological Institute of Poultry, Sergiev Posad, Russia

### **Abstract**

The trial on commercial flock of Cobb Avian 48 broiler breeders housed in Veranda Breeder cage batteries (Vencomatic) proved that stocking density of hens recommended by the producer of the equipment can be effectively increased from 60 to 64 hens per cage with the same number of males (6 cocks per cage), i.e. stocking density can be increased from 12.5 to 13.2 birds/m<sup>2</sup> without any deterioration of reproductive performance of the flock. The intensity of lay at higher stocking densities was higher by 1.1-2.6% in compare to control, percentage of eggs suitable for incubation higher by 0.9-5.5%.

**Key words:** *Broiler Breeder Flock, Stocking Density, Cage Housing, Reproductive Performance in Hens, Intensity of Lay.*

### **Introduction**

Cage housing system for broiler breeder flock is considered more effective in compare to floor systems in terms of area efficiency, savings of energy and capital investments, feed efficiency. Tier cages substantially increase the capacity of poultry houses.

New advanced equipment for cage housing systems implying high levels of mechanization and automation of the operations can help in the realization of the genetic productivity potential of broiler breeders.

Earlier research in the adaptation of poultry to cage housing (Giller, 1980; Dronova, 1986; Silin, 1983; Slepukhin, 2000; Stollyar et al., 1991) evidenced that locomotor activity in cage-housed birds depends primarily on the stocking density. In a case of floor housing systems stocking density is restricted by the condition of the litter. Cage housing is not restricted by this factor and stocking density in cages is usually higher than on the floor.

The aim of our study was to determine the effects of different stocking density in cage housed broiler breeders on the reproductive efficiency of the flock.

### **Materials and Methods**

The trial was performed on the commercial Cobb Avian 48 boiler breeder flock kept in a poultry house equipped with Veranda Breeder 4-tier cage

batteries with nests (Vencomatic Group, the Netherlands). Cage size was 4.6 × 1.15 m. The producer of the equipment recommended stocking density 802 cm<sup>2</sup>/bird, or 66 birds per cage, with sex ratio 1:10 (6 cocks per 60 hens in a cage).

The breeders were housed since 20 to 60 weeks of age. The flock (20,000 birds) was allotted in four treatments with different stocking density and sex ratio according to the scheme presented in Table 1.

Table 1. The scheme of the trial

T	HPC	CPC	SR	Stocking density		FS**	PPN
				birds/m <sup>2</sup>	cm <sup>2</sup> /bird		
1(c)	60	6	1:10	12.5	802	13.8	8
2	62	6	1:10.3	12.9	778	13.8	8
3	64	6	1:10.6	13.2	756	13.8	8*
4	67	7	1:9.5	14.0	715	13.8	8*

T: Treatment, HPC: Hens per cage, CPC: Cocks per cage, SR: Sex ratio (♂/♀), Feeder space (cm/hen)\*\*, BPN: Birds per nipple, \* 1 additional nipple was set., \*\* feeder space for cocks was 18 cm/cock.

The flock was fed standard diets for breeders with contents of necessary nutrients balanced in accordance with the Cobb recommendations for this cross.

### Results and Discussion

The age of first egg laid in treatment 3 was lower by 3, 3, and 5 days in compare to treatments 1, 2, and 4, respectively. This treatment was also the first that reach 5, 50, and 60% of the intensity of lay. Peak of the egg production in treatment 3 was reached at 198 days of age, earlier by 1, 2, and 6 days in compare to treatments 1, 2, and 4, respectively.

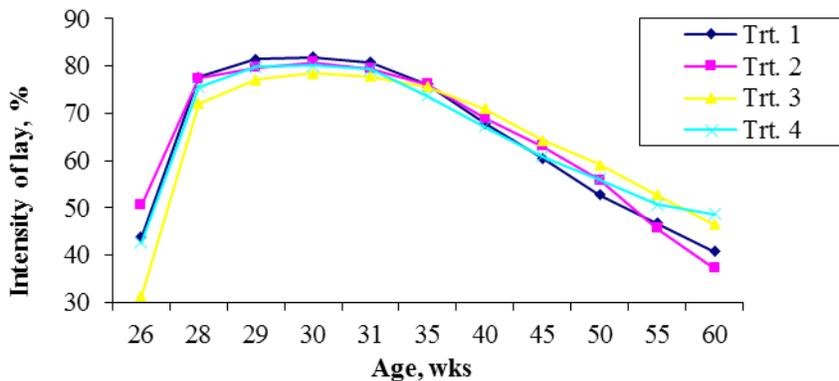


Figure 1. The age dynamics of the intensity of lay in hens caged with different stocking density

Peak level of the intensity of lay was reached at 30 weeks of age by all treatments. The peak level (above 70%) lasted for 5 weeks in treatments 1, 2, and 4, while in treatment 3 peak level was maintained during 6 weeks (Fig. 1). The best average egg production throughout the trial per initial hen was found in treatment 3 (149.7 eggs per hen), higher by 1.1; 2.6 and 1.3% in compare to treatments 1, 2, and 4, respectively.

The percentage of eggs suitable for incubation throughout the entire experiment (20-60 weeks of age) was also found in treatment 3 (89.78%), higher by 0.9; 1.6 and 5.5% in compare to treatments 1, 2, and 4, respectively; egg fertility rate was the highest in treatment 4 (90.58%), higher by 1.6; 4.1 and 4.7% in compare to treatments 1, 2, and 3, respectively. We consider that this increase in fertility rate was related to the lowest sex ratio in treatment 4 (9.5 hens per cock vs. 10.0-10.6 in other treatments).

### Conclusions

The trial on commercial flock of Cobb Avian 48 broiler breeders housed in Veranda Breeder cage batteries (Vencomatic) proved that stocking density of hens recommended by the producer of the equipment can be effectively increased from 60 to 64 hens per cage with the same number of males (6 cocks per cage), i.e. stocking density can be increased from 12.5 to 13.2 birds/m<sup>2</sup> without any deterioration of reproductive performance of the flock.

### References

- GILLER A. (1980). Housing of broiler breeder flock in cage batteries KBR-2. *The Advanced Experience in Poultry Science and Production: Express information*, No 2, p. 15-16. (in Russian)
- DRONOVA N.V. (1986). New protocols for the cage housing of the broiler breeders improving egg fertility and mortality rates. *Proc. of Kuban Agric. Institute*, issue 265, p.15-22. (in Russian)
- SILIN E. (1983). On the cage housing of broiler breeders. *Ptitsevodstvo* (Moscow), No 2, p. 26-27. (in Russian)
- SLEPUKHIN V.V. (2000). Broiler Breeders: Cage Housing. Krasnodar: Kuban State Agrarian Univ., 39 pp. (in Russian)
- STOLLYAR T.A., SLKYAR V.T., SHAKHNOVA L.V. *et al.* (1991). The technologies of housing of broiler breeder hens in cage batteries: The guidelines. Zagorsk: VNITIP, 1991. 56 pp. (in Russian)

## The Chick Quality

D. Nariç, E. Aydemir S. Baytur, T. Aksoy

<sup>a</sup>Department of Animal Science, Faculty of Agriculture, Akdeniz University, Antalya, 07100, Turkey; <sup>b</sup>Department of Biotechnology, Faculty of Agriculture, Namık Kemal University, Tekirdağ, 59100, Turkey; <sup>c</sup>Department of Genetics, Faculty of Veterinary Medicine, Namık Kemal University, Tekirdağ, 59100, Turkey

### Abstract

The chick quality has great importance in poultry sector because it determines the number of saleable chicks. Quality chicks are identified as healthy with normal growth during incubation and they have high-survive ability and good muscle mass with high growth rate at posthach period. There are some genetic and environmental factors affecting chick quality. A number of qualitative and quantitative methods are generally used to determine the chick quality; some of them are visual assessment, live weight and length of day-old chick, yolk free body weight, rate of body weight loss, chick size, Tona score, and Pasgar score. In particular, Tona and Pasgar score methods are being studied recently. Both methods provide information on the incubation performance with the detection of the chick length and the potential performance of the chick in the later stages, when the last problems of the broiler are estimated. Both methods provide information about the prediction of the problems at the incubation period and the potential performance of the chicks in the future. All these methods are used to evaluate the chick quality, to increase profitability in production stages and to obtain quality products. The aim of this study is to give information about the factors affecting chick quality and to introduce the methods used in measuring chick quality.

**Keywords:** *Incubation, Chick quality, Tona Score, Pasgar Score*

### Özet

Kanatlı sektöründe civciv kalitesi oldukça öneme sahiptir çünkü satılabilir civciv sayısını civciv kalitesi belirlemektedir. Kaliteli bir civcivler, kuluçka süresince normal gelişme göstermiş ve yüksek büyüme oranı ile iyi kas kitlesine sahip, sağlıklı ve yüksek yaşama gücü gösteren civcivler olarak tanımlanmaktadır. Civciv kalitesini etkileyen genetik ve çevresel faktörler bulunmaktadır. Civciv kalitesinin belirlenmesinde kullanılan nitel ve nicel yöntemler genellikle; görsel değerlendirme, vücut ağırlığı, sarısız vücut kitlesi, civciv boyu, ağırlık kaybı oranı, Tona skor, Pasgar skor gibi yöntemlerdir. Özellikle son dönemlerde Tona ve Pasgar skor yöntemleri

üzerinde durulmaktadır. Her iki yöntem de kuluçkanın son dönemindeki sorunların tahmin edilmesinde ve ilerleyen dönemlerde civcivin potansiyel performansı hakkında bilgi vermektedir. Tüm bu yöntemler civciv kalitesinin değerlendirilmesinde, üretim aşamalarında karlılığı artırmak ve kaliteli ürün elde amacıyla kullanılmaktadır. Bu çalışmanın amacı civciv kalitesini etkileyen unsurlar hakkında bilgi vermek ve civciv kalitesinin ölçülmesinde kullanılan yöntemlerin tanıtılmasıdır.

**Anahtar kelimeler:** *Kuluçka, Civciv kalitesi, Tona skoru, Pasgar skoru*

### **Introduction**

Breeder enterprises want to offer a large number of chicks with commercial value, but producers tend to demand high quality chicks due to the fact that the performance characteristics of chicks with poor scores in quality are also low. The period of chick quality begins with the combination of gametes in the infundibulum and the matching of the chromosomes, is shaped by incubation, and ends up with the chicks being placed in the shipping chests (Molenaar et al., 2008). In this process there are a large number of genetic and environmental factors that affect the quality chicks, these can be listed as follows; genotype of breeder line, flock age, incubation conditions, egg quality, egg storage conditions, flock healthy and nutritional quality. Even if it is perceived as a subjective concept when it is referred to as "chick quality", the concept is regarded as a character that can be expressed numerically by using some developed protocols. While some of the aforementioned protocols (sensory evaluation, weight measurement, height measurement, rate of body weight loss, weight mass index, etc.) are more empirical, it is possible to create quality indices over 100 and 10 points respectively according to Tona and Pasgar scoring methods using various criteria for chicks (Willemsen et al., 2008). When chick quality is determined by Tona or Pasgar methods, the characteristics such as cleanliness, dryness, free from deformities, without dirt and contamination and skin lesions or deformity, bright eyes, sealed and clean navels, no yolk sac or dried membranes around of navel, leg conformation, beak shape, weight and length are taken into consideration. Then these qualitative findings are transformed to quantitative data by experienced operators. The purpose of this study is to review the factors that affect chick quality and is to introduce the various protocols used to determine quality.

### **Factors Affecting Day Old Chick Quality**

It is known that the chick quality is high in some chicken breeds with high egg production, such as Rhode Island Red and Leghorn. Even if the meat is yield-oriented, the use of the lines mentioned above in order to increase the annual egg production in commercial flocks has also led to an increase in

chick quality. Apart from this, chick quality of the breeds that have well egg quality is also good. Breeder flock age affects egg weight and therefore daily chick weight. Chick quality may be adversely affected when the quality of albumen is high in younger hens (albumen barrier effect). It has also been reported that albumen quality and Haugh unit decreased, embryo mortality and discard chick ratio increased in stored eggs of old breeder flocks. Storage of the eggs over seven days causes an increase in the incubation period and causes to deteriorate on hatchability and chick quality. The most important factors are the conditions of temperature, humidity, turning and ventilation of incubator affecting day-old chick quality (Willemsen et al., 2008). The high temperature in incubator during the incubation period adversely affects the normal development of the embryo, chick quality and it increases the chick abnormalities. The humidity of incubator is one of the factors that need to be constantly checked for normal embryonic development. The moisture level in the machine must be adjusted depending on the water vapor conductivity of the egg shell. Humidity of about 11-13% should be lost of hatching eggs in the pre-development stage. Inadequate turning during the pre-development period causes the delay of the hatch time and it causes the prolongation of the incubation period, thus the quality of the day-old chicks is adversely affected. One of the most important factors directly affecting the quality of the day-old chicks and their performance is dehydration. In order to prevent dehydration, the hatched chicks in incubator need to be kept for no longer than 12 hours (Molenaar et al., 2008).

### **Chick Quality Assessment Methods**

A number of qualitative and quantitative methods are generally used to determine the chick quality; some of them are visual assessment, live weight and length of day-old chick, yolk free body weight, rate of body weight loss, chick size, Tona score and Pasgar score. Tona and Pasgar score methods transform qualitative data into quantitative data. It is especially important to assess the chick quality in terms of breeding. Heritability of chick quality and genetic relationships with other characteristics are being studied in the recent. The characteristics considered and their scores in Tona and Pasgar methods are presented in Tables 1 and Table 2, respectively (Tona et al., 2003; Willemsen et al., 2008).

### **Conclusion**

Development of chick quality can be to reduce first week mortality and to improve the performance and the uniformity of the flock. Tona score is more detailed while Pasgar score is simple easy to teach.

**Table 1. Tona score protocol**

Characteristics	Points
Activity	Good: 6 to Weak: 0
Downs and appearance	Clean and dry: 10 to Wet: 8 to Dirty and wet: 0
Retracted yolk	Body with normal swallowed yolk: 12 to Body with swallowed large yolk and rather hard to touch: 0
Eyes	Opened and bright: 16 to Opened and not bright: 8 to Closed eyes: 0
Legs	Normal legs and toes: 16 to One infected leg: 8 to Two infected legs: 0
Navel	Completely closed and clean: 12 to Not completely closed and not discolored: 6 to Not closed and discolored: 0
Remaining membrane	No membrane: 12 to Small membrane: 8 to Large membrane: 4 to Very large membrane: 0
Remaining yolk	No yolk: 16 to Small yolk: 12 to Large yolk: 8 to Very large yolk: 0

**Table 2. Pasgar score protocol**

Characteristics	Points
Poor reflex	10 minus 1 point
Poor navel	10 minus 1 point
Red hocks	10 minus 1 point
Red spot/dirty beak	10 minus 1 point
Full belly	10 minus 1 point

**References**

- MOLENAAR, R., REIJERINK, I.A.M., MEIJERHOF, R. and VAN DEN BRAND, H. (2008) Relationship between chick length and chick weight at hatch and slaughter weight and breast meat yield in broilers. *World's Poultry Science Journal* 64: 599-603.
- TONA, K., BAMELIS,F., DE KETELAERE, B., BRUGGEMAN,V., MORAES, V.M.B., BUYSE, J.,ONAGBESAN, O. and DECUYPERE, E. (2003) Effects of egg storage time on spread of hatch, chick quality, and chick juvenile growth. *Poultry Science*, Auburn, 82(2):736-741.
- WILLEMSSEN, H., EVERAERT, N., WITTERS, A., DE SMIT, L., DEBONNE, M., VERSCHUERE, F., GARAIN, P., BERCKMANS, D. and BRUGGEMAN, V. (2008) Critical assessment of chick quality measurements as an indicator of posthatch performance. *Poultry Science* 87: 2358-2366.

## Effect of egg weight on breast muscle development in fast- and slow-growing broiler embryos and chicks

Mojtaba Vafaenia<sup>a</sup>, Gamze Turgay İzzetođlu<sup>b</sup>, Serhat Yıldırım Aydın<sup>a</sup>,  
Neslihan Kalkan<sup>a</sup>, Servet Yalçın<sup>a\*</sup>

<sup>a</sup>Ege University Faculty of Agriculture Department of Animal Science, Bornova, İzmir, Turkey

<sup>b</sup>Ege University Faculty of Science Department of Biology, Bornova, İzmir, Turkey

\*Corresponding author

### Abstract

The aim of the present experiment was to investigate the effect of strain and egg weight on muscle development in broiler embryos and chicks. Two strains (fast- and slow-growing) with 2 egg weight (heavy or light respectively) classification were studied. A significant strain effect was found for embryo weight, breast muscle width and length on d 18 of incubation, while strain effect was not significant for chick weight and breast muscle width on d of hatch. Egg weight significantly affected chick weight and sternum length on d of hatch. Our results showed that egg weight did not have a significant effect on muscle fiber area of slow-growing embryos and chicks, however, heavier eggs resulted larger muscle fiber area in fast-growing broilers.

**Keywords:** *breast muscle, broiler, egg weight, fiber area, strain*

### Özet

Bu çalışmada, genotip ve yumurta ağırlığının kas gelişimine etkisinin incelenmesi amaçlanmıştır. Farklı yumurta ağırlığına (ağır veya hafif) sahip iki genotip (hızlı ve yavaş gelişen) seçilmiştir. Kuluçkanın 18.gününde embriyo ağırlığı, göğüs genişliği ve uzunluğu üzerine genotip etkisi önemli bulunurken, 21.günde genotipin civciv ağırlığı ve göğüs kası genişliğine etkisi önemsiz bulunmuştur. Kuluçkadan çıkışta yumurta ağırlığı, civciv ağırlığını ve sternum uzunluğunu etkilemiştir. Bulgularımız, yumurta ağırlığının yavaş gelişen genotipte kas lifi alanına etkisinin olmadığını, fakat hızlı gelişenlerde yumurta ağırlığının artmasının kas alanını artırdığını göstermiştir.

**Anahtar kelimeler:** *etlik piliç, fibril alanı, genotip, göğüs kası, yumurta ağırlığı*

## **Introduction**

Muscle growth, which is significantly determined by the number of muscle fibers, has two main aspects; embryonic muscle development and posthatch growth. During embryogenesis, the number of muscle fibers continues to increase (Al-Musawi et al., 2011) and total fiber numbers are set at the day of hatch. Posthatch muscle growth is due to hypertrophy of the existing fibers. Muscle fiber characteristics are influenced by genetic selection (Chen et al., 2007; Oshima et al., 2007). Scheurmann et al. (2004) reported that increase in muscle weight during the posthatch depended on the increased length and area of the myofibers. They found higher fiber number in broilers than leghorn-type chickens at the same age (Scheurmann et al., 2004). Previous studies also showed significant differences in fiber number and area between fast- and slow-growing broilers during postnatal stage (Verdiglione et al., 2013).

It is well known that egg weight increases with breeder age (Suarez et al., 1997). Egg weight directly affects embryo development and chick weight. Several studies demonstrated that broiler chickens hatched from heavy eggs were significantly heavier than those which hatched from lighter eggs (Ulmer-Franco et al., 2010; Wilson., 1991). However, breast muscle development of chicks due to egg weight was not investigated yet. Because understanding of the muscle growth is critical to meat quality, this study aimed to evaluate the effect of strain and egg weight on breast muscle characteristics in broiler embryos and chicks.

## **Material and method**

Eggs from fast- (Ross 308) and slow-growing (Hubbard JV) broiler breeder strains aged 58 weeks were obtained from the same breeder company. All eggs from each strain were numbered and weighed and a total of 192 eggs were selected (96 from each strain) and classified as light or heavy egg (LEgg or HEgg), respectively. There were 48 eggs for each egg weight and strain. Mean egg weight for LEgg and HEgg was  $64 \pm 1$  and  $72 \pm 1$  g, respectively. All eggs were incubated under standard incubation conditions. There were 4 replicate egg trays for each strain and egg weight group with 12 eggs each. On d 18, 10 eggs were randomly selected from each group and weighed, embryos were removed, weighed of embryo and breast muscle were obtained. Breast muscle width and length and sternum length were measured. The same measurements were repeated at day of hatch. At ED 18 and 21 after dissection, approximately 5 g of breast muscle was sampled for muscle histology. The samples were mounted in an embedding medium (Sigma, P0091), kept at  $-20^{\circ}\text{C}$ , cut using a cryostat (Leica, Germany). The samples were fixed then stained with Periodic acid-Schiff and images were recorded using a light microscope (Zeiss Axio Scope A1, Germany). Five photographs of different cross-sections from each muscle were taken and

were analyzed by computer image analysis (Zen Software, Zeiss, Germany) using a semi-automated procedure and the fiber area was defined. Data were evaluated using General Linear Model (GLM) procedures of JMP 5.0.1 software. When differences were significant, means were compared by using t- test.

### **Results**

Fast-growing broiler embryos had significantly heavier weight ( $P \leq 0.05$ ), wider and longer breast muscle ( $P \leq 0.05$ ) compared to slow-growing broiler embryos on d 18 of embryogenesis. There was no effect of strain on sternum length (Table 1). As expected, HEggs had heavier embryo weight than those LEggs. Egg weight effect was not significant for breast muscle width, and length and sternum length. Although fiber area was significantly affected by strain, a significant interaction between strain and egg weight showed that LEggs embryos from both strains had similar fiber area on d 18 (Table 2).

On d of hatch, the strain had no effect on chick weight, breast muscle width and sternum length. Breast muscle length of slow-growing chicks was shorter than fast-growing chicks (Table 1). Chicks from LEggs had longer sternum and this effect was more pronounced for fast-growing chicks (Table 2). The largest fiber area was obtained for chicks from fast-growing HEggs. However, egg weight effect on fiber area was not significant for slow-growing chicks on d of hatch.

### **Conclusion**

The results of the present study indicated that breast muscle width and length was not influenced by egg weight. It was concluded that strain affected muscle fiber area of broiler embryos and chicks; however, this effect was depended on the egg weight; i.e. chicks from lighter eggs had similar fiber area regardless of strain. Due to the important role of fiber area on breast muscle weight, more research is required on fiber area development.

Table1.Effect of strain and egg weight on embryo weight, breast muscle width and length, sternum length, and fiber area on d 18 and at hatch

Strain	Embryo/chick weight g		Breast muscle width cm		Breast muscle length cm		Sternum length cm		Fiber area $\mu\text{m}^2$	
	18d	Hatch	18	Hatch	18	Hatch	18	Hatch	18	Hatch
	Fast	36.00	48.00	18.15	15.02	18.44	21.39	12.83	20.06	39.03
Slow	34.24	49.39	17.24	15.36	17.62	19.98	12.52	19.94	35.23	28.32
SEM	0.61	0.62	0.38	0.22	0.31	0.39	0.29	0.34	1.18	0.88
	*	NS	*	NS	*	*	NS	NS	**	NS
Egg Weight										
Heavy	35.90	51.22	17.54	15.14	17.67	20.33	12.47	18.37	38.02	31.31
Light	34.33	46.18	17.87	15.23	18.39	21.04	12.88	21.63	36.24	26.94
SEM	0.61	0.63	0.37	0.22	0.32	0.39	0.28	0.34	1.15	0.88
	NS	*	NS	NS	NS	NS	NS	*	NS	*

\* P<0.05, \*\* P<0.001, NS: Not significant

Table 2. Effect of interaction between strain and egg weight on sternum length at hatch and fiber area on d 18 and at hatch

	Strain	Egg weight	
		Heavy	Light
Chick weight, g	Fast	49.52 <sup>a</sup> *	46.49 <sup>b</sup> NS
	Slow	52.91 <sup>a</sup>	45.86 <sup>b</sup>
Sternum length, cm, hatch	Fast	17.93 <sup>b</sup> NS	22.20 <sup>a</sup> NS
	Slow	18.81 <sup>b</sup>	21.07 <sup>a</sup>
Fiber area, $\mu\text{m}^2$ , d18	Fast	43.44 <sup>a</sup> *	34.62 <sup>b</sup> NS
	Slow	32.59 <sup>b</sup>	37.87 <sup>b</sup>
Fiber area, $\mu\text{m}^2$ , hatch	Fast	33.31 <sup>a</sup> *	26.55 <sup>b</sup> NS
	Slow	29.31 <sup>b</sup>	27.32 <sup>b</sup>

<sup>a,b</sup> Means within a trait and row with no common superscript differ significantly,\* Means within a trait and column differ significantly P<0.05.

### References

- AL-MUSAWI, S.L., LOCK, F. SIMBI, BIGGY. H., BAYOL, S. A. M., STICKLAND, N. C. (2011) Muscle specific differences in the regulation of myogenic differentiation in chickens genetically selected or divergent growth rates differentiation. *Poultry Science* 82:127–135.
- CHEN, X.D., MA, Q.G., TANG, M.Y., JI, C. (2007) Development of breast muscle and meat quality in Arbor Acres broilers, Jingxing 100 crossbred chickens and Beijing fatty chicken. *Poultry Science* 77:220-227.
- OSHIMA, I., IWAMOTO, H., TABATA, S., ONO, Y., ISHIBASHI, A., SHIBA, N., MIYACHI, H., GOTOH, T., AND NISHIMURA, S. (2007) Comparative observations on the growth changes of the histochemical property and collagen architecture of the musculus pectoralis from Silky, layer-type and meat-type cockerels. *Animal Science Journal* 78:619–630.
- SCHEUERMANN, G. N., BILGILI, S. F., TUZUN, S., AND MULVANEY, D.R. (2004) Comparison of chicken genotypes: Myofibernumber in pectoralis muscle and myostatin ontogeny. *Poultry Science* 83:1404–1412.

- SUAREZ, M.E., WILSON, H.R., MATHER, F.B., WILCOX, C.J., MCPHERSON, B.N. (1997) Effect of strain and age of the broiler breeder female on incubation time and chick weight. *Poultry Science* 76(7):1029-36.
- ULMER-FRANCO, A. M., FASENKO, G. M., AND CHRISTOPHER, E. E. O'DEA. (2010) Hatching egg characteristics, chick quality, and broiler performance at 2 breeder flock ages and from 3 egg weights. *Poultry Science* 89:2735–2742.
- VERDIGLIONE, R., AND CASSANDRO, M. (2013) Characterization of muscle fiber type in the pectoralis major muscle of slow-growing local and commercial chicken strains. *Poultry Science* 92:2433–2437.
- WILSON, H.R. (1991) Interrelationships of egg size, chick size, posthatching growth and hatchability. *World's Poultry Science* 47: 5-20.

## Climatic Environment and Control in Hen House

Sezai Alkan<sup>1</sup>, İsmail Türker<sup>2</sup>, Kemal Karabağ<sup>3</sup>, Taki Karşlı<sup>4</sup>

<sup>1</sup> Ordu University, Agriculture Faculty, Animal Science Department, Ordu

<sup>2</sup> Bozok University, Agriculture Faculty, Animal Science Department, Yozgat

<sup>3</sup> Akdeniz University, Agriculture Faculty, Agricultural Biotechnology Department, Antalya

<sup>4</sup> Akdeniz University, Agriculture Faculty, Animal Science Department, Antalya

### Abstract

Hens are more sensitive to environmental factors than other animal species. Therefore, developed suitable hen house types for adequate environmental control to eliminate the negative effects of climatic environment factors on hens. The aim of building hen house is to remove the negative effects of climatic environment on animals and to provide more comfortable conditions for animals. The most important function of the hen house is to meet the climatic demands of the hens. For this reason, the climatic conditions of the region and the climatic environmental desires of the chickens should be taken into account in the construction of the hen house. In order to keep the climatic environment in the hen houses at optimum limits, heat exchange through the conduction, convection and radiation must be kept to a minimum. When climatic environment is kept at optimal limits in the hen house, benefiting of genotypic potential and the yield are increase and, also losses are kept at lower levels.

**Keywords:** *Hen, Hen house, Climatic environment, Heat*

Tavuk Kümeslerinde İklimsel Çevre ve Denetimi

### Özet

Tavuklar diğer hayvan türlerine oranla çevresel etmenlere karşı daha duyarlıdır. Bundan dolayı, iklimsel çevre etmenlerinin (sıcaklık, nem, hava hızı vb.) tavuklar üzerindeki olumsuz etkilerini gidermek için yeterli düzeyde çevre denetimine uygun kümes tipleri geliştirilmiştir. Tavuklara kümes yapmadaki amaç, iklimsel çevrenin tavuklar üzerindeki olumsuz etkilerini optimum sınırlar içerisinde gidermek ve tavuklara daha rahat yaşam koşulları sağlamaktır. Kümeslerin en önemli fonksiyonu tavukların iklimsel isteklerini karşılamaktır. Bu nedenle de kümes yapımında bölgenin iklimsel koşulları ve tavukların iklimsel çevre istekleri dikkate alınmalıdır.

Kümeslerde iklimsel çevrenin optimum sınırlarda tutulabilmesi için, kümeste kondüksiyon, konveksiyon ve radyasyon yoluyla oluşan ısı değişimi minimum düzeyde tutulmalıdır. Kümeslerdeki iklimsel çevre optimum sınırlarda tutulduğunda genotipik potansiyelden yararlanma ve verim iyileşmekte, kayıplar ise daha düşük düzeyde kalmaktadır.

*Anahtar kelimeler: Tavuk, Kümes, İklimsel Çevre, Isı*

## The Situation of Organic Poultry within Organic Livestock in Turkey

E. Uruk<sup>1</sup>, F. Yenilmez<sup>2\*</sup>

<sup>1</sup>Food, Agriculture and Livestock Ministry, Adana, Turkey.

<sup>2\*</sup>Cukurova University, Vocational School of Tufanbeyli, Adana, Turkey,  
fyenilmez@cu.edu.tr

In recent years, organic products are very common in our country, as all over the world. The people know that animal products have an important role supplying of the protein requirements in human life. Furthermore, the consumers generally believe that organic animal products are healthier and safer than the conventionally produced foods, so it is preferred by people. Because the use of synthetic fertilizers, pesticides, growth promoters, and additives are forbidden, additionally is better for the environment and animal welfare. Organic poultry sector is improves faster, because poultry farming is easier, the cost is lower, feed conversion rate is higher than the other animals. Therefore, organic poultry product production is increase day by day. According to the data of 2016 published by the Ministry of Food, Agriculture and Livestock, there are 188 farmers deal with organic animal production and 92 of these are deal with organic poultry in Turkey. 16 provinces have organic poultry farm in Turkey. Çanakkale, Ordu and Manisa provinces are in forefront terms in organic animal production, Ordu province is the first in organic laying hens production and Manisa province is the first in broiler breeding. Totally 7.234 organic cattle, 23.296 organic sheep-goat and 1.184.042 organic chickens are produced in our country. Total organic egg production is 147.600.367. Total meat production is 1.564 tons and 1.486 tons of this is organic chicken meat. Organic chicken meat is 95 % of total organic meat. This are demonstrates that the importance of organic poultry meat production in organic meat production (Table 1).

**Key Words:** *Organic animal, organic poultry, organic product*

**Table 1.** Organic Animal Data by Cities.

Cities	PS	Total Number of Farmers	Total Number of Poultry	Total Amount of Meat (ton)	Total Amount of Egg (number)
Adana	LH	1	6.000	0	1.250.000
Afyonkarahisar	LH	1	3.450	0	930.750
Ankara	SG	0	15.139	0	0
Aydın	C	1	394	0	0
Bayburt	SG	3	4.513	0	0
Bitlis	C	5	371	0	0
	SG	2	1.060	45	0
Bolu	LH	6	54.985	0	14.410.477
Bursa	LH	1	7.500	0	1.288.000
Çanakkale	C	41	2.994	38	0
	SG	5	3.644	3,9	0
Elazığ	BR	1	19.140	36,3	18.183
	LH	0	44.275	0	11.157.300
Gümüşhane	C	3	776	0	0
İzmir	C	3	347	0	0
	BR	2	13.800	9,6	4.800
	LH	4	71.924	0	17.472.037
Kastamonu	C	9	41	0	0
Kayseri	LH	2	7.900	0	1.494.500
Kırklareli	LH	2	32.857	0	9.141.390
Konya	LH	1	12.715	0	3.433.050
Malatya	LH	1	2.750	0	401.500
Manisa	C	1	1.801	0	0
	BR	22	249.522	624	0
	LH	0	151.154	0	40.255.380
Ordu	LH	36	10.750	0	211.500
Sakarya	LH	2	33.000	0	4.050.000
Samsun	C	2	510	36	0
	BR	1	326.400	816	0
	LH	0	105.000	0	32.959.500
Tekirdağ	LH	1	11.700	0	3.159.000
Uşak	LH	8	19.220	0	5.963.000
Total		188	1.215.632	1.609	147.600.36

7

Resource: The Ministry of Food, Agriculture and Livestock, 2016, PS: Poultry Species, LH: Layer hens, SG: Sheep-Goat, C: Cattle, BR: Broiler,

In the near future, it is expected that, organic poultry production will be increased more than the other organic livestock husbandry branches in our country.

## The Effect of Socio-Economic Status on Consumers' Thinking Towards Organic Products in TR72 Region (Kayseri, Sivas and Yozgat)

Hasan Eleroğlu<sup>a</sup>, Hüdaverdi Bircan<sup>b</sup>, Arda Yıldırım<sup>c</sup>

<sup>a</sup>Cumhuriyet Üniversitesi, Şarkışla Aşık Veysel Meslek Yüksekokulu, 58400 Şarkışla/Sivas, Türkiye, eleroglu@cumhuriyet.edu.tr

<sup>b</sup>Cumhuriyet Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İşletme Bölümü, 58140 Sivas, Türkiye, hbircan@gmail.com

<sup>c</sup>Gaziosmanpaşa Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü, 60250 Tokat, Sorumlu yazar: Hasan Eleroğlu, eleroglu@cumhuriyet.edu.tr

### Abstract

In this study, face-to-face surveys were conducted with 1350 families in order to determine the opinions of consumers on organic products in TR72 region (Kayseri, Sivas and Yozgat). The sample volume was determined by a single, unstructured simple random probability sampling method based on population ratios. While all consumers participated in the necessity of consuming organic poultry products, there were significant differences ( $P < 0.01$ ) in terms of gender, occupational groups and cities. Some of the consumers gave the "undecided" and the other part the "I agree" answer to the question "Non-organic products are harmful to health", and the differences were significant in terms of gender, age groups, education status, occupation and cities ( $P < 0.01$ ). Differences in gender, occupational groups and cities ( $P < 0.01$ ) were found to be significant in terms of having a high price of organic products and adequate knowledge of organic products. Consumer's general view on both sides is undecided. There was significant ( $P < 0.01$ ) differences in gender, educational status and cities with respect to the amount of extra to be paid for organic products, which resulted in an overall overcharge of 18.92%.

*Key words: Organic, Eggs, Chicken, Demographic, Price*

### TR72 Bölgesinde (Kayseri, Sivas ve Yozgat) Tüketicilerin Organik Ürünlere Yönelik Düşünceleri Üzerine Sosyo-Ekonomik Koşulların Etkisi

#### Özet

Bu çalışmada TR72 bölgesinde (Kayseri, Sivas ve Yozgat) tüketicilerin organik ürünlere yönelik görüşlerini belirlemek üzere

1350 aile ile yüz yüze anket uygulaması yapılmıştır. Örnek hacmi ana kitle oranlarına dayalı kümelendirilmemiş tek aşamalı basit tesadüfi olasılık örnekleme yöntemi ile belirlenmiştir. Organik tavukçuluk ürünlerinin tüketilmesinin gerekliliğine tüketicilerin tamamı katılırken, cinsiyetler, meslek grupları ve iller bakımından önemli ( $P<0,01$ ) farklılıklar bulunmuştur. “Organik olmayan ürünler sağlığa zararlıdır” görüşüne tüketicilerin bir kısmı “kararsızım”, diğer bir kısmı “Katılıyorum” cevabını vermiş olup, bu soru bakımından cinsiyet, yaş grupları, eğitim durumu, meslek ve iller bakımından önemli ( $P<0,01$ ) farklılıklar belirlenmiştir. Organik ürünlerin fiyatının yüksek olmasının normal ve organik ürünler hakkında yeterli bilgiye sahip olma bakımından cinsiyet, meslek grupları ve iller bakımından önemli ( $P<0,01$ ) farklılıklar belirlenmiştir. Genel görüş kararsızlık olarak belirlenmiştir. Organik ürünlere fazladan yapılacak ödeme miktarı bakımından cinsiyet, eğitim durumu ve iller bakımından önemli ( $P<0,01$ ) farklılıklar bulunmuş, genel olarak %18,92 fazladan ücret ödeme yapılabileceği sonucuna varılmıştır.

**Anahtar kelimeler:** Organik, Yumurta, Tavuk, Demografik, Fiyat

## Effects Of Energized Oxygen In Drinking Water On The Performance Of Broiler Chicken

Mustafa Saatci<sup>a</sup>, Hasan Katrancı<sup>b</sup>, Özlem SAHAN Yapicier<sup>c</sup>

<sup>a</sup>Muğla Sıtkı Koçman University, Faculty of Agriculture, Department of Animal Science, Fethiye, Turkey, 48300

<sup>b</sup>Hasan Katrancı Broiler Farm, Salihli, Manisa, Turkey.

<sup>c</sup>Mehmet Akif Ersoy University, Veterinary Faculty, Department of Microbiology, Burdur, Turkey

### Abstract

In this study, usage and the effects of “energized oxygen” on the performance of broiler in a commercial farm was examined. Energized oxygen application into the drinking water is one of those treatments. Mean of mortality, slaughter live weight (kg), carcass weight (kg), FCR and EPEF of two parties before and after the application were evaluated. Results of before and after the applications were 9.06 and 8.46, 2440 and 2655, 1918 and 2045, 1.74 and 1.68, 315 and 367 respectively. Results may suggest that “energized oxygen” can bring new and applicable facilities to the broiler chicken farms in terms of water and water equipment hygiene, feed conversion efficiency and performance of birds.

**Key Words:** *Broiler, energized oxygen, hygiene, performance*

## İçme Suyundaki Enerjilendirilmiş Oksijenin Broyler Tavukların Performansına Etkisi

### Özet

Bu çalışmada, "enerjilendirilmiş oksijen" kullanımının ticari bir çiftlikteki broyler performansına etkileri incelenmiştir. Uygulama, enerjilendirilmiş oksijenin içme suyuna verilmesi ile yapıldı. Uygulama öncesi ve sonrası mortalite, kesim ağırlığı(kg), karkas ağırlığı, FCR ve EPEF değerlendirildi. Uygulama öncesi ve sonrasında sırasıyla 9.06 ve 8.46, 2440 ve 2655, 1918 ve 2045, 1.74 ve 1.68, 315 ve 367 sonuçları elde edildi. Sonuçlar "enerjilendirilmiş oksijen" içme suyu ve ekipmanlarının hijyeni, yem dönüştürme verimliliği ve kanatlıların performansı açısından broyler tavuk çiftliklerinde yeni ve uygulanabilir bir system getirebileceğini düşündürmektedir.

**Anahtar Kelimeler:** *Broyler, enerjilendirilmiş oksijen, hijyen, performans*

### **Introduction**

Farm animals need optimal environment for development and growth in order to reach their genetic capacity. Any weakness of the components of environment may decrease the performance. Consuming water is one of the main pillars of the obtained performance. Importance of consumed water by animals during the growing and fattening period is a reality in the whole livestock sector. Water is considered as nutrient and essential element for all the metabolism activity. This importance also shows itself in the short-term life of broiler chicken. According to general knowledge, chicken consume double amount of water than their food. This amount is variable according to environmental factors. This fact makes the quality and quantity of the water more important. Many researchers have mentioned the importance of drinking water and its quality on various aspects for broiler chicken performance. Also it has been mentioned that daily water intake patterns can be an important indicator of flock performance in broiler (Feddes et al, 2002; Watkins et al., 2009; Tabler et al. 2013).

Warm environment in the broiler houses can cause microbial increasing in the water storage and delivering systems. This also may result in formation of a sticky microbial biofilm in the several parts of the water equipment. Those biofilms threaten the hygiene of the whole water system and health of the birds. It was quite difficult to remove these biofilms and, many ways, including chemicals, are used for this duty (Tabler et al. 2013; Hancock et al. 2007).

The quality of water is evaluated according to taste, color, odor, pH, molds, fungi and bacterial contamination. Clear, colorless, tasteless, odorless, and hygienic water are desired for the consumption of birds (Brake and Hess 2001). Additionally, providing clean and quality water is essential to those broilers for the best performance. Moreover, water quality takes on valuable role as public concern over antibiotic use in animal feed shifts the poultry industry away from the use of antibiotics (Tabler et al 2013).

Various applications can be applied on the drinking water of broiler chicken, in order to reach optimum quality level (Watkins, 2008). Chlorine, chlorine dioxide, hydrogen peroxide, and ozone are used for this aim. Besides the benefits, all these applications have more or less negative effects on the health of poultry and the environment.

New generated and named, as “energized oxygen (O<sub>2</sub>)” is a product that can be introduced to the broiler sector in order to deal with the problems related to disinfection, water hygiene and water quality. It may also be considered as an effective direct and indirect factor on the performance of birds. The “energized oxygen” generator has been approved by Ministry of Health and the produced gas has been defined with special features, which is indicating the differences from ozone (O<sub>3</sub>) (Profoks, 2017; IBU, 2012; TPMDA, 2016). This study has been employed to investigate the usage and the effects of “energized oxygen” on the performance of broiler in a commercial farm.

### **Material and Methods**

**Sample collection and procedures.** All the materials and used methods in this study were considered under the rules of contract commercial broiler production system. In order to see the effects of “energized O<sub>2</sub>”, the experiment has been conducted with Ross broiler in 50.000 broilers capacity farm of a private company in Salihli/Manisa, Turkey. Data were collected between 5<sup>th</sup> July 2016 and 20<sup>th</sup> April 2017. Device has been installed on the water system on 15<sup>th</sup> December 2016. Energized oxygen has been obtained from a generator. Generated gas has been hosed into the drinking water tank, 1,6g/sec energized oxygen was diffused in the 40 tone water. This treated water was provided ad-libitum. After the application of device, drinking water specimen have been taken from the nipples and the membrane filtration technique has been used for the analysis of water by Bornova Veterinary Contol Research Instute, Turkey (MFAL, 2016)

**Experimental design.** Mean of the space allowance during the evaluation period was 0.06 m<sup>2</sup>/bird. The temperature of the house was 33°C at the beginning and it was gradually decreased to 23°C by day 26 (0.5°C reduction in each there days) and then it remained 23°C until the end of 41<sup>th</sup> day. Average relative humidity was 65% during the each party. Continuous lightning was applied in the first ten days, and then it was reduced to 18h/day until the 23<sup>rd</sup> day. Twenty-three hours lightning was kept constant between 24 and 41 days.

Animals were fed loose and pelleted concentrates in the periods of starter (0-12 days), grower (13-23 day) and finisher (24-41day). Crude protein (%) and metabolizable energy (Mcal/kg) levels of three periods were 33CP and 3050ME, 22CP and 3150ME, 20CP and 3280ME respectively. Diets in the periods were formulated according to NRC (NRC, 2014). Any interruption was not allowed to the normal operating system in the broiler house and works continued as they

were. All the routine applications, such as vaccinations, medication, and supervision have been employed to the birds according to sector rules from the beginning to the end of each party. The only difference was “energized oxygen” application in the last two parties.

Total (mass) measurements according to rolls of production system were taken from parties just before the slaughtering process. Means of live weight and carcass weights were calculated dividing the total measurements by the number of birds in each party. In the second step of the evaluation, data obtained from experimental broiler house were compared with the data of other farms in the same contracted system, which had their birds slaughtered with the same rules in the same slaughterhouse at the same time (Figure1).

### **Results and Discussion**

Collected data from each party before and after the application according to commercial sector criteria have been defined in Table1.

Mean of mortality, slaughter live weight (kg), carcass weight (kg), FCR and EPEF of two parties before and after the application were 9.06 and 8.46, 2440 and 2655, 1918 and 2045, 1.74 and 1.68, 315 and 367 respectively. The differences between the mean values for the evaluated traits were 0.6, 215g, 127g, 0.06 and 52 respectively. The differences between two mean values showed that performance of the birds after the application was better than the previous ones for each examined trait. Figure 1 illustrates that, “energized oxygen” application has dramatically increased the EPEF values according to the general mean of slaughterhouse.

Evaluated results showed the effects of energized oxygen on broiler and their housing system. The first effects have been determined in the quality of drinking water and the water installments. According to analyses, any *E. coli*, *Enterococcus sp.* and total coliform have not been detected in the water specimen and the water used in the farm has been approved as suitable. All the sticky films, residues and sediments in the water pipes were disappeared just after the 10 days of application. Clogged water lines, filters and nipple drinkers were completely opened and cleaned. Although there is not any previously completed scientific result related with “energized O<sub>2</sub>”, some similar effects of O<sub>3</sub> usage in various areas and broiler houses have been mentioned by researchers (Jensen, 2014; Schwean- Lardner et al. 2009; Ormerod, 1995; Li et. al. 2015). According to laboratory analyses, energized O<sub>2</sub> shows many diversities from O<sub>3</sub> (Profoks,2017; IBU, 2012; TPMDA, 2016), and it is more friendly to the live metabolism activities, therefore it can be safely used to reach

the suitable drinking water and clean water pipe lines in broiler production units.

Mortality did not show any dramatic fluctuation among the parties. However, 0.6% less mortality was defined in the treated groups. Although Schwean-Lardner et al. (2009), did not recommend O<sub>3</sub> usage in for commercial broiler units because of the increases in morbidity and mortality of the birds subjected to O<sub>3</sub>, energized O<sub>2</sub> reduced the mortality in the experimental farm. Additionally Schwean-Lardner et al. (2009) mentioned serious health problems of O<sub>3</sub> usage for both producers and birds, but in our experiment any problems have not been observed in both sides. Schwean-Lardner et al. (2009) reported the negative effects of O<sub>3</sub> gas on body weight gain and feed consumption of broiler.

In our study, feed conversion efficiency (FCR) was better in the treated groups. Although, all the parties had been under the same management and feeding regime, the birds, those consumed the treated water with energized O<sub>2</sub> have produced more live and carcass weights. Averagely 200g heavier carcass weight of a bird in the treated groups may indicate the effect of application. These two results show that animals in the treated groups consumed less feed but produced more weight. After the detection of this dramatic increase, it is a necessity to define and to detail the causes of these results.

EPEF value is an important measurable standard for the broiler sector, which combines all the criteria of performance. In other words, the higher the value, the better the performance (Szollosi et al. 2014). Therefore, evaluating the EPEF values gives an opportunity to see the inputs and outputs of the whole system and compare with the others. As can be seen in Table 1 and Figure 1, EPEF values from the treated groups were higher than the EPEF values of non-treated groups in the studied farm. According to the data of slaughterhouse, which is used by the commercial contract production system, EPEF values from the treated groups were also better than the mean EPEF values of the other farms under the same organization.

## **Conclusion**

Obtained results may suggest that “energized oxygen” can bring new and applicable facilities to the broiler chicken system in terms of water and water equipment hygiene, feed conversion efficiency and performance of birds. Even defined traits such as, consuming less food and producing more weight are important results for broiler sector. These outputs also give an opportunity to slaughter the births earlier than the certain time. Additionally, disinfection features of the

generated gas can reduce the usage of disinfectants, chemicals and detergent in the broiler houses.

All these evaluated data and the comments are the result of an introduction of a device to the sector, but it is worth to continue and find some relation with the generated gas and the evaluated traits. For this aim, a planned study that can provide statistically analyzable data have to be employed.

Table1. Forty-first day performance of the parties before and after the application

	<i>B1</i>	<i>B2</i>	<i>A1</i>	<i>A2</i>
Starting day	05.07.2016	08.09.2016	11.01.2017	10.03.2017
Number of chicks	45300	49040	47500	49680
Mortality (%)	7.79	10.32	8.91	8.01
Slaughter Weight (g)	2430	2450	2750	2560
Carcass Weight (g)	1948	1887	2118	1971
FCR	1.77	1.71	1.67	1.69
EPEF	322	307	367	366

FCR: Feed Conversion Ratio, EPEF: European Production Efficiency Factor (Average grams gained/day X % survival rate)/Feed Conversion X 10), B: Before application, A: After application.

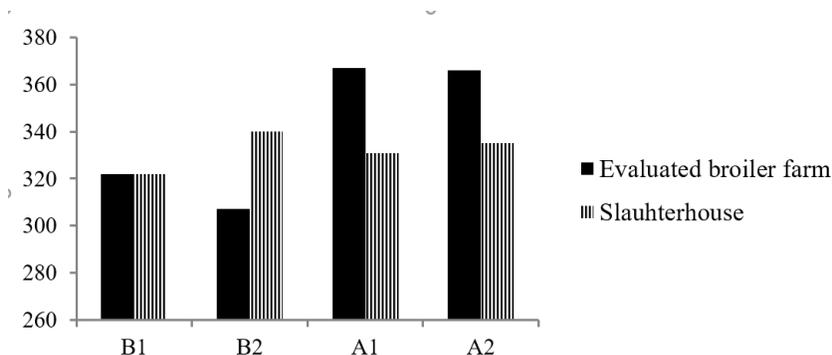


Figure 1. Comparison of the examined EPEF values in the study and the mean EPEF values of the slaughterhouse at the same slaughter time before (B) and after (A) the application.

## References

- BRAKE, J.P., HESS, J.B. (2001) Evaluating water quality for poultry. Publ. ARN-1201. 4

- FEDDES JR, EMMANUEL EJ, and ZUIDHOF MJ. (2002) Broiler performance, bodyweight variance, feed and water intake, and carcass quality at different stocking densities. *Poult Sci.* 81:774-779.
- HANCOCK, A, HUGHES, J, WATKINS, S. (2007) In search of ideal waterline cleaner. Avian advice. University of Arkansas Cooperative Extension Service, Fayetteville. 9:1-3.
- IBU. (2012) Abant İzzet Baysal University, Analyse report of Environmental Engineering Department 12.09.2012, Bolu, Turkey.
- JENSEN, K. (2014) Ozone used in chicken farm. Available from: [www.Ozonosolutions.com/journal/2014](http://www.Ozonosolutions.com/journal/2014). [Accessed 14 July 2017].
- LI, X., LIU, L.L., YANG, L.Y., LI, Y.T. and SHANG, S.H. (2015) Influence of ozone on water purification efficiency by biofilm in the pipeline. *Journal. J. Beijing Inst. Tech.* 41:912-918.
- MFAL, (2016) Examination report 29.12.2016. Ministry of Food, Agriculture and Livestock,
- NRC, (1994) Nutrient Requirements for Poultry. 9th rev. ed. Natl. Acad. Press, Washington, DC.
- ORMEROD, K. (1995) The influence of disinfection processes on biofilm formation in water distribution systems. *Water Res.* 29: 1013-1021.
- PROFOKS, (2017) Professional oxygen systems. Omrak Plaza, Ankara, Turkey. Available from: [www.Profoks.com](http://www.Profoks.com). [Accessed 14 July 2017].
- SCHWEAN-LARDNER, K., DAHIYA, J.P., OLKOWSKI, A.A., BARBER, E.M., RIDDELL, C. and CLASSEN, H.L. (2009) Effect of adding ozone into an intensive broiler production unit on performance, mortality, ammonia levels, and bacterial levels as compared with a non-ozone-treated broiler unit. *J. Appl. Poult. Res.* 18:649-657.
- SZOLLOSI, L., SZUCS, I. and NABRADI A. (2014) Economic issues of broiler production length. *Economics of Agriculture.* 61:633-646.
- TABLER, T., WELLS, J. and ZHAI, W. (2013) Water quality critical to broiler performance. Mississippi State Uni. Extension Service, Available from: [www.extension.msstate.edu/sites/default/files/publications](http://www.extension.msstate.edu/sites/default/files/publications). [Accessed 14 July 2017].
- TPMDA, (2016) Information report from T. C. Ministry of Health, Turkey Pharmaceuticals and Medical Devices Agency 16.08.2016, Ankara, Turkey

- WATKINS, S. (2008) Water: Identifying and correcting challenges. University of Arkansas Cooperative Extension Service, Fayetteville. *Avian Adv.* 10:10-15.
- WATKINS, S., TABLER, G.T. (2009) Broiler water consumption. *Avian Adv.* 11:11-12.

## The Effect of Conventional and Enriched Litter System upon Incubation Result and Plumage Score in Layer Breeder Hens

Bülent Tarım<sup>a</sup>, Murat Doğu<sup>a</sup>, Diydem Doğan<sup>a</sup>, Ayten Aşkın Kılınç<sup>a</sup>, Sunay Demir<sup>a,1</sup>, H. Öztürk<sup>b</sup>

<sup>a</sup>: Poultry Research Institute, Ankara, Turkey

<sup>b</sup>: Department of Physiology, Veterinary Faculty, Ankara University, Ankara, Turkey

<sup>1</sup>Corresponding author: sunay.demir@tarim.gov.tr

### Abstract

This study was carried out to determine the effects of two different breeding systems as traditionally used and enriched of them on their performance and plumage score. In the study, 2400 Barred Rock Brown layer hens and 240 Barred Rock line Roosters were used in the Ankara Poultry Research Institute. The animal material was divided into 4 treatment groups (Conventional and Enriched 2 / 3 Slatted Litter Floor System, Conventional and Enriched Deep Litter Floor Systems), and each group was divided into 5 replications. Each replication is arranged to be 120 chickens. The trial lasted up to 52 weeks of age. When the obtained results were analyzed by variance analysis technique and multiple comparison method, the difference between groups was found to be statistically significant ( $p < 0,05$ ) between plumage score. The differences between groups in term of incubation result was not statistically significant ( $p > 0,05$ ).

**Key Words:** *Conventional floor systems, alternative systems, plumage scores, layer breeders hens*

### Yumurta Tavuklarında Geleneksel ve Zenginleştirilmiş Sistemlerin Kuluçka Sonuçları ve Tüy Skoru Üzerine Etkileri

#### Özet

Bu çalışma, yerde yetiştirmede geleneksel olarak kullanılan iki farklı yetiştirme sistemi ve bu yetiştirme sistemlerinin zenginleştirilmesi halinde performansa ve tüy skoruna etkilerini belirlemek amacıyla yapılmıştır. Araştırmada 2400 adet Ankara Tavukçuluk Araştırma Enstitüsünde bulunan Barred Rock hattı kahverengi yumurtacı tavuklar ile 240 adet aynı hattın horozları kullanılmıştır. kullanılmıştır.

Hayvan materyali 4 adet muamele grubuna (Geleneksel ve Zenginleştirilmiş 2/3 Izgara Tabanlı Yer Sistemi ile, Geleneksel ve Zenginleştirilmiş Tamamı Altlıklı Yer Sistemleri) ayrılmış ve her grup 5 tekerrür olacak şekilde bölmeler yapılmıştır. Her tekerrür 120 tavuk olacak şekilde düzenlenmiştir. Deneme 52 haftalık yaşa kadar sürmüştür. Elde edilen sonuçlar varyans analiz tekniği ve çoklu karşılaştırma yöntemi ile analiz edildiğinde tüy skoru bakımından gruplar arasında ki farklılık istatistik olarak önemli bulunurken ( $p < 0,05$ ), kuluçka sonuçları açısından ise önemli bulunmamıştır ( $p > 0,05$ ).

**Anahtar Kelimeler:** Geleneksel yer sistemleri, alternatif sistemler, tüylenme skoru, yumurta tavukları

### **Introduction**

In the world, work is being done to ensure that the housing conditions are in accordance with the nature of the chickens. In the light of these studies, egg hatches are housed in traditional and enriched housing systems. The pens were prepared in accordance with the standards adopted by the European Union and welfare decisions. The effects on the egg production and quality of the housing systems have been determined. Compared to the efficiency obtained from the unit poultry floor area.

### **Material and Methods**

Barred chickens were used as animal material in the study. After the breeding eggs from the hatchlings to be chickened are accepted in the egg acceptance section, the ones with breeding characteristics are selected and placed in the growth trays. The breeding eggs placed in the development vehicles were fumigated in the fumigation chamber before being placed in the development machine, free from harmful microorganisms that could be found on the egg shell surface. The breeding eggs placed in the development machines completed 18 days of 21 day incubation on these machines. Eggs that have completed 18 days in the development machine were excluded from the embryo development in bright light under this light, and the live embryo eggs were placed in the exit cups with the vacuum egg transfer machine. The eggs completed the last three days of their 21 day development period in the exit machines and they performed incubation exits in these machines. The emerging chicks were transferred to the growth house, and the test materials reaching the gender maturity were then transferred from growth house with the standard cage to breeding

house until the 52th age (until the end of the trial). Four treatment groups were used: a traditional deep litter system, an enriched deep litter system, a traditional 2/3 slatted floor system, an enriched 2/3 slatted floor system and a total of 20 groups of 5 replications per group. The sizes of the divisions are calculated to be equal for each treatment group. 8cm thick sawdust was laid on the floor as a base material, the nest made of galvanized material. The number of nest is calculated to be one to four to five chickens. Grid material is wood. A nipple was provided for every 4-6 chickens. Feeding ad- libitum and standard feeding program were applied. It is made on the basis of the poultry house with lighting windows.

Observation data obtained as a result of the experiment were evaluated by variance analysis technique. When there is a difference between at least two means as a result of the variance analysis, when the result is obtained, the difference between the group averages is statistically significant.

## Results

The values obtained from the study results in terms of incubation results in order of group for Enriched 2/3 Slatted Floor System, Conventional 2/3 Slatted Floor System, Enriched Deep Litter System, Conventional Deep Litter System are Fertility (%): 95,42±0,52, Hatching Results (%): 84,02±1,66, Hatching Egg Ratio (%):67,86±1,03, Pasgar Score: 9,79±0,016; Fertility (%):96,22±0,49, Hatching Results (%):83,52±1,75 Hatching Egg Ratio (%):67,3±1,04, Pasgar Score: 9,73±0,018 ; Fertility (%):96,53±0,54, Hatching Results (%):82,63±1,27 Hatching Egg Ratio (%):68,89±0,95, Pasgar Score: 9,78±0,017 ; Fertility (%):95,42±0,74, Hatching Results (%):83,78±1,82, Hatching Egg Ratio (%):70,43±0,93, Pasgar Score: 9,77±0,016

There was no significant difference in terms of fertility rate, hatchery yield, hatching egg ratio and Pasgar Score ( $p > 0,05$ ).

The results obtained when analyzing the values obtained in terms of plumage score. Statistically significant differences were found between the groups ( $p < 0,05$ ). The results of the project with regard to plumage condition are given in the table below:

Groups	<i>Plumage Conditions of Hens</i>						
	NECK	ABDOMEN	WING	TAIL	BACK	CLOAK	TOTAL
Enriched 2/3 Slatted Floor System	3,28±0,05 <sup>a</sup>	3,50±0,05	3,58±0,04 <sup>c</sup>	3,61±0,04 <sup>b</sup>	3,45±0,05 <sup>b</sup>	3,9869±0,05	21,457±0,169 <sup>b</sup>
Conventional 2/3 Slatted Floor System	3,25±0,06 <sup>ab</sup>	3,61±0,05	3,60±0,04 <sup>c</sup>	3,68±0,03 <sup>b</sup>	3,59±0,05 <sup>ab</sup>	3,9896±0,005	21,749±0,162 <sup>b</sup>
Enriched Deep Litter System	3,05±0,06 <sup>b</sup>	3,41±0,05	3,78±0,03 <sup>b</sup>	3,73±0,03 <sup>b</sup>	3,56±0,05 <sup>ab</sup>	3,935±0,004	21,562±0,152 <sup>b</sup>
Conventional Deep Litter System	3,27±0,05 <sup>ab</sup>	3,47±0,04	3,93±0,01 <sup>a</sup>	3,89±0,02 <sup>a</sup>	3,72±0,03 <sup>a</sup>	3,9918±0,004	22,311±0,099 <sup>a</sup>
p	0,035	0,064	0	0	0,003	0,835	0

## Discussion

When the data obtained from the project is evaluated; as a result of conventionally 2/3 slatted floor system and conventionally deep litter systems are enriched; When comparing the traditional and enriched systems in terms of plumage scoring, the difference between the groups was not statistically significant. This result indicates that enrichment is not an effect on the feather score. Generally, plumage score is higher than slatted floor system systems in deep litter system systems. Controversial results have been obtained in research projects on UK (Elson, 1981), Holland (Brantas et al., 1978), Switzerland (Oester, 1985) and Germany, on get-away cages. When the sand pool was found in the cages, the welfare of the chickens was observed. However, problems such as aggression, cannibalism and plumage pulling have emerged, making it difficult to observe and catch chickens. Similar to the results in the literature; wing and tail area, and the total feather score in the enriched litter system is lower than in the conventional litter system. The beak length is high, the feather score is similar to the traditional system.

## References

- Anonymous. 2011. Official newspaper. Regulation on the welfare of farm animals. 23.12.2011, sayı: 28151
- ABRAHAMSSON, P., TAUSON, R. And ELWINGER, K. 1996 b. Effects on production, health and egg quality of varying proportion of wheat and barley in diets for two hybrids of laying hens kept in different housing systems. *Acta Agric. Scand., Section A, Animal Science*, 46: 173-182.
- BLOKHUIS, H.J., JONES, R.B., GEERS, R., MIELE, M. and VEISSIER, I. (2003) Measuring and monitoring animal welfare: transparency in the food product quality chain. *Animal Welfare* 12, 445-455.
- BLOKHUIS, H.J., 2004., Recent development in European and International Welfare Regulation. 22 th World Poult. Sci. Congress, İstanbul, TURKEY
- BRANTAS, G.C., WENNRICH, G. AND DE VOS-REESINK, K. (1978) Behavioural observations on laying hens in get-away-cages (Ethologische Beobachtungen an Legehennen in Get-away-Kaefigen). *Archie fur Geflugelkunde* 42, 129-132.
- CAMPO, J.L., GIL, M.G., DAVILA S.G. and MUNOZ I., 2005. Influence of perches and footpad dermatitis on tonic immobility and heterofil to lymphocyte ratio of chickens, *Poultry Science*, No: 84, pp: 1004-1009.

- DAVIS, G.S., ANDERSON, K.E. and CARROLL, A.S. 2000. The effects of long-term caging and molt of Single Comb White Leghorn hens on heterophil to lymphocyte ratios, corticosterone and thyroid hormones. *Poult. Sci.*, 79: 514-518
- DİKMEN, B.Y., İPEK, A., ŞAHAN, U., PETEK, M., SÖZCÜ, A. 2016. Egg production and welfare of laying hens kept in different housing systems (conventional, enriched cage, and free range). *Poultry Science* 95:1564–1572
- ELSON, H.A. (1981) Modified cages for layers. In: Alternatives to intensive husbandry systems. Universities Federation for Animal Welfare, Potters Bar, UK, pp. 47-50.
- ELWINGER, K and TAUSON, R. 1999. Valj ratt honor vid glovinhysning. Fakta jordbruk 1999 I.SLU Publikationstjänst, Box, 7075, 750 07 UPPSLA, Sweden.
- GROSS, W. B. and P.B. SIEGEL, P.B., 1983. Evaluation of the heterophil/lymphocyte ratio as a measure of stress in chickens. *Avian Dis.*, 27: 972-979.
- KAHRAMAN, N.Ş., 2008. Yumurta üretim işletmelerindeki barındırma ve iç ayrıştırma sistemlerinin güncelleştirilme olanakları, Doktora Tezi, Akdeniz Üniversitesi Fen Bilimleri Enstitüsü, Antalya.
- KOELEBECK, K. W. and CAIN, J. R. 1984. Performance, behaviour, plasma corticosterone, and economic returns of laying hens in several management alternatives. *Poult. Sci.*, 63: 2123-2131.
- KONUK, T. 1975. Practical Physiology. Ankara University Veterinary Medicine Publication, Ankara University Press, Ankara, 250 pp
- NICOL, C. J., BROWN, S. N., GLEN, E., POPE, S. J., SHORT, F. J., WARRISS, P. D., ZIMMERMAN, P. H., WILKINS, L. J. 2006. Effects of stocking density, flock size and management on the welfare of laying hens in single-tier aviaries. *Brit. Poult. Sci.*, 47: 135-146
- OESTER, H. (1985) Die Beurteilung der Tiergerechtigkeit des Get-Away-Haltungssystems der Schweizerische Geflagelzuchtschule, Zollikofen für Legehennen. PhD thesis, University of Bern, Switzerland.
- SARICA M., CAMCI Ö., MIZRAK C., AKBAY R., TÜRKÖĞLU M., YAMAK U.M.S., (2012). Overview of Poultry Breeding Strategy in Turkey. Network access:(<http://www.organikpin.com/image/data/pdf/Turkiyede-kanatli-islak-stratejilerine-baki.pdf>)

- SHINI, S. 2003. Physiological Responses of Laying Hens to the Alternative Housing Systems. *Int. Journal of Poult. Sci.*, 2(5): 357-360.
- TAUSON,R., AMBBROSEN, T. and ELWİNGER, K., 1984 'Evaluation of procedures for scoring the integument of laying hens: independent scoring of plumage condition', *Acta Agriculturae Scandinavica, Section A: Animal Science*, 34, pp. 400–408.
- TAUSON, R. and Holm, K.E. (1998) Evaluation of the Marielund Keeping System. Report 244, Swedish University of Agricultural Sciences, Dept. Animal Husbandry and Management, Funbolovsta research Centre. 755 97 UPPSALA, Sweden.
- TAUSON R., WAHLSTROM, A. and ABRAHAMSSON, P. 1999. Effect of two floor housing systems and cages on healt production and fear response in layers. *Journal of Applied Poultry Research*, 8: 152-159.

### **Performance Characteristics of Slow Growing Broilers Used in Alternative Broiler Breeding Systems**

**Ahmet Şekeroğlu<sup>a</sup>, Mustafa Duman<sup>b</sup>**

<sup>a</sup>Ömer Halisdemir University, Ayhan Sahenk Faculty of Agricultural Sciences and Technologies, Department of Animal Production and Technologies, Niğde –Turkey  
<sup>b</sup>Ömer Halisdemir University, Bor Vocational, School, Department of Laboratory and Veterinary Health, Bor, Niğde – Turkey

#### **Abstract**

In the second half of the 21<sup>th</sup> century, the growth rate of commercial broiler chickens increased dramatically. In the 1950s, they reached their live weight of 1.5 kg in 120 days, whereas today they reach the same weight just in 30 days. Likewise, the feed conversion ratio has decreased from 4.4 to 1.47. However, in 2000s, a worldwide public opinion was raised against the traditional broiler production systems. For this reason, alternative breeding systems and slow growing broiler chickens suitable for these systems have been developed to meet consumer demands. In this review, brief information is given about broiler chickens used in alternative breeding systems and attention is paid to this issue.

**Key words:** *Broiler, Production Systems, Slow Growing Broilers*

**Alternatif Etlik Piliç Yetiştiriciliğinde kullanılan Yavaş Gelişen Etlik Piliçlerin Performans Özellikleri**

## Özet

Yirminci yüzyılın ikinci yarısında, ticari etlik piliçlerin büyüme oranı büyük ölçüde artmıştır. 1950 yıllarında 120 günde ulaştıkları 1,5 kg canlı ağırlığa günümüzde 30 günde ulaşabilmektedir. Aynı şekilde yemden yararlanma oranı 4,4 den 1,47'ye düşmüştür. Ancak, dünya genelinde 2000 yıllarında geleneksel etlik piliç yetiştiriciliğine karşı bir kamuoyu oluşmuştur. Bu nedenle tüketici taleplerini karşılamak amacıyla alternatif yetiştirme sistemleri ve bu sistemlere uygun olan yavaş gelişen etlik piliçler geliştirilmiştir. Bu derlemede alternatif yetiştirme sistemlerinde kullanılan etlik piliçler konusunda bazı bilgiler verilerek, konuya dikkat çekilmeye çalışılmıştır.

**Anahtar kelimeler:** *Etlik Piliç, Yetiştirme Sistemleri, Yavaş Gelişen Etlik Piliç*

### **Introduction**

Local breeds have been created that have adapted to different parts of the world. These breeds have been used to meet human needs for eggs and meat. From these local breeds Legorn, Rhode Island Red, Plymouth Rock, Cornish and New Hampshire came to be the most recognized breeds in the world. Today's commercial laying hybrids are derived from Leghorn, Rhode Island Red and White Plymouth Rock breeds. In addition, breeds such as Barred Plymouth Rock, White Plymouth Rock, Cornish and New Hampshire were used for broiler production.

In the year 2000, due to consumer concern about animal welfare and changes in the concept of safe food, a public campaign against traditional farm chicken breeding has emerged all over the world. For this reason, alternative breeding (free-range, certified production and organic breeding) systems have been developed to meet consumer demands. However, fast growing broiler breeds used in the traditional system are not suitable for alternative production systems. Alternative systems require slow growing broiler genotypes and longer production duration.

### **Welfare Problems**

At the beginning of broiler breeding, some welfare problems arise due to selection based on live weight (Scahaw, 2000; Bessei, 2006). Most of the welfare problems stem from genetic (sudden death syndrome, ascites, skeletal disorders, low mobility, susceptibility to stress) and environmental factors (contact dermatitis, thermal discomfort) and their interactions (Bessei, 2006). Despite being slaughtered at 5-7

weeks of age, the mortality rate is being tried to be reduced below 5% in fast growing broilers. Due to problems with skeletal and leg disorders such as bone weakness, gait disturbance and lameness increase, the ability of animals to move decreases (Danbury et al., 2000; Stojcic and Bessei, 2009).

While 57% of fast growing broilers have serious leg problems while this rate is about 17% for slow growing ones (De Jong et al., 2011). In the same way, hock burn is about 20% in fast growing broilers and less than 1% in slow growing broilers. The rate of foot pad dermatitis is 22% in fast growing broilers and 7% in slow growing broilers (Welfare Quality® (2009). The reason that these problems are low in the slow growing broilers is that the leg development in slow growing broilers chickens has a supportive effect on body development (Haslam et al., 2006).

### **Meat Quality Properties pH, Color and Internal Organ Weight**

Many factors such as slaughter age, genotype (fast, average and slow growing), breeding system, physical activity, green grass consumption and feeding influence the quality of meat (Castellini et al., 2008). Aben and Bergoglio (2001) found 1.85-2.58% fat and 74.81-75.5% moisture content in breast meat when they were working with three different commercial broiler hybrids. Lichovniková et al. (2009) found higher fat and statistically lower moisture content in fast growing broiler meat than slow ones in 49th and 90th days. In general, the meat ratio of the broiler chickens increases with the increase in the age, while the humidity decreases (Fanatico et al., 2005). Bogosavljevic-Boskovic et al. (2010) reported that while the ratio of total fat in broiler meat decreased, protein content increased in free-range comparing with extensive production system. The abdominal fat rate of animals raised in the free-range system is lower than that of the traditional broiler production system (Li et al., 2016).

The meat color is determined by L\*, a\*, b\* scores. Color can be effected by pre-slaughter factors, stunning methods and chilling regimes (Karunanayaka et al., 2016). The a \* score of broiler meat grown in the conventional system is higher than that grown in the free-range system, but the b \* score is lower. There is a negative correlation between the L \* score and the pH of the meat. As age increases, pH increases while L \* decreases. The animals grown in the free-range system have a higher taste and flavor of meat compared to the meat from traditional system because the stress level of animal decreases by the comfort and welfare conditions of the free-range system (Bogosavljevic-Boskovic et al., 2010).

## **Slow-Growing Genotypes and Performance Characteristics Used in Alternative Breeding Systems**

Companies (Cobb-Vantress, Aviagen and Hubbard) which dominate the commercial broiler production around the world, have been developed the JA 57, JA 57 K, JA 7, JA 57 KI, RedBro M , redBro S, P6N, CobbSASSO, Ross Rowan and Hubbard Colored slow growing broilers to meet the consumer demands (De Jong et al., 2012). These chickens reach 2.0-3.0 kg live weight in 49-81 days depending on the growing system. According to the results of the researches about the performance with the slow growing broilers in alternative systems; slaughter age 64-112 days, slaughter live weights 1200-2400 g; the feed conversion ratio varies between 2.05-4.41. As can be seen, the age, weight and feed conversion ratio of genotypes differ from each other. However, generally accepted age is over 81 days.

It is reported that the 84th day live weight and feed conversion ratio of Sasso slow growing broiler chickens (T44, T44N1, T55, T77N, T88N, T44N, T55Npb, T88, Gris center, T77, Sussex, Malvoisine) is 2300 g and approximately 3 respectively (Sasso, 2018). The performance characteristics of slow-growing broiler parents, 5% yield age of the slow-growing broiler chickens is 22-24 weeks, 5% yield age weight is 1790-2350 g, peak yield age is 28-30 weeks, 64 weeks egg yield is 182-222 eggs and hatching egg number is 181-211 per hen (Hubbard, 2018; Cobbsasso, 2018 ).

## **Conclusion**

As a result, intensive studies on the breeding of poultry genotypes have been started which are suitable for alternative broiler breeding systems, have a cut-off age of over 56 days, have high adaptability in natural conditions, are resistant to adverse effects of the environment, and meet consumer demands about meat quality. Scientific studies for the welfare, meat quality, consumer demand and sustainable production of fast and slow growing broiler chickens used in traditional and alternative breeding systems should be continued.

## **References**

- ABENI, F. and BERGOGLIO, G. (2001) Characterization of different strains of broiler chicken by carcass measurements, chemical and physical parameters and NIRS on breast muscle. *Meat Science*, 57 (2): 133-137.
- BESSEI, W. (2006) Welfare of broilers: a review. *Worlds Poultry Science Journal*, 62:455-466.

- BOGOSAVLJEVIC-BOSKOVIC, S., MITROVIC, S., DJOKOVIC, R., DOSKOVIC, V. and DJERMANOVIC V. (2010) Chemical composition of chicken meat produced in extensive indoor and free-range rearing systems. *African Journal of Biotechnology* 9: 9069–9075.
- CASTELLINI, C., BERRI, C., LE BIHAN-DUVAL, E., and MARTINO, G. (2008) Qualitative attributes and consumer perception of organic and free-range poultry meat. *World's Poultry Science Journal* 64 (4): 500-512.
- COBBSASSO (2018) Slower Growing Colored Chicken. [https://cobbstorage.blob.core.windows.net/guides/CobbSasso\\_Breeder\\_Management\\_Supplement\\_v1\\_EN.pdf](https://cobbstorage.blob.core.windows.net/guides/CobbSasso_Breeder_Management_Supplement_v1_EN.pdf), accessed: 20 December 2017.
- DANBURY, T.C., WEEKS, C.A., CHAMBERS J.P., WATERMAN-PEARSON A.E. and KESTIN S.C. (2000). Self selection of the analgesic drug carprofen by lame broiler chickens. *Veterinary Record* 146: 307–311.
- DE JONG, I., BERG, C., BUTTERWORTH, A. and ESTEVÉZ, I. (2012) Scientific report updating the EFSA opinions on the welfare of broilers and broiler breeders. Supporting Publications 2012:EN-295. [116pp.]. Available online: [www.efsa.europa.eu/publications](http://www.efsa.europa.eu/publications). Date of Access: 29 December 2017.
- FANATICO, A.C., CAVITT, L.C., PILLAI, P.B., EMMERT, J.L., OWENS, C.M. (2005). Evaluation of slowing growing broiler genotypes grown with and without access: meat quality. *Poultry Science* 84 (11): 1785–1790.
- HASLAM, S.M., BROWN, S.N., WILKINS, L.J., KESTIN, S.C., WARRISS, P.D. and NICOL, C.J. (2006) Preliminary study to examine the utility of using foot burn or hock burn to assess aspects of housing conditions for broiler chicken. *British Poultry Science* 47(1):13-18.
- HUBBARD (2018) Recessive Products. <https://www.hubbardbreeders.com/premium/premium-females/7758-recessive-products.html>, accessed: 15 December 2017.
- KARUNANAYAKA, D.S., JAYASENA, D.D. and JO, C. (2016) Prevalence of pale, soft, and exudative (PSE) condition in chicken meat used for commercial meat processing and its effect on roasted chicken breast. *Journal of Animal Science and Technology* 58 (27): 1-8.

- LI, X., WANG, J., WANG, C., ZHANG, C., LI, X., TANG, C. and WEI, X. (2016) Effect of dietary phosphorus levels on meat quality and lipid metabolism in broiler chickens. *Journal of Agricultural and Food Chemistry* 64: 9412–9420.
- LICHOVNÍKOVÁ, M., JANDÁSEK, J., JUZL, M. and DRACKOVA, E. (2009) The meat quality of layer males from free-range in comparison with fast-growing chickens. *Czech Journal of Animal Science* 54 (11): 490–497.
- SASSO (2018) Slow growth chickens ADG<30g. <http://www.sasso.fr/best-chicken-breeds-slow-growth-for-free-range-poultry-breeding.html>, accessed: 11 December 2017.
- SCAHAW (2000) The welfare of chickens kept for meat production (broilers). Report of the Scientific Committee on Animal Health and Animal Welfare European Commission. pp.149
- STOJCIC, M.D. and BESSEI, W. (2009) The effect of locomotor activity and weight load on bone problems in fast and slow growing chickens. *Archive Fur Geflugelkunde* 73: 242-249.
- WELFARE QUALITY® (2009). Welfare Quality® assessment protocol for poultry (broilers, laying hens). Welfare Quality® Consortium, Lelystad, The Netherlands.

# An Overview of World's Goose Production and Global Trade

Ahmet Şekeroğlu<sup>a</sup>, Mustafa Duman<sup>b</sup>

<sup>a</sup>: Niğde Ömer Halisdemir University, Ayhan Sahenk Faculty of Agricultural Sciences and Technologies, Department of Animal Production and Technologies, Niğde – Turkey

<sup>b</sup>: Niğde Ömer Halisdemir University, Bor Vocational, School, Department of Laboratory and Veterinary Health, Bor, Niğde – Turkey

## Abstract

In many parts of the world, geese production is being done locally or internationally. According to FAO's data for 2016, the amount of the world geese and guinea fowl is approximately 380 million units. The five most important producer countries are China (315350 thousand), Russia (15448 thousand), Mozambique (12291 thousand), Egypt (7045 thousand) and Ukraine (5115 thousand). In terms of exports of goose and guinea fowl meat, the European continent is 39394 tons (75%), the Asian continent 12248 tons (24%), the African continent 497 tons (1%). The export amount and proportion of the major fatty liver exporter countries are France with 2376 tons (63%), Bulgaria with 353 tons (9%), Belgium with 339 tons (9%), Russia with 275 tons (7%). More than 90% of goose feather and down cluster is produced in Asia. As a result, it can be said that goose remains important both locally and globally. Because it is an important commercial activity, especially in some regions of Asia, Europe and Africa.

**Key words:** *Export, Fatty Liver, Feather, Goose, Import, Trade*

## Dünya Kaz Üretimi ve Global Ticareti Üzerine Bir Bakış

### Özet

Dünyanın birçok bölgesinde yöresel olarak ya da uluslararası anlamda kaz üretimi yapılmaktadır. FAO 2016 yılı verilerine göre, Dünyada kaz ve beç tavuğu miktarı yaklaşık olarak 380 milyon adettir. En önemli beş üretici ülke ise Çin ( 315350 bin adet) , Rusya (15448 bin adet), Mozambik (12291 bin adet), , Mısır (7045 bin adet) ve Ukrayna'dır (5115 bin adet). Kaz ve beç tavuğu eti ihracatı bakımından; Avrupa kıtası 39394 ton (%75), Asya kıtası 12248 ton

(%24), Afrika kıtası 497 ton (%1) ile en başta yer almaktadırlar. Önemli yağlı karaciğer ihracatçısı ülkelerin ihracat miktarı ve oranı ise; Fransa 2376 ton (%63), Bulgaristan 353 ton (%9), Belçika 339 ton (%9), Rusya 275 ton (%7)'dir. Kaz tüyü ve alt tüylerin üretiminin %90'ndan fazlası Asya kıtasında üretmektedir. Sonuç olarak kazın yöresel ve küresel düzeyde önemini koruduğunu söyleyebilir. Çünkü Asya, Avrupa ve Afrika kıtasının bazı bölgelerinde önemli bir ticari faaliyettir.

**Anahtar kelimeler:** İhracat, Yağlı Karaciğer, Tüy, Kaz, İthalat, Ticaret

### **Introduction**

In many parts of the world, goose production is being done locally or internationally. Goose is one of the first domesticated animals and poultry in the world. The goose is mainly produced for meat, liver, feather and down clusters. They protect their environment against foreigners. They are used in the struggle of weeds in plant breeding, especially in the fight against the rapidly spreading water hyacinths. Geese are resistant to many poultry diseases. Management easy and can live up to fifteen years of age. However, they have some disadvantages such as low reproductive rate and low fertility (Farell, 2004).

### **Goose and goose products trade**

According to FAO's data for 2016, the amount of the world goose and guinea fowl is approximately 380 million units. The five most important producer countries are China (315350 thousand), Russia (15448 thousand), Mozambique (12291 thousand), Egypt (7045 thousand) and Ukraine (5115 thousand). Turkey is ranked 15<sup>th</sup> in the world with 774 thousand geese and guinea fowl (FAO, 2017). When it is evaluated in terms of continents, 85% of goose and guinea fowl are found in Asia, 9% in Africa and 6% in Europe. Live goose exporter countries are Germany, France, Hungary and Czech Republic. Approximately 40% of live goose exports are made in Germany, 25% in France and 12% in Hungary. The value of imports of live goose is 1,868 thousand USD. The major importing countries are Hungary, Romania and the United States (ITC, 2018).

In terms of exports of goose and guinea fowl meat, the European continent is 39394 tons (75%), the Asian continent is 12248 tons (24%), the African continent is 497 tons (1%). The proportion of America and Oceania (0.0%) is too low to be tested (FAO, 2018).

Major countries exporting goose meat in the world is Poland, South Africa and Hungary. World Goose meat export value is 17,260 thousand USD. Among this export, 6265 thousand USD is done by Poland, 5908 thousand USD is done by South Africa and 4228 thousand USD is done by Hungary (ITC, 2018). World goose meat import value is approximately 18393 thousand USD. The major importing countries are Germany (7186 thousand USD), Lesotho (5880 thousand USD), Austria (1180 thousand USD) (ITC, 2018).

One of the most important products of geese is fatty liver. For the production of fatty liver, the geese are subjected to forced nutrition. By this method, livers having a weight of about 900 g are produced. The export amount and proportion of the major fatty liver exporter countries are France, Bulgaria, Belgium and Russia with 2376 tons (63%), 353 tons (9%), 339 tons (9%), 275 tons (7%), respectively (ITC, 2018). Major goose liver importing countries are Spain with 1810 tons (45%) and Belgium with 585 tons (15%).

More than 90% of the production of goose feather and down cluster occur in Asia. The quantity and quality of feathering are influenced by genetics and indirectly by the environmental or nutritional factors (Leeson and Walsh, 2004). The middle and heavy adult geese have about 150-230 gr feather, which is about 6% of the live weight. The feather constitutes about 10% of the income from goose production.

## **Conclusion**

Demand for alternative poultry products continues to increase worldwide. Goose is also one of the alternative poultry. A number of reactions have been developed against forced feeding in the production of fatty liver and this method is banned in many countries. However, consumption of goose meat remains importance both locally and globally. For this reason, it is an important commercial activity, especially in some regions of Asia, Europe and Africa.

## **References**

- FARRELL, D.J.** (2004). Management, nutrition and products of domestic geese: a review. In: T. A. Scott, R. A. E. Pym, E. F. Anninson, D. Balnave, W. L. Bryden, D. J. Farrell, D. R. Fraser, R. J. Hughes and W. I. Muir, 16th Annual Australian Poultry Science Symposium. *Australian Poultry Science Symposium*, Sydney, pp.139-144.
- FAO** (2018) Faostat. <http://www.fao.org/faostat/en/#data/OA>, accessed 01 January 2018

**ITC**, (2018) Trade Map. <https://www.trademap.org/> accessed 01 January 2018

**LEESON, S. and WALSH, T.** (2004) Feathering in commercial poultry II. Factors influencing feather growth and feather loss. *World's Poultry Science Journal*

# Energized Oxygen Disinfection of Egg Shell

Özlem Sahan Yapicier<sup>a</sup>, Mustafa Saatci<sup>b</sup>

<sup>a</sup> Mehmet Akif Ersoy University, Department of Microbiology, Faculty of Veterinary Medicine, Burdur, Turkey, 15030

<sup>b</sup> Mehmet Akif Ersoy University, Department of Animal Science, Faculty of Veterinary Medicine, Burdur, Turkey, 15030

## Abstract

Eggshell disinfection is as important unit operation in egg processing and improves safety of eggs to consumers. The objectives of this study were to evaluate alternative eggshell disinfection method without affecting human health by using energized oxygen (O<sub>2</sub>) gas. A total of 90 eggs were collected from layer house's egg storage and studied in 5 treatment groups: before energized oxygen gas was sprayed to the egg surface, swab samples were taken in 30 second, 24-48 h later after gas was sprayed and egg vial samples. All treatments reduced microbiological counts below the level of detection. Results showed that any microorganisms could be found in egg surface. Therefore, these egg disinfection treatment with energized O<sub>2</sub> can be used to improve safety for human consuming.

**Key Words :** Egg hygiene, Energized Oxygen, Layers

## Enerjilendirilmiş Oksijen İle Yumurta Kabuğu Dezenfeksiyonu

### Özet

Yumurta kabuğu dezenfeksiyonu yumurta işleme prosesinin en temel bölümüdür ve tüketiciler için yumurtanın güvenli olmasını sağlar. Bu çalışmanın amacı, insan sağlığını etkilemeden, enerjilenmiş oksijen gazı kullanarak alternatif yumurta kabuğu dezenfeksiyonunun sonuçlarını değerlendirmektir. Toplam 90 yumurta çiftliğin yumurta deposundan toplandı ve 5 gruba ayrılarak çalışıldı: enerjilenmiş oksijen gazını yumurta yüzeyine püskürtmeden önce, püskürttükten 30 dakika, 24 ve 48 saatten sonra alınan svaplar ve yumurta viyollerinden alınan svap örnekleridir. Tüm uygulamalar mikroorganizma sayımında düşmeye sebep oldu. Sonuçlar yumurta yüzeyinde mikroorganizma olmadığını gösterdi. Bu nedenle, enerjilendirilmiş O<sub>2</sub>

ile yapılan yumurta dezenfeksiyonu, insan tüketimi için yumurta güvenilirliğini artırmak için kullanılabilir.

**Anahtar Kelimeler:** Enerjilendirilmiş oksijen, Yumurtacı tavuk, Yumurta hijyeni

## **Introduction**

Eggs shell can be contaminated with many types of microorganisms, including bacterial pathogens, and thus present a risk for the transmission of foodborne disease to consumers (Al-Ajeeli et al., 2016). The external and internal quality of eggs is influenced by a broad range of factors especially nutritional or technological properties was controlled from farm to fork. Poultry breeder, farmers, food, egg sorting, and marketing companies, the main priorities are to deliver a safe product which is accepted by the consumers (Nys, 2009). Egg quality is to determined with some characteristics such as leanness, soundness, smoothness, and shape of eggshells. Cleanliness is also one of the most important shell qualities and the egg industry has utilized several methods to achieve this goal (Stadelman and Cotterill, 1995).

Egg processors are currently using several practices to minimize the potential of egg contamination from shells. Chlorine and quaternary ammonium compounds (QAC) are the most common disinfection compounds. However, these sanitizers are unable to completely eliminate microbial contamination on eggshells and represent a significant cost (Musgrove et al., 2006). Reducing eggshell contamination at processing and packaging will help to ensure egg safety, egg quality and maintain consumer confidence in eggs produced under commercial conditions. Therefore, methods to reduce egg wash water contamination and improved methods of eggshell sanitization are needed to obtain maximum microbial reduction during shell egg processing. Thus, energized oxygen as a new disinfectant system and it is aimed to be able to carry out the disinfection process which prevents microbial contamination cheap, easy to apply and which does not affect the human health in particular.

## **Material and Methods**

### **Sampling**

Egg samples were collected with random sampling from egg storage in the layers farm. Sampling was described as below;

1. egg surface swab samples were collected before energized O<sub>2</sub> gas was sprayed as controls,

2. gas was sprayed to the egg surface and then swab samples were taken 30 minutes later
3. gas was sprayed to the egg surface was placed into the bag and then swab samples were taken 24 hours later,
4. gas was sprayed to the eggs and standard packaging was done, then swab samples were taken both 24 and 48 hours later,
5. Empty vials were sampling after the gas was sprayed.

Energized O<sub>2</sub> (1.6g/sec) was diffused to all treatment samples for ten minute. Three vials containing 30 eggs were numbered 1, 2 and 3 respectively. 5 eggs randomly selected from the vials that above applications were done. The selected egg surfaces were moistened by sterile swabs soaked with sterile distilled water. Then the sampling was done from the wet egg surface by another swabs. Same protocol was done for empty vials.

**4. Microbiological analysis:** Five pooled swab samples from egg surface were put into into a sterile falcon test tube (50 ml) with 45 mL sterile saline solution (0.85% NaCl). Each samples mixed in this solution tube was brought to volume (10 mL) with 0.9% sterile saline solution. Samples (0.1 mL) were serially diluted via 10-fold dilutions (from 10<sup>-1</sup> to 10<sup>-10</sup>). Violet Red Bile Lactose agar (VRBA), Plate Count agar (PCA) and Sabouraud Dextrose agar (SDA) supplemented with chloramphenicol (0.05 mg/ml) were used for the enumeration of total aerobic bacterial count, *E. coli*, and total fungal count, respectively. All PCA and VRBA plates were incubated at 37°C, aerobically, for 24-48h, all SDA plates also were incubated at 25°C, aerobically, for 5-10 days and the number of colonies was counted. After incubation, colonies formed on double inoculated media were counted and the average number of colonies on double medium was taken. All the data were expressed as CFU/g.

## **Result and Discussion**

The number of microorganisms on the shell of unwashed eggs varies between 10<sup>2</sup> and 10<sup>7</sup> (Adler et al., 1978) This flora includes gram-positive cocci and bacilli, coliform bacteria, and some yeasts and molds (Fraizer et al., 1991). The presence of these microorganisms on the surface of the shells of eggs represents a potential risk of contamination of egg content (Svobodava and Tumova, 2014). It is also dangerous for people who consume this egg and at that point disinfection is a priority in egg processors. In the present study Table 1 was reported the counts of mesophilic aerobic microorganisms on the eggshell of treated and untreated eggs and vials. There was no fungal and *E. coli* obtained from control counts. Results of this

experiment indicate that energized O<sub>2</sub> gas completely eliminated bacteria on the eggshell and vial.

Several researches was conducted about egg shell sanitizing especially about chlorine, quarterner amonyum, acetic and lactic acid that are most common disinfectants. Favier et. al. (2000), was determined that solutions of chlorine (50,100 and 200mg/l), acetic and lactic acids reduced the populations of mesophilic microbial flora to 0.2, 1.28 and 2.15 log<sub>10</sub>; 0.28 and 0.7 log respectively. Kuo et al. (1997) was revealed to reduction of aerobic microorganisms by using chlorine. Smulders and Geer (1998) reported the antibacterial efficacy of organic acids. In contrast to these study we were not used chemicals so we eliminated the harmful effects or any residues, concentration problems. Thus, energized O<sub>2</sub> a new disinfectant system and it is aimed to be able to carry out the disinfection process which prevents microbial contamination cheap, easy to apply and which does not affect the human health in particular. In our study, it was evaluate the efficacy of energized O<sub>2</sub> for egg disinfection as an alternative treatment.

Table 1. Aerobic plate counts of eggshell surfaces of eggs treated by energized O<sub>2</sub>

	<i>Total aerobic bacterial count (CFU/g)*</i>	<i>Total fungi/ yeast count (CFU/g)</i>	<i>Total E. coli count (CFU/g)</i>
1. sample before gas	4x10 <sup>1</sup>	-	-
2. sample before gas	8x10 <sup>1</sup>	-	-
3. sample before gas	4x10 <sup>1</sup>	-	-
vial sample before gas	1x10 <sup>1</sup>	-	-
1. sample, 30 min after gas	-	-	-
2. sample, 30 min after gas	-	-	-
3. sample, 30 min after gas	-	-	-
vial sample, 30 min after gas	-	-	-
1. sample with bag, 24 h after gas	-	-	-
2. sample with standart package, 24 h after gas	-	-	-
3. sample with standart package, 48 h after gas	-	-	-

\*CFU/g: Colony forming unit in per gram

## Conclusion

In summary, eggshell disinfection with energized O<sub>2</sub> gas provided reduction of microorganisms. These findings could have important implications for egg industry and further studies should be done for

alternative type of housing systems of laying hens (aviary, litter or free range) where the number of microorganisms on the surface of eggshell is higher than cage systems and different conditions especially temperature, humidity.

## References

- ADLER, H. E., DA MASSA, A. J. and SCOTT, N. F. (1978) Studies on egg disinfection. *Poult. Sci.* 58:799–806.
- AL-AJEELI, M.N., TAYLOR, A.M., ALVARADO, C.Z. and COUFAL CD. (2016) Comparison of eggshell surface sanitization technologies and impacts on consumer acceptability. *Poult. Sci.* 95:1191–1197
- FAVIER, G.I., ESCUDERO, M.E., MATTAR, M.A. and GUZAMN, A.M.S. (2000) Survival of *Yersinia enterocolitica* and mesophilic aerobic bacteria on eggshell after washing with hypochlorite and organic acid solutions. *J. Food Protection.* 63: 1053-1057.
- FRAZIER, W.C., and WESTHOFF D.C. (1991) Contaminación, conservación y alteración de los huevos, p. 252–265. In S. A. Acribia (ed.), *Microbiología de los Alimentos*. Zaragoza, Spain.
- MUSGROVE, M. T., COX, N. A., JR, L. RICHARDSON, J., JONES, D.R. and NORTHCUTT, J. K. (2006) Comparison of shell egg sanitizers and application methods. *Poult. Sci.* 85:162.
- NYS, Y. (2009) Factors contributing to improvement in egg quality. *Volumul de Lucrări-Stiințifice Seria Zootehnie* 52:247–253.
- KUO, F.L., RICKE, S.C. and CAREY, J.B. (1997) Shell egg sanitation UV radiation and egg rotation to effectively reduce populations of aerobes, yeasts, and molds. *J. Food Prot.* 60:694–697.
- SMULDERS, F. J., and GREER, G. G. (1998) Integrating microbial decontamination with organic acids in HACCP programmes for muscle foods: prospects and controversies. *Int. J. Food Microbiol.* 44:149– 169.
- SVOBODOVA, J and TUMOVA, E. (2014). Factors Affecting Microbial Contamination of Market Eggs: A Review. *Sci. Agric. Bohem.* 45: 226-237.
- STADELMAN, W.J. and COTTERILL, O.J. (1995) Egg science and technology. The Haworth Press, London.

## The Effect of Production System and Slaughtering Age on Meat Quality of Pheasants

Mehmet Akif Boz<sup>a</sup>, Umut Sami Yamak<sup>b</sup>, Musa Sarıca<sup>b</sup>, Fatih Öz<sup>c</sup>, Ahmet Uçar<sup>d</sup>

<sup>a</sup>Bozok University, Faculty of Agriculture, Department of Animal Science, Yozgat/TURKEY, <sup>b</sup>Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun/TURKEY, <sup>c</sup> Atatürk University, Faculty of Agriculture, Department of Food Engineering, Erzurum/TURKEY, <sup>d</sup>Ankara University, Faculty of Agriculture, Department of Animal Science, Ankara/TURKEY

### Abstract

In this study, the effect of rearing system and slaughtering age on the content of breast and thigh meat nutrients and fatty acids were determined. For this purpose, the composition of dry matter, crude protein, crude ash, crude fat and fatty acids in breast and thigh meat has been revealed. The animal material of the study was formed in barn and free-range system (male-female mixed) pheasants grown for 14, 16 and 18 weeks. Analyzes were made on a total of 24 samples, 2 repetitions of which were breasts and thigh meat samples. Analyzes were carried out on meat samples stored at -18/-22°C. In the research, the amount of dry matter and ash in the pheasants was found higher at 18 weeks, as to C18 at 16 weeks, and C20:1 at the free-range system. Breast meat C18:2n6c, supersaturated fatty acids were higher and n6 was higher at 18 weeks, C22:1n9 and n3 at 16 weeks. As a result; it has been shown that the effect of age and rearing system on some meat quality characteristics of breast and thigh meat is important in this study. It was determined that saturated fatty acids were high and polyunsaturated fatty acids were low.

**Key words:** *Nutrient Content, Pheasants, Fatty Acids, Rearing System*

## Sülünlerde Et Kalitesi Üzerine Yetiştirme Sistemi ve Kesim Yaşının Etkisi

### Özet

Bu çalışmada, yetiştirme sistemi ve kesim yaşının sülünlerin göğüs ve but eti besin madde ve yağ asitleri içeriği üzerine etkisi belirlenmiştir. Bu amaçla göğüs ve but etinde kuru madde, ham protein, ham kül, ham yağ ve yağ asitleri kompozisyonu ortaya koyulmuştur. Çalışmanın hayvan materyalini kapalı ve serbest gezinmeli sistemde 14, 16 ve 18 hafta yetiştirilen (erkek-dişi karışık) sülünler oluşturmuştur. Göğüs ve but eti örneklerinden 2 tekerrür olmak üzere

toplam 24 örnek üzerinde analizler gerçekleştirilmiştir. Analizler -18/-22°C'de muhafaza edilen et örnekleri üzerinde yapılmıştır. Çalışmada sülünlerin but eti kuru madde ve kül miktarı 18. haftada, C18 ise 16. haftada ve C20:1 serbest gezinmeli sistemde daha yüksek bulunmuştur. Göğüs eti C18:2n6c, aşırı doymuş yağ asitleri toplamı ve n6 18. hafta, C22:1n9 ve n3 ise 16. haftada daha yüksek belirlenmiştir. Sonuç olarak; bu çalışmada sülün göğüs ve but etinde yaş ve yetiştirme sisteminin bazı et kalite özellikleri üzerine etkisinin önemli olduğu görülmüştür. Doymuş yağ asitlerinin yüksek, çoklu doymamış yağ asitlerin ise düşük olduğu belirlenmiştir.

**Anahtar kelimeler:** *Besin Madde İçeriği, Sülün, Yağ Asitleri, Yetiştirme Sistemi*

### **Introduction**

Today, especially the hunting animals that are being tried to be produced by people come with partridges, pheasants and guinea fowls (Özdemir, 2007). In addition, an increase in the protein requirement, along with an increasing population, has led to searches for animal protein sources. This led farmers to alternate poultry farming in order to meet their protein needs in a short time (Yakan et al., 2012). The pheasants are included in these poultry species. The most important factor of rearing system is seen with the genotype on the composition of the nutrients in poultry. The effect on the nutrient composition of the free-range rearing system depends on age, physical activity and ability to reach the feed in the outdoor environment (Bogosavljevic-Boskovic et al., 2012). The choosing of the rearing system is a very important parameter among the non-genetic factors affecting the quality characteristics of slaughtering, carcass and meat (Meluzzi et al., 2009). In this study, the effect of slaughtering age and rearing system on some meat quality characteristics of pheasants were investigated.

### **Materials and Methods**

The material of the study was skinless breast and thigh meat obtained from free-range and barn systems (male-female mixed) grown for 14, 16 and 18 weeks. Analyzes were made on a total of 24 samples, 2 repetition of which were breasts and thigh meat samples. Analyzes of nutrient and fatty acids contents were made according to Gökçalp et al., 2010. The experiment was conducted according to the factorial trial plan (2 raising systems, 3 slaughtering age, 2 repetitions). Variance analysis was used in the evaluation of the obtained data for rearing

system and slaughtering age. The Duncan multiple comparison test was used to determine the differences between the means (Özdamar, 2002).

### **Results and Discussion**

In the study, the amount of dry matter and ash was found higher at 18 weeks, as to C18 at 16 weeks, and C20:1 at the free-range system ( $P<0.05$ ). Breast meat C18:2n6c, supersaturated fatty acids were higher and n6 was higher at 18 weeks, C22:1n9 and n3 at 16 weeks ( $P<0.05$ ). The effect of rearing system and slaughtering age on other characteristics was found insignificant ( $P>0.05$ ). In the barn and free-range system, the dry matter, protein, fat and ash ratio of breast meat was determined as 27.36-27.36%, 23.57-23.78%, 0.37-0.35% and 1.02-1.15%, respectively. In the same order, the percentage of dry matter, protein, fat and ash was found to be 24.70-24.82%, 20.02-19.34%, 0.95-0.80% and 0.96-0.94% in thigh meat. The proportion of saturated fatty acids and total unsaturated fatty acids in the breast and thigh meat were determined as 50.90-47.92% and 49.09-52.07% in the barn system, 40.98-41.69% and 59.01-58.30% in the free-range system, respectively. In this study, nutritional composition similar to literature was found (Hofbauer et al., 2010). On the other hand, higher saturated fatty acids and lower unsaturated fatty acids were identified in this study (Nuernberg et al., 2011).

### **Conclusion**

As a result, despite the presence of low fat in breast and thigh of pheasants, the high level of saturated fatty acids in fatty acids appears to be negative in terms of human health. Feeding, rearing system and optimum environmental demands with meat quality characteristics should be supported with more scientific research.

### **References**

- BOGOSAVLJEVIC-BOSKOVIC, S., RAKONJAC, A., DOSKOVIC, V. and PETROVIC M. D. (2012) Broiler rearing systems: a review of major fattening results and meat quality traits. *World's Poultry Science Journal*, 68: 217-228.
- GOKALP, H. Y., KAYA, M., TULEK, Y. and ZORBA, Ö. (2010). Et ve ürünlerinde kalite kontrolü ve laboratuvar uygulama kılavuzu. (V. Baskı), Atatürk Üniv. Yayınları, Yayın No: 751, Ziraat Fak. Yayın No: 318, Ders Kitapları Seri No:69, Atatürk Üniversitesi, Ofset Tesisi, Erzurum.

- HOFBAUER, P., SMULDERS, F.J.M., VODNANSKY, M., PAULSEN, P. and EL-GHAREEB, W.R. (2010). A note on meat quality traits of pheasants (*Phasianus colchicus*). *Eur. J. Wildl. Res.*, 56: 809–813. DOI 10.1007/s10344-010-0396-7
- MELUZZI, A., SIRRI, F., CASTELLINI, C., RONCARATI, A., MELLOTTI, P. and FRANCHINI, A. (2009) Influence of genotype and feeding on chemical composition of organic chicken meat. *Italian Journal of Animal Science*, 8: 766-768.
- NUENBERG, K., SLAMECKA, J., MOJTO, J., GASPARIK, J. and NUERNBERG, G. (2011). Muscle fat composition of pheasants (*Phasianus colchicus*), wild ducks (*Anas platyrhynchos*) and black coots (*Fulica atra*). *Eur J Wildl Res.*, 57: 795–803. DOI 10.1007/s10344-010-0489-3
- ÖZDAMAR, K. (2002) Paket programlar ile istatistiksel veri analizi I., 4. baskı, Kaan Kitabevi, Eskişehir.
- ÖZDEMİR, G. (2007). Kaya keklikleri'nin (*Alectoris graeca*) yer ve kafes sistemlerinde büyüme, besi performansı ve karkas özellikleri. Fırat Üniversitesi, Sağlık Bilimleri Enstitüsü, Doktora tezi.
- YAKAN, A., AKSU ELMALI, D., ELMALI, M., ŞAHİN, T., MOTOR, S. and CAN, Y. (2012). Halk elinde yetiştirilen beyaz ve alaca kazlarda karkas ve et kalitesi özellikleri. *Kafkas Univ. Vet. Fak. Derg.*, 18 (4): 663-670, DOI:10.9775/kvfd.2012.6238

# Comparison of Atabey and Atak-S Native Commercial Layer Hens in Term of Egg Quality Traits

İsmail Türker<sup>a</sup>, Serdar Kamanlı<sup>b</sup>, Sezai Alkan<sup>c</sup>

<sup>a</sup>Agricultural Faculty of Bozok University, Department of Animal Science

<sup>b</sup>Poultry Research Institute

<sup>c</sup>Agricultural Faculty of Ordu University, Department of Animal Science

## Abstract

This study was carried out using a total of 200 layer hens, 100 white layer hens from Atabey and 100 brown layer hens from Atak-S genotypes, in the Poultry Research Institute. White layer Atabey genotype obtained by hybridization with HTBRV and YTDLY coded white layer pure lines, at the same time brown layer Atak-S genotype obtained by hybridization with RRBLR ile BRBLR coded brown layer pure lines. This study was conducted during 80 weeks production period. After reaching 50% of egg yield, egg quality traits of 30 eggs from each genotype were determined at 4 weekly intervals.

There was determined significant difference between the genotypes in terms of the egg quality traits in this study. According to the obtained results, Atabey genotype was found superior to eggshell strength, albumen height, haugh unit and egg shell thickness, whereas Atak-S genotype was found superior in terms of egg weight.

It was determined that Atak-S eggs were in the large (L) and Atabey eggs were in the medium size (M) class in point of general egg weight.

**Key Words:** *Hen, Hybrid, Atabey, Atak-S, Egg Quality*

# The Factors Affecting on Poultry Products Consumption in Kayseri Province

Hasan Elerođlu<sup>a</sup>, Hüdaverdi Bircan<sup>b</sup>, Arda Yıldırım<sup>c</sup>

<sup>a</sup>Cumhuriyet Üniversitesi, Şarkışla Aşık Veysel Meslek Yüksekokulu, 58400

Şarkışla/Sivas, Türkiye, eleroglu@cumhuriyet.edu.tr

<sup>b</sup>Cumhuriyet Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İşletme Bölümü, 58140

Sivas, Türkiye, hbircan@gmail.com

<sup>c</sup>Gaziosmanpaşa Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü, 60250 Tokat,

Sorumlu yazar: Hasan Elerođlu, eleroglu@cumhuriyet.edu.tr

## Abstract

In this study, face-to-face surveys were conducted with 510 families in order to determine the factors affecting egg and poultry consumption in Kayseri city center. The sample volume was determined by a single, unstructured simple random probability sampling method based on population ratios. 86.8% of the participants are in the 18-54 age group, which is considered as the active age group. The sum of high school and college graduates was 60.4%. The difference between the income groups in terms of monthly food intake was significant ( $P < 0.001$ ) and the average monthly food intake was calculated as TL 409.31. In terms of the proportion of poultry products in monthly food expenditures, significant ( $P < 0.001$ ) differences were determined among the income groups and the average of the participants was determined as 19.33%. Monthly average egg consumption per household was calculated as 37.37 units / month and annual egg consumption per capita was 129.20. The monthly egg consumption per household was significantly ( $P < 0.001$ ). Whereas monthly average household consumption of chicken meat was 6.1 Kg / month, average annual chicken meat consumption per person was determined as 19.79 Kg / Year ( $P < 0.01$ ). On the consumption of poultry, family income level, number of family members and occupational groups were effective, but these factors as well as education levels were effective on egg consumption.

**Key words:** Kayseri, Eggs, Chicken meat, Socioeconomic

## Kayseri İl Merkezinde Tavukçuluk Ürünleri Tüketimi Üzerine Etki Eden Faktörler

### Özet

Bu çalışmada, Yozgat kent merkezinde yumurta ve tavuk eti tüketimi üzerine etki eden faktörleri belirlemek amacıyla 510 aile ile yüz yüze anket uygulaması yapılmıştır. Örnek hacmi ana kitle oranlarına dayalı kümelendirilmemiş tek aşamalı basit tesadüfî olasılık örnekleme yöntemi ile belirlenmiştir. Katılımcıların %86,8 aktif yaş grubu olarak kabul edilen 18-54 yaş aralığında yer almaktadır. Lise ve Yüksekokul mezunlarının toplamı %60,4 olarak bulunmuştur. Aylık gıda gideri bakımından gelir grupları arasında gözlenen farklılık önemli ( $P<0,001$ ), ortalama aylık gıda gideri 409,31 TL olarak hesaplanmıştır. Aylık gıda giderleri içerisinde tavukçuluk ürünlerin oranı bakımından da gelir grupları arasında önemli ( $P<0,001$ ) farklılıklar belirlenmiş olup, katılımcıların ortalaması %19,33 olarak belirlenmiştir. Aylık hane halkı yumurta tüketim değerleri bakımından gelir gruplarında gözlenen farklılık önemli ( $P<0,001$ ), hane halkı aylık ortalama yumurta tüketimi 37,37 Adet/Ay, kişi başına yıllık yumurta tüketimi 129,20 Adet/Yıl olarak hesaplanmıştır. Aylık hane halkı tavuk eti tüketim değerleri bakımından gelir grupları arasında gözlenen farklılık ( $P<0,01$ ) önemli bulunmuş, aylık hane halkı tavuk eti tüketimi ortalama 6,1 Kg/Ay olmasına karşılık, kişi başı yıllık tavuk eti tüketim değeri ortalama olarak 19,79 Kg/Yıl olarak belirlenmiştir. Tavuk eti tüketimi üzerine Aile gelir seviyesi, Aile birey sayısı ve meslek grupları etkili olurken, yumurta tüketimi üzerine bu faktörler ile birlikte eğitim düzeyleri de etkili olmuştur.

**Anahtar Kelimeler:** Kayseri, Yumurta, Tavuk Eti, Sosyoekonomik, Demografik.

# **Behavioural Responses Of Broiler Chickens Fed Increasing Levels Of Wheat Distiller's Dark Grains With Solubles Managed Under Controlled Environment**

**N. B. Rano,<sup>a</sup> A. S. Chaudhry<sup>b</sup> and S. A. Edwards<sup>b</sup>**

<sup>a</sup>Department of Animal Science, Bayero University Kano, Nigeria, <sup>b</sup>School of Agriculture, Food & Rural Development, Newcastle University, Newcastle upon Tyne, UK, \*Corresponding author.

## **Abstract**

Four groups of 36 day-old Ross broiler chicks were weighed, wing tagged and distributed into sixteen similar groups, giving four replicates of the four dietary treatments, for a 42-day trial in a one-phase feeding system in a completely randomized design. Recordings of bird behaviours were performed weekly using mounted video cameras to film four sets of pens on consecutive days. Different behaviours of broiler chickens were significantly ( $P < 0.05$ ) affected by age. In the subsequent experiment, Comfort behaviours (preening and dust bathing) as well as agonistic behaviours (aggression and pecking) were infrequently performed and were not affected by age.

**Keywords:** *Behaviour, Broilers, Wheat Dark Grains*

## **Introduction**

A relationship between feed intake and exhibited behaviour has been found to exist within animals (Johannson, 2008). Much research has aimed to investigate how animals behave and why they do so. Fraser and Broom (1997) and Broom (1991) explored abnormal behaviour and defined it as that which differs in frequency, context or pattern compared with the majority of individuals within a species, particularly in an environment where a full range of behaviours can be exhibited. Behavioural problems, such as feather pecking and aggressiveness, have been found to be suppressed by the provision of fibre to the diet of chickens.

## **Results and Discussion**

The purpose of this study was to determine the behavioural response of broiler chickens fed different levels of wheat distiller's dried grains with solubles under a controlled environment. In experiment 1, different levels of wheat distillers dried grains with solubles

(wDDGS) had no significant effect on the behaviour of birds. However, different behaviours of broiler chickens were significantly ( $P < 0.05$ ) affected by age. At the age of 35 and 42 days, more birds were found to be resting (Fig.1). In the first seven days of the experiment, more birds were engaged in feeding and drinking. At a young age, all animals, including human beings take interest in new things; this is why the exploration behaviour indicating curiosity of birds was higher at a younger age with very few birds performing resting behaviour. When birds grew older, they became more experienced, and used less time for eating and drinking. As they increased body weight, more birds showed resting behaviour and reduced general activity. The greater number of birds performing resting behaviour in the latter part of this experiment (days 35-42) could probably be explained by the birds being housed in a deep litter system, which provides them with much higher welfare levels as reported by Sosnowka-Czajka *et al.* (2005), and possibly due to the high breast meat yield and decreased space for movement in the pen and perhaps some leg problems (Hall, 2001). Weeks *et al.* (2000) also reported age-related increases in lying and sitting behaviour by broilers which might be attributed to the high breast meat yield that predisposes them to perform increased sitting behaviour.

In the subsequent experiment, intermediate levels (0, 15, & 30%) of wDDGS supplemented with enzymes were tested in the same way. Feeding, walking, exploration, and resting behaviours were significantly ( $P < 0.05$ ) affected by age (Table 1). More birds were engaged in feeding and walking behaviours during the middle (days 14-21) of the experiment. Resting behaviour increased with increasing age (days 35-42) of the experiment while exploration behaviour was decreased as birds grew older. Comfort behaviours (preening and dust bathing) as well as agonistic behaviours (aggression and pecking) were infrequently performed and were not affected by age.

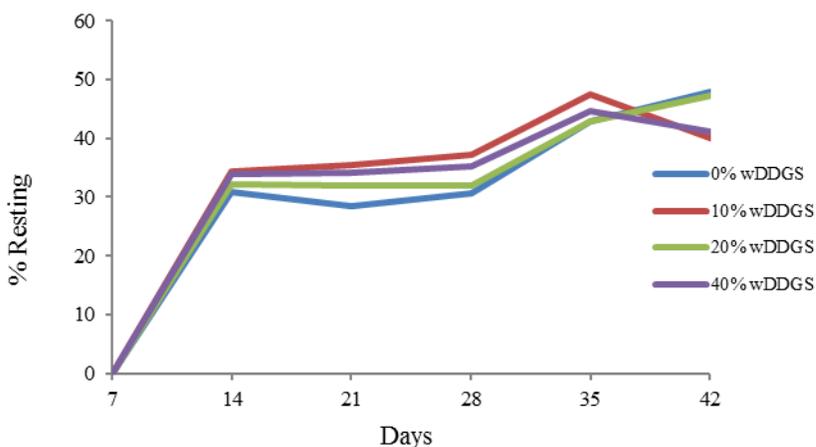


Figure 1. Proportion of birds showing resting behaviour

Table 1. The medians of observations of different behaviours shown by birds in different periods of the experiment

Days	1-7	14-21	35-42	P value
Feeding	33 <sup>b</sup>	43 <sup>a</sup>	33 <sup>b</sup>	0.001
Drinking	19	17	20	0.067
Walking	10 <sup>b</sup>	14 <sup>a</sup>	11 <sup>ab</sup>	0.016
Exploration	43 <sup>a</sup>	43 <sup>a</sup>	22 <sup>b</sup>	0.001
Standing	14	14	13	0.243
Resting	36 <sup>b</sup>	57 <sup>a</sup>	60 <sup>a</sup>	0.001
Aggression	0	14	50	0.317
Preening	0	14	14	0.828
Dust bathing	0	14	14	1.000
Pecking	0	24	20	0.607

Medians within columns that do not share a letter are significantly different

## Conclusion

It appeared that the responses observed in this study were only affected by the age of the birds, whereas, different levels of wDDGS with and without enzymes supplementation had no effect on any of the behaviours of the birds. The greater number of birds performing resting behaviour in the latter part of both experiments (days 35-42) as well as infrequent performance of comfort behaviours (preening and dust-bathing) demonstrated the consistent agreement of the findings in the two experiments.

## References

- BROOM, D.M. (1991) 'Animal welfare: concepts and measurement', *Journal of Animal Science*, 69(10), 4167-4175
- HALL, A.L. (2001) 'The effect of stocking density on the welfare and behaviour of broiler chickens reared commercially', *Animal Welfare*, 10(1), 23-40.
- FRASER, A.F. AND BROOM, D.M. (1997) *Farm Animal Behaviour and Welfare* CAB International
- SOSNOWKA-CZAJKA, E., MUCHACKA, R., KRYNSKI, A. AND WRZESIEN, R. (2005) 'Effect of management system on behaviour and productivity of broiler chickens', *Animals and Environment*, 2, 106-110
- WEEKS, C.A., DANBURY, T.D., DAVIES, H.C., HUNT, P. AND KESTIN, S.C. (2000) 'The behaviour of broiler chickens and its modification by lameness', *Applied Animal Behaviour Science*, 67(1), 111-125

# Fear Related Behavioral Responses of Slow and Fast Growing Broiler Chicks at Early Ages

Tahir Shah, Serhat Yıldırım Aydın, Sezen Özkan

Ege University Faculty of Agriculture Department of Animal Science, Bornova,  
İzmir, Turkey

## Abstract

This study aimed to investigate the sociality and fear related behavioral differences in slow-growing (SG) and fast-growing (FG) broilers at early ages (0-19 d) through various tests namely tonic immobility (TI), t-maze, and open field. No sociality difference was observed between the genotypes through t-maze and open field test (OF). A clear difference of fear response in TI test was seen between the fast and SG broilers with longer duration for TI in SG broilers. Under the experimental conditions, our results, provided evidence for SG broilers being more fearful than FG broilers at early ages (without outdoor access).

**Key words:** Broiler, Sociality, Fear, Behavior, Genotype

## Özet

Bu çalışma, yavaş (SG) ve hızlı (FG) gelişen etlik civcivlerde, tonik immobilite (TI), t-labirent ve açık alan (OF) gibi testlerle erken yaştaki sosyallik ve korku ile ilişkili davranış farklılıklarını araştırmayı amaçlamıştır. Genotipler arasında t-labirent ve OF testlerinde hiçbir sosyallik farklılığı gözlenmemiştir. TI testinde yavaş ve hızlı gelişen etlik civcivlerin korku yanıtları arasında belirgin bir fark görülmüştür. Yavaş gelişenlerde TI süresi daha uzun olmuştur. Bulgularımız, bu deneme koşullarında yavaş gelişen etlik civcivlerin, hızlı gelişen etlik civcivlere göre erken yaşlarda (gezinme alanına çıkmadan) daha korkak olduğunu göstermiştir.

**Anahtar kelimeler:** Etlik Piliç, Sosyallik, Korku, Davranış, Genotip

## Introduction

Today's FG birds have been selected to gain weight rapidly and had a big impact on the development of commercial broiler production. However, some welfare concerns have arose due to metabolic disorders and increased mortality in FG broilers. Therefore, the increase in production of broilers is accompanied by the increase in

consumer demand for poultry meat from different production systems such as free range or organic (Dimitri et al., 2002). These systems use SG broilers with availability of outdoor access which relies on consumer perception presuming better meat quality and animal welfare. SG broiler lines can achieve the slaughter weight of >2.2 kg at later ages i.e. 63 to 81 d and the SG birds are more acceptable as animal welfare point of view as compared to FG ones (Fanatico et al., 2007). Earlier studies indicated that behavioral differences between SG and FG broiler lines exist. Bokkers et al. (2003) reported that SG broilers walked and scratched more as compared to FG broilers. Furthermore, ground pecking and aggression tended to be more obvious in SG broilers. In general, authors concluded that FG birds tended to be less active than SG broilers and tended to perform more behaviors in sitting posture (Bokkers et al., 2003).

One of the important welfare indicators in free range or organic poultry production is outdoor access where the birds are thought to perform their normal behavioral repertoire. However, earlier studies showed that daily outdoor access in both broiler and layer chickens quite limited. Dawkins et al. (2003) estimated that percentage of birds had outdoor access was 15% in broilers and ranged between 7 to 38% in layers. Accumulated information from studies on encouraging range usage of birds pointed out that range cover (Rodriguez-Aurrekoetxea et al., 2014), design and size of pop halls (Rault et al., 2017) may have significant effect on outdoor access. However, fearfulness of birds is believed to be one of the most important limiting factor for outdoor use. It has been reported that increased fearfulness in laying hens is related to lower free-range activity (Grigor et al., 1995). Recently, Campbell et al. (2016) studied how individual differences in fearfulness affected range use. They reported that indoor-preferring laying hens had less vocalizations during manual restrain test and longer latency to move in an open field (OF) test indicating high level of fearfulness as compared to outdoor-preferring hens. In the same direction, Stadig et al. (2017) found that there was also association between fearfulness and free-range use in broiler chickens with more fearful birds stayed close to the building.

Different behavioral tests are used to measure fearfulness and sociality in chickens. Tonic immobility test response is a reliable measure of fearfulness. Behavioral responses of birds to T-maze and OF tests contain both social (stress response to isolation and motivation for social reinstatement) and fear related components (latency to move). Fear and sociality related behavioral differences between SG and FG broiler lines are scarce. Therefore the main purpose of this study was

to investigate the sociality and fear related behavioral differences in SG and FG broilers at early ages through various tests such as tonic immobility, t-maze, and OF.

### **Material and methods**

One-day old Ross 308 FG and Hubbard SG chicks were used in the study. Chicks were allocated in two brooding cages with wire floor (70x100 cm) and kept as mixed. First 5 days, paper bedding was supplied on the wire floor. Birds could eat and drink ad-libitum. Mesh feed from a commercial feed mill (Özlem Yem, Manisa) was provided continuous light and standard brooding temperature were used.

**T-maze test.** The maze apparatus consisted of a 21x21 cm isolation chamber (start box) leading to a 21 cm long x 7 cm wide corridor to two perpendicular, open-ended arms, each measuring 7x7 cm (Marín et al., 1997). Each T-maze was situated in a 35x60 cm section of 95x60 cm wooden brooders. On day 2, each chick was randomly chosen and placed in the center of the chamber. Latencies to 1<sup>st</sup> move, escape from start box, escape from corridor and turning towards cage mates with max test duration of 5 minutes. **Open field test.** Each chick was tested individually for its response to an OF arena on day 5. OF arena dimensions were 45x45x45 cm. The floor of the arena was divided into 25 equal squares (9x9 cm). The bird was placed in the center of the arena and behavior was observed for a 5-min period. Latency to 1<sup>st</sup> movement, number of calls, and number of squares moved were recorded during the 5 min period. **Tonic immobility (TI)** test was conducted at day 7, 12 and 19 (Jones et al., 1981). Live Body Weight of birds were recorded at day 7 and 12 after TI test was performed.

**Statistical Analysis.** Data from T-maze and OF tests were analyzed using Wilcoxon Kruskal-Wallis One way ANOVA test. MANOVA for repeated measures by JMP statistic software (SAS, 2002) was used for TI durations and number of vocalizing during the TI. The model included age (time), genotype and interaction effects. Means were separated with t-test when the effect was significant ( $P < 0.05$ ).

### **Results**

Although SG chicks showed a tendency for shorter latencies to first move ( $3.55 \pm 0.77$ s) and to exit start box ( $90.44 \pm 26.73$ ) than FG ones ( $4.45 \pm 0.65$ s and  $109.66 \pm 33.23$ ), respectively; difference between genotypes was not significant. An association between individual T-maze performance and growth rate has been reported in commercial FG broilers (Marín et al., 2003). They concluded that quick escape

from T-maze indicates higher sociality and is followed by higher growth rate. In this study, latency to escape from T-maze and approach to cage mates did not differ between genotypes. OF test is usually performed to measure both fear and sociality related behaviors of birds. No significant difference in any of the open field behavior was seen in either of the SG or FG broiler genotypes. Hocking et al. (2001) observed significant difference in behaviors between 2 commercial layer genotypes indicating more active birds as more social.

A significant difference for TI duration was observed between FG and SG birds (Table 1). SG broiler chicks had significantly longer TI duration as compared with the FG ones ( $P \leq 0.05$ ). This result suggests that SG broiler chicks are more fearful as compared to FG broiler chicks. Campbell et al. (2016) suggested that hens showing less outdoor access were more fearful as indicated by longer latencies to move and less activity in open field test. However, they reported that ranking groups according to frequency of outdoor access were not different for TI duration. Our results are consistent with findings from Stadig et al. (2017) who observed a shorter TI duration in 3 week old broiler chicks that travel further from house ( $>5m$ ) when they had outdoor access. They concluded that less fear response associated with better range use. To the authors knowledge, there is a lack of information on fearfulness in broilers before outdoor access in a free-range system as it was also pointed out by Stadig et al. (2017). A clear difference was observed between body weight of the genotypes ( $P \leq 0.05$ ). FG chicks gained weight at a much faster rate as compared to the SG chicks. The FG chicks had a mean weight of  $120.70 \pm 2.90$  gr and  $286.39 \pm 7.12$  gr on day 7. However, the mean body weight of SG broilers was  $111.63 \pm 2.21$  gr and  $219.89 \pm 5.41$  gr on day 12, respectively. This finding is within the expectation as reported in earlier research studies (Fanatico et al. 2005, 2008).

Table 1. Tonic Immobility (TI) durations of slow-growing and fast-growing broilers at different ages.

	Age		
	Day 7	Day 12	Day 19
Genotype	TI (s)		
Slow (n=20)	136.00±23.02	135.05±21.85	143.11±20.93
Fast (n=11)	114.36±30.26	86.00±28.72	47.55±27.51
Source of Variation	P-value		
Genotype	0.002		
Age (time)	0.263		
Genotype x Age	0.236		

## **Conclusion**

In this study a clear difference of fear response in TI test was seen between the FG and SG broilers with longer duration for TI in SG broilers. Fearfulness is considered as an important problem in poultry farming system. Therefore, our results may supply evidence that SG broilers were more fearful than FG broilers at early ages (before outdoor access). Fearfulness might be one of the factors limiting range use of SG broilers later in life and consequent welfare concerns may arise in free range systems. As very limited scientific information is available, it is worth to study further on the association between fearfulness and range use of broilers and relations with meat quality and welfare.

**Acknowledgement:** We thank to Brian Tainika for his help in behavioral test.

## **References**

- BOKKERS, E. A., & KOENE, P. (2003) Behaviour of fast-and SG broilers to 12 weeks of age and the physical consequences. *Applied Animal Behaviour Science* 81:59-72.
- CAMPBELL, D. L., HINCH, G. N., DOWNING, J. A., & LEE, C. (2016) Fear and coping styles of outdoor-preferring, moderate-outdoor and indoor-preferring free-range laying hens. *Applied Animal Behaviour Science* 185:73-77.
- DAWKINS, M. S., COOK, P. A., WHITTINGHAM, M. J., MANSELL, K. A., & HARPER, A. E. (2003) What makes free-range broiler chickens range? In situ measurement of habitat preference. *Animal behaviour* 66:151-160.
- DIMITRI, C., & GREENE, C. (2002) Recent growth patterns in the US organic foods market. Agriculture Information Bulletin 777. Washington DC: US Department of Agriculture. *Economic Research Service*.
- FANATICO, A., PILLAI, P., CAVITT, L., OWENS, C., & EMMERT, J. (2005) Evaluation of slower-growing broiler genotypes grown with and without outdoor access: Growth performance and carcass yield. *Poultry Science* 84:321-1327.
- FANATICO, A., PILLAI, P. B., EMMERT, J., & OWENS, C. (2007) Meat quality of slow-and FG chicken genotypes fed low-nutrient or standard diets and raised indoors or with outdoor access. *Poultry Science* 86:2245-2255.

- FANATICO, A., PILLAI, P., HESTER, P., FALCONE, C., MENCH, J., OWENS, C., & EMMERT, J. (2008) Performance, livability, and carcass yield of slow-and FG chicken genotypes fed low-nutrient or standard diets and raised indoors or with outdoor access. *Poultry Science* 87:1012-1021.
- GRIGOR, P., HUGHES, B., & APPLEBY, M. (1995) Effects of regular handling and exposure to an outside area on subsequent fearfulness and dispersal in domestic hens. *Applied Animal Behaviour Science* 44:47-55.
- HOCKING, P., CHANNING, C., WADDINGTON, D., & JONES, R. (2001) Age-related changes in fear, sociality and pecking behaviours in two strains of laying hen. *British poultry science* 42:414-423.
- JONES, R. B., & FAURE, J. M. (1981) Sex and strain comparisons of tonic immobility (“righting time”) in the domestic fowl and the effects of various methods of induction. *Behavioural Processes* 6:47-55.
- MARIN, R., SATTERLEE, D., CASTILLE, S., & JONES, R. (2003) Early T-maze behavior and broiler growth. *Poultry Science* 82:742-748.
- RAULT, J.-L., & TAYLOR, P. S. (2017) Indoor side fidelity and outdoor ranging in commercial free-range chickens in single-or double-sided sheds. *Applied Animal Behaviour Science* 194:48-53
- RODRIGUEZ-AURREKOETXEA, A., LEONE, E. H., & ESTEVEZ, I. (2014) Environmental complexity and use of space in SG free range chickens. *Applied Animal Behaviour Science* 161:86-94.
- STADIG, L. M., RODENBURG, T. B., AMPE, B., REUBENS, B., & TUYTTENS, F. A. (2017) Effect of free-range access, shelter type and weather conditions on free-range use and welfare of SG broiler chickens. *Applied Animal Behaviour Science* 192:15-23.

## Production Parameters and Feather Scores of Local Layer Hybrids Kept in Enriched Cages

Kamanli S<sup>a</sup>, Özkan S<sup>b</sup>, Taşdemir A.N<sup>a</sup>, Demirtaş Ş<sup>a</sup>, Tülek E<sup>a</sup>, Pekcan, M.,<sup>c</sup> Kurtdele, E.,<sup>c</sup> Öztürk, H.<sup>c</sup>

<sup>a</sup>Poultry Research Institute, <sup>b</sup>Ege University, Faculty of Agriculture, Department of Animal science, , <sup>c</sup>Ankara University Faculty of Veterinary Medicine

### Abstract

Some production parameters and feather scores of local layer hybrids kept in enriched cages were investigated in this study. Atabey, white layer, had significantly higher hen-day egg production but lower livability as compared with both of brown layers, Atak and Atak-s. Significantly higher feed consumption and worse feed conversion ratio have been observed in brown layers as compared with Atabey. Heavier eggs were recorded in Atak as compared to Atak-s; however, Atabey hens had similar egg weights to Atak and Atak-s. The percentage of broken eggs was lower in Atabey than that of both brown layer genotypes; but Atabey had more cracked eggs. Average feather score significantly differed with genotypes and Atabey had the best score while Atak was worst and Atak-s was between them.

**Key words:** *Laying Hens, Genotype, Enriched Cages, Performance, Feather Score*

### Özet

Bu çalışmada, yerli yumurtacı hibritlerin zenginleştirilmiş kafes koşullarında verim özellikleri ve tüy skorları incelenmiştir. Zenginleştirilmiş kafes koşullarında beyaz yumurtacı Atabey genotipi kahverengi yumurtacı Atak ve Atak-s genotiplerinden önemli düzeyde daha yüksek yumurta verimine (tavuk/gün) ulaşmış; ancak yaşama gücü daha düşük bulunmuştur. Kahverengi yumurtacı hibritler Atabey'e göre daha yüksek yem tüketimi göstermiş dolayısı ile yemden yararlanma değeri daha geri bulunmuştur. Atak genotipinde yumurta ağırlığı Atak-s'den daha yüksek olurken Atabey ortada bir değer almıştır. Kırık yumurta oranı Atabey'de her iki kahverengi genotipten daha düşük bulunmuş; ancak çatlak yumurta oranı Atabey'de daha yüksek olmuştur. Genel ortalamaya bakıldığında tüy skoru bakımından genotipler arasında önemli farklılık gözlenmiş ve

Atabey genotipi en iyi t y skoruna sahip olurken Atak en k t  ve Atak-s ikisi arasında yer almıřtır.

*Anahtar kelimeler:* Yumurta Tavuęu, Genotip, Zenginleřtirilmiř Kafes, Performans, T y Skoru

### **Introduction**

Because, conventional battery cages have been subjected to strong criticism regarding to hen welfare; different housing systems including enriched cages or non-cage systems have been thought to be better alternatives. Legislation on banning conventional cages (Anonymous, 1999) has been applied in the European Union in the year of 2012. Enriched cages have equipped with perch and nest box; and offered the birds a larger area to perform their natural behaviors with an increased group size. Feather pecking is one of the most important damaging behavior in laying hens and had a great attention due to increased tendency of using non-cage systems in EU (Rodenburg et al., 2017). A conventional cage ban has also been suggested in Turkey (Anonymous, 2011). Ongoing studies for to develop local egg type hybrids in Ankara Poultry Research Institute have been yielded three hybrids namely Atabey, Atak, and Atak-s. Therefore, gathering information from enriched cage conditions using local layer hybrids would extended our knowledge and feedback to the breeding studies in Ankara Poultry Research Institute.

### **Material and Methods**

Information presented in this study comes from a larger experiment which has been conducted in Ankara Poultry Research Institute. A total of 576 hens from three genotypes (Atabey, Atak, and Atak-s), 192 each, were used in the study. At the age of 16 weeks, pullets were moved from rearing cages to enriched cages in two adjacent experimental rooms of the poultry house. Each room contained 18 cages (240×63.5×68 cm) with 16 hens each. Therefore, each genotype represented in both rooms with 6 cages for each genotype. Performance records were kept till age of 64 weeks and each bird was scored for feather condition at the ages of 30<sup>th</sup>, 45<sup>th</sup>, and 64<sup>th</sup> week. Each body part (head-upper neck, back, rump, tail, cloaca-abdomen, breast, and wings) was scored using a scale 0 (best) to 5 (worst) (Bilcik and Keeling, 1999). Production data was analyzed using ANOVA with genotype as main effect. For feather scoring data, genotype, age, and interaction effects were included in statistical model. Cage effect was also included in the model as nested within

genotype, age and room effects. When effect was significant t-test was used to separate ls-means. Significance was based on  $P < 0.05$ .

### **Results and Discussion**

Atabey, white layer, had significantly higher hen-day egg production (83.96 %) than brown layers, Atak (75.12%) and Atak-s (73.46%). However, significantly reduced livability (86.98%) was observed in Atabey with high mortality due to cloacal cannibalism at the peak egg production. Livability were 92.71 and 96.88 % for Atak and Atak-s hybrids.

Atabey had significantly lower feed consumption (113.0 g) and better feed conversion ratio (2.10) as compared with Atak and Atak-s. Daily feed consumption was 117.9 and 118 g; feed conversion ratio was 2.54 and 2.47 for Atak and Atak-s, respectively. Significantly heavier eggs were recorded in Atak (60.62 g) as compared to Atak-s (58.83 g) while Atabey hens had similar egg weights (59.31 g) to both Atak and Atak-s. The percentage of broken eggs (2.06%) was lower in Atabey than brown layer genotypes with values of 4.03 and 3.35% for Atak and Atak-s, respectively. However, Atabey had more cracked eggs (11.18%). Average feather score significantly differed with genotypes ( $P < 0.05$ ). Atabey had the best average feather score (1.65) while Atak was worst (3.00) and Atak-s (2.13) was between them.

Egg production and feather conditions results obtained in this study were in accordance with some of the earlier reports on local layer hybrids (Durmuş et al., 2009; Yamak and Sarıca, 2012). Under conventional cage conditions, Yamak and Sarıca (2012) reported that Atabey and Atak-s had similar egg production (233 and 236 eggs at 64<sup>th</sup> week) which was significantly higher than Atak (224 eggs). They also reported significantly worse feather condition in Atak hens than both Atak-s and Atabey genotypes at any age, which was in the similar line with our findings.

### **Conclusion**

Preliminary results may suggest that local layer hybrids showed significant difference in feather condition and mortality under enriched cage conditions. Further behavioral differences among the genotypes are being analyzed and would give important cues for feather pecking and cannibalism.

**Acknowledgement:** Results presented here are a part of TAGEM project numbered with TAGEM/HAYSÜD/A/16/A06/P03/01

## References

- ANONYMOUS (1999). COUNCIL DIRECTIVE 1999/74/EC. Laying down minimum standards for the protection of laying hens. *Official J. European Communities*, No L 203, 0053-0057.
- ANONYMOUS (2011). Çiftlik hayvanlarının refahına ilişkin yönetmelik. *Resmi gazete* No: 28251, 23.12.2011
- DURMUŞ, İ, SARICA, M., AKTAN, S., YILDIZ, T., KAHRAMAN, Z., ERTAŞ, S. (2009). Geliştirilmekte olan yerli yumurtacı ticari hibritlerin verim özelliklerinin belirlenmesi. *Tavukçuluk Araştırma Dergisi*, 8:5-9.
- YAMAK, U., SARICA, M. (2012). Relationships between feather score and egg production and feed consumption of different layer hybrids kept in conventional cages. *Arch.Geflügelk.*, 76: 31–37.
- RODENBURG, B., BERG, J., DIMITROV, I., J. EDGAR, van der EIJK, J., ESTEVEZ, I., FARRANTE, V, de HAAS, KOSTAL, L., LIABUET, L., MICHELE, V., NORDGREEN, J., ÖZKAN, S., PIETTE, D., PICOVA, K., RIBER, A., SOSSIDOU, E., TOSCANO, M., VALROS, A., ZUPAN, M., JANCZAK, A (2017). The GroupHouseNet COST Action: exploiting European synergy to reduce feather pecking in laying hens. *WPSA 10<sup>th</sup> European Symposium on Poultry Welfare, Proceedings* 41-47. 19-22 June, France.

# The Effect of Conventional and Enriched Litter System upon Performance and Plumage Score in Roosters

Bülent Tarım<sup>a</sup>, Murat Doğu<sup>a,1</sup>, Diydem Doğan<sup>a</sup>, Ayten Aşkın Kilinç<sup>a</sup>,  
Sunay Demir<sup>a</sup>, Hakan Öztürk<sup>b</sup>

<sup>a</sup>Poultry Research Institute, Ankara, Turkey;

<sup>b</sup>Department of Physiology, Veterinary Faculty, Ankara University, Ankara, Turkey.

<sup>1</sup>Corresponding author: murat.dogu@tarim.gov.tr

## Abstract

This study was carried out to determine the effects of two different breeding systems as traditionally used and enriched of them on their performance and some blood parameters. In the study, 240 Barred Rock roosters were used in the Ankara Poultry Research Institute. The animal material was divided into 4 treatment groups (Conventional and Enriched 2 / 3 Slatted Litter Floor System, Conventional and Enriched Deep Litter Floor Systems), and each group was divided into 5 replications. Each replication is arranged to be 12 roosters. The trial lasted up to 52 weeks of age. When the obtained results were analyzed by variance analysis technique and multiple comparison method, The differences between groups in term of performance were not statistically significant ( $p > 0,05$ ).

**Key Words:** *Conventional floor systems, alternative systems, egg production, blood parameters*

## Introduction

All of the world, work is being done to ensure that the housing conditions are in accordance with the nature of the livestock. In the project prepared in the light of these studies, egg hatches are housed in traditional and enriched housing systems. The pen were prepared in accordance with the standards adopted by the European Union and welfare decisions. The effects on the egg production and quality of the housing systems have been determined with project. Compared to the efficiency obtained from the unit poultry floor area.

Hens are able to perform of several type of their natural behaviours and sufficient excersices in alternative systems but the mainly complicatons are foot problems, feather pecking, social stres and dirty

ant cruked eggs in this environments. This experiment investigated the effects of feather score,of layer breeder cockerels.

### **Material and methods**

Barred roosters were used as animal material in the study. After the breeding eggs from the hatchlings to be chickened are accepted in the egg acceptance section, the ones with breeding characteristics are selected and placed in the growth trays. The breeding eggs placed in the development vehicles were fumigated in the fumigation chamber before being placed in the development machine, free from harmful microorganisms that could be found on the egg shell surface. The breeding eggs placed in the development machines completed 18 days of 21 day incubation on these machines. Eggs that have completed 18 days in the development machine were excluded from the embryo development in bright light under this light, and the live embryo eggs were placed in the exit cups with the vacuum egg transfer machine. The eggs completed the last three days of their 21 day development period in the exit machines and they performed incubation exits in these machines. The emerging chicks were transferred to the growth house, and the test materials reaching the gender maturity were then transferred from growth house with the standard cage to breeding house until the 52th age (until the end of the trial). Four treatment groups were used: a traditional deep litter system, an enriched deep litter system, a traditional 2/3 slatted floor system, an enriched 2/3 slatted floor system and a total of 20 groups of 5 replications per group. The sizes of the divisions are calculated to be equal for each treatment group. 8cm thick sawdust was laid on the floor as a base material, the nest made of galvanized material. Feeding ad- libitum and standard feeding program were applied. It is made on the basis of the poultry house with lighting windows. Observation data obtained as a result of the experiment were evaluated by variance analysis technique. When there is a difference between at least two means as a result of the variance analysis, when the result is obtained, the difference between the group averages is statistically significant. It used a 1-4 point scale on 5 individual body parts. The number of parts the body is split into and the number of available scores given for each part offer different degrees of exact description of the status of a bird (Tauson,et all.,1984).

### **Results**

Live weight and survival values of hens in order of group for Enriched 2/3 Slatted Floor System, Conventional 2/3 Slatted Floor System,

Enriched Deep Litter System, Conventional Deep Litter System are  $2537 \pm 35,5$  and  $99,833 \pm 0,167$ ;  $2473 \pm 32,9$  and  $99,833 \pm 0,167$ ,  $2493 \pm 37,5$  and  $99,667 \pm 0,204$ ,  $2450 \pm 35,8$  and  $99,833 \pm 0,167$ . There was no statistically significant difference between the groups in terms of the obtained values ( $p > 0,05$ ).

The results obtained when analyzing the values obtained in terms of plumage score. Statistically significant differences were found between the groups ( $p < 0,05$ ). The results of the project with regard to plumage condition are given in the table below:

Groups	<i>Plumage Conditions of Roosters</i>						
	NECK	ABDOMEN	WING	TAIL	BACK	CLOAK	TOTAL
Enriched 2/3 Slatted Floor System	3,61±0,14 <sup>bc</sup>	3,75±0,05	3,27±0,14 <sup>b</sup>	3,47±0,16 <sup>b</sup>	3,75±0,11 <sup>b</sup>	3,88±0,05	21,861±0,348 <sup>b</sup>
Conventional 2/3 Slatted Floor System	3,57±0,14 <sup>c</sup>	3,71±0,05	3,51±0,09 <sup>ab</sup>	3,71±0,09 <sup>ab</sup>	3,80±0,07 <sup>ab</sup>	3,77±0,09	22,314±0,295 <sup>b</sup>
Enriched Deep Litter System	3,90±0,05 <sup>ab</sup>	3,87±0,05	3,84±0,07 <sup>a</sup>	3,78±0,08 <sup>ab</sup>	3,96±0,03 <sup>a</sup>	3,81±0,08	23,394±0,15 <sup>a</sup>
Conventional Deep Litter System	3,91±0,06 <sup>a</sup>	3,91±0,04	3,86±0,07 <sup>a</sup>	3,88±0,05 <sup>a</sup>	4±0,00 <sup>a</sup>	3,83±0,06	23,583±0,134 <sup>a</sup>
p	0,036	0,356	0	0	0,038	0,724	0

## **Discussion**

When the data obtained from the project is evaluated; as a result of conventionally 2/3 slatted floor system and conventionally deep litter systems are enriched; When comparing the traditional and enriched systems in terms of plumage scoring, the difference between the groups was not statistically significant. This result indicates that enrichment is not an effect on the feather score. Generally, plumage score is higher than slatted floor system systems in deep litter system systems. Controversial results have been obtained in research projects on UK (Elson, 1981), Holland (Brantas et al., 1978), Switzerland (Oester, 1985) and Germany, on get-away cages. When the sand pool was found in the cages, the welfare of the chickens was observed. However, problems such as aggression, cannibalism and plumage pulling have emerged, making it difficult to observe and catch chickens. Similar to the results in the literature; wing and tail area, and the total feather score in the enriched litter system is lower than in the conventional litter system.

**Acknowledgement:** Results presented here are a part of TAGEM project numbered with TAGEM/HAYSUD/14/A06/01/07

## **References**

- ANONYMOUS. 2011. Official newspaper. Regulation on the welfare of farm animals. 23.12.2011, sayı: 28151
- ABRAHAMSSON, P., TAUSON, R. And ELWINGER, K. 1996 b. Effects on production, health and egg quality of varying proportion of wheat and barley in diets for two hybrids of laying hens kept in different housing systems. *Acta Agric. Scand., Section A, Animal Science*, 46: 173-182.
- BLOKHUIS, H.J., JONES, R.B., GEERS, R., MIELE, M. and VEISSIER, I. (2003) Measuring and monitoring animal welfare: transparency in the food product quality chain. *Animal Welfare* 12, 445-455.
- BLOKHUIS, H.J., 2004., Recent development in European and International Welfare Regulation. 22 th World Poult. Sci. Congress, İstanbul, TURKEY
- BRANTAS, G.C., WENNRICH, G. AND DE VOS-REESINK, K. (1978) Behavioural observations on laying hens in get-away-cages (Ethologische Beobachtungen an Legehennen in Get-away-Kaefigen). *Archie fur Geflugelkunde* 42, 129-132.

- CAMPO, J.L., GIL, M.G., DAVILA S.G. and MUNOZ I., 2005. Influence of perches and footpad dermatitis on tonic immobility and heterophil to lymphocyte ratio of chickens, *Poultry Science*, No: 84, pp: 1004-1009.
- DAVIS, G.S., ANDERSON, K.E. and CARROLL, A.S. 2000. The effects of long-term caging and molt of Single Comb White Leghorn hens on heterophil to lymphocyte ratios, corticosterone and thyroid hormones. *Poult. Sci.*, 79: 514-518
- DİKMEN, B.Y., İPEK, A., ŞAHAN, U., PETEK, M., SÖZCÜ, A. 2016. Egg production and welfare of laying hens kept in different housing systems (conventional, enriched cage, and free range). *Poultry Science* 95:1564–1572
- ELSON, H.A. (1981) Modified cages for layers. In: *Alternatives to intensive husbandry systems*. Universities Federation for Animal Welfare, Potters Bar, UK, pp. 47-50.
- ELWINGER, K and TAUSON, R. 1999. Valj ratt honor vid glovinhysning. Fakta jordbruk 1999 I.SLU Publikationstjänst, Box, 7075, 750 07 UPPSLA, Sweden.
- GROSS, W. B. and P.B. SIEGEL, P.B., 1983. Evaluation of the heterophil/lymphocyte ratio as a measure of stress in chickens. *Avian Dis.*, 27: 972-979.
- KAHRAMAN, N.Ş., 2008. Yumurta üretim işletmelerindeki barındırma ve iç ayırntı sistemlerinin güncelleştirilme olanakları, Doktora Tezi, Akdeniz Üniversitesi Fen Bilimleri Enstitüsü, Antalya.
- KOELEBECK, K. W. and CAIN, J. R. 1984. Performance, behaviour, plasma corticosterone, and economic returns of laying hens in several management alternatives. *Poult. Sci.*, 63: 2123-2131.
- KONUK, T. 1975. *Practical Physiology*. Ankara University Veterinary Medicine Publication, Ankara University Press, Ankara, 250 pp
- NICOL, C. J., BROWN, S. N., GLEN, E., POPE, S. J., SHORT, F. J., WARRISS, P. D., ZIMMERMAN, P. H., WILKINS, L. J. 2006. Effects of stocking density, flock size and management on the welfare of laying hens in single-tier aviaries. *Brit. Poult. Sci.*, 47: 135-146
- OESTER, H. (1985) Die Beurteilung der Tiergerechtheit des Get-Away-Haltungssystems der Schweizerische Geflagelzuchtschule, Zollikofen far Legehennen. PhD thesis, University of Bern, Switzerland.

- SARICA M., CAMCI Ö., MIZRAK C., AKBAY R., TÜRKOĞLU M., YAMAK UMU.S., (2012). Overview of Poultry Breeding Strategy in Turkey. Network access: (<http://www.organikpin.com/image/data/pdf/Turkiyede-kanatli-islak-stratejilerine-baki.pdf>)
- SHINI, S. 2003. Physiological Responses of Laying Hens to the Alternative Housing Systems. *Int. Journal of Poult. Sci.*, 2(5): 357-360.
- TAUSON,R., AMBBROSEN, T. and ELWİNGER, K., 1984 'Evaluation of procedures for scoring the integument of laying hens: independent scoring of plumage condition', *Acta Agriculturae Scandinavica, Section A: Animal Science*, 34, pp. 400-408.
- TAUSON, R. and Holm, K.E. (1998) Evaluation of the Marielund Keeping System. Report 244, Swedish University of Agricultural Sciences, Dept. Animal Husbandry and Management, Funbolovsta research Centre. 755 97 UPPSALA, Sweden.
- TAUSON R., WAHLSTROM, A., ABRAHAMSSON, P. 1999. Effect of two floor housing systems and cages on healt produntion and fear response in layers. *Journal of Applied Poultry Research*,8:152-15.

# Effect of Different Colours Clothes on Fear and Stress Responses, Some Meat Quality Traits and Performance in Broilers

Evrin Dereli Fidan

Adnan Menderes University, Faculty of Veterinary Medicine, Department of Animal Science, 09016, Aydın-TURKEY

## Abstract

In study, a total of 192 1 day-old male broiler chicks were randomly assigned to eight treatment groups based on the different colour clothing (red, blue, green, gray) and visual human contact groups (60 and 300 s). TI duration in 60 and 300 s visual contact groups were as follows: 244.10 s and 227.16 s, respectively. The H/L ratio was the highest (0.89) in the green clothing group. It was determined that clothing colour has statistically significant effects on L\* value in breast meat. Final body weights were recorded as high in blue coloured clothing group than green clothing group.

**Key words:** *Broiler, Clothing colour, Heterophil/lymphocyte ratio, Tonic immobility, Human visual contact*

## Farklı Renk Kıyafetlerin Etlik Piliçlerde Korku ve Stres Cevapları, Bazı Et Kalite Özellikleri ve Performans Değerleri Üzerine Etkisi

### Özet

Çalışmada, bir günlük yaşta toplam 192 adet (Ross 308) erkek civcivler farklı renk kıyafet (kırmızı, mavi, yeşil ve gri renk) ve görsel temas süresi (60 ve 300 s görsel temas) faktörlerine göre sekiz gruba rastgele olarak dağıtılmıştır. TI süresi 60 ve 300 s insan görsel temas gruplarında sırasıyla 244.10 s and 227.16 s olarak bulunmuştur. En yüksek H/L oranı değeri (0.89) yeşil renk kıyafet giyilen grupta saptanmıştır. Göğüs eti L\* değeri üzerine kıyafet renginin etkisi istatistiksel anlamda önemli bulunmuştur. Mavi renk kıyafet grubunda final canlı ağırlıkları yeşil renk kıyafet grubundaki etlik piliçlerdekinden daha yüksek değerlerde kaydedilmiştir.

**Key words:** *Broyler, Hareketsizlik süresi ölçümü, Heterofil/lenfosit oranı, İnsan görsel temas, Kıyafet rengi*

## **Introduction**

Relations between human and animals are the undeniable part of modern intensive poultry productions. Normally, there is no fear of humans in poultry, but during the routine rearing procedure poultry is repeatedly exposed to different kinds of stressors such as stockpersons, noise, and lighting (Waiblinger et al., 2006). TI is commonly used to measure the level of fear in poultry (Jones and Faure, 1981). Stress response is generally expressed based on heterophil lymphocyte (H/L) ratio, some blood parameters and meat quality traits (Gross and Siegel, 1983; Zhang et al., 2009). Some studies revealed that visual contact was as effective as physical contact in reducing the fear of humans in poultry (Jones, 1993; Zulkifli and Siti Nor Azah, 2014). It's very important to get more information about the relations between spectral traits of the impulse and the colour perception of the birds. There are lots of studies about the response of poultry to coloured food, feeders, drinkers, lights and stockperson's clothings (Rozenboim et al., 1999; 2004; Lecuelle et al., 2011). The objective of this study was to evaluate the effects of regular visual contact by the stockperson wearing clothings of a different colour on fear, stress reactions, some meat quality traits and performance.

## **Materials and Methods**

As a material, a total of 192 male broilers (Ross 308) were used in the study. On day 1, the chicks were individually weighed, wing-tagged and housed in groups of 24 chicks in eight treatment pens with deep litter of wood shavings in an experimental barn. Four different colour clothing groups (red, blue, green and gray colour clothing) and two visual human contact groups (60 and 300 s durations) were designed as to 4X2 experimental design. Commencing from day 15, the chickens were exposed to the regular visual human contact by the same stockperson, who wore the different colour clothings for once a day. The colours chosen differed from the colours usually worn by the stockpersons (red, blue, and green). During the visual contact procedure, the stockperson wearing clothings of different colour slowly and entered the pens with the minimal noise and stood in the centre of the pens. On day 41, 13 broilers of each pen (total 104) were randomly selected and TI test were made. TI test from remaining of 88 broilers (11 broilers of each pen) were used for determining the blood samples. Blood samples were collected from wing vein. Samples were taken into two tubes, one contained EDTA for estimating the H/L ratio and the other had no anticoagulant for

estimating glucose, cholesterol, triglyceride, total protein and lactate dehydrogenase (LDH) levels. A total of 88 birds were slaughtered by exsanguination through a neck cut to determine meat quality traits (pH, colour, cooking loss (CL), water holding capacity (WHC)) at the age of 42 days. All the birds were individually weighed on day 1, 14 and 42. Total feed consumption (pen basis) on day 14 and 42 day was recorded. Feed conversion ratio (FCR, feed per gain) was calculated as the ratio of feed consumption to body weight gain. Mortality was also recorded daily. SPSS version 15.0 was used for analysis and a General Linear Model (GLM) was designed to reveal the effects of the colour of clothing, visual contact duration and their interaction on blood parameters, TI duration and body weight. Kruskal-Wallis ANOVA was used for TI induction, feed consumption, and FCR data.

### **Results and Discussion**

The induction numbers recorded for each chicken and visual contact had a non-significant effect on susceptibility to TI. Despite lack of statistical differences between visual contact groups groups, it was determined that TI duration (the level of fear) decreased to 227.16 s from 244.10 s as parallel to an increase in visual contact durations by human (Table 1). It was determined that broilers exposed to regular visual contact with stockperson for 300 s had led to a decrease in H/L ratio, but this has not reached statistically significance. Visual human contact and human clothing colour were determined not to have significant effect on some blood parameters such as glucose, cholesterol, triglyceride, total protein and LDH levels in broilers. It was determined that visual human contact has no significant effect on some breast meat quality parameters such as pH<sub>15</sub>, pH<sub>u</sub>, L\*, a\*, b\*, CL and WHC in broilers (Table 1). There was no mortality in all visual contact groups. Feed consumption (FC) and FCR in 60 and 300 s visual contact groups were found as follows; 4599.55 and 4325.55 g and 1.84 and 1.79 (g feed/g gain) respectively. The number of TI inductions in red, blue, green and gray colour groups were found as 1.31, 1.07, 1.15 and 1.15, respectively (P>0.05). H/L ratios of 0.2, 0.5, and 0.8 are important indicators for low, medium, and chronic stress, respectively. It can be said that the lowest stress level (0.45) was determined in red coloured (long wavelength of maximum absorption at 565-570 nm) clothing group. It was determined that average pH values in all colour groups varied in acceptable range (from 5.81 to 5.88). The FC's were found as 4432.31, 4626.64, 4191.56 and 4599.69 g, FCR's were determined as 1.80, 1.82, 1.83 and 1.83 (g feed/g gain) for red, blue, green and gray colour groups, respectively (P>0.05). On

day 42, the highest live weight (2593.82 g) was determined in blue coloured clothing group ( $P < 0.001$ ). Also, the body weight in red, blue, green and gray colour groups were found as follows; 2514.13, 2593.82, 2348.42 and 2548.15 g, respectively. Body weight in 60 and 300 s visual contact groups were found as 2543.48 and 2458.77 g, respectively ( $P > 0.05$ ). In some studies in which the effect of the colour of light investigated were similarly determined that body weight at slaughter was higher in blue light groups than red light groups ( $P < 0.05$ ), and FCR and mortality rates have not reached statistically significance (Rozenboim et al. ,1999; 2004; Cao et al., 2008). Rozenboim et al<sup>7,8</sup> determined that blue light stimulated growth while red light stimulated reproduction in chickens. It's thought that highest body weight in blue colored clothing group can be attributed to the relaxing effect of blue colour (short wavelength at 430-460 nm).

Table 1. The least square means for some stress parameters, meat quality traits, and TI duration

Parameters	Clothing colours treatment (CCT)				Visual contact treatment (VCT)		Pooled SED	F value and significant		
	Red (n=22)	Blue (n=22)	Green (n=22)	Gray (n=22)	60 second (n=44)	300 second (n=44)		CCT	VCT	CCT X VCT
<b>Hematological</b>										
H/L ratio	0.45 <sup>b</sup>	0.47 <sup>b</sup>	0.89 <sup>a</sup>	0.56 <sup>b</sup>	0.61	0.57	0.03	9.725 <sup>***</sup>	0.268 <sup>-</sup>	1.654 <sup>-</sup>
<b>Meat quality traits</b>										
pH <sub>15</sub>	6.33	6.36	6.38	6.37	6.39	6.32	0.02	0.293 <sup>-</sup>	3.390 <sup>-</sup>	0.911 <sup>-</sup>
pH <sub>24</sub>	5.88	5.81	5.83	5.81	5.83	5.84	0.02	1.151 <sup>-</sup>	0.068 <sup>-</sup>	1.889 <sup>-</sup>
L*	52.88 <sup>ab</sup>	54.67 <sup>a</sup>	50.23 <sup>c</sup>	51.97 <sup>bc</sup>	52.94	51.94	0.41	5.069 <sup>**</sup>	1.467 <sup>-</sup>	0.687 <sup>-</sup>
a*	2.36	2.19	2.42	2.33	2.16	2.49	0.09	0.307 <sup>-</sup>	3.706 <sup>-</sup>	0.997 <sup>-</sup>
b*	2.44	3.29	2.09	2.39	2.62	2.46	0.19	1.793 <sup>-</sup>	0.195 <sup>-</sup>	0.947 <sup>-</sup>
CL	27.12	29.78	29.37	29.93	28.82	27.79	0.65	1.299 <sup>-</sup>	0.628 <sup>-</sup>	0.313 <sup>-</sup>
WHC	11.64	11.84	11.23	11.80	11.53	11.73	0.27	0.277 <sup>-</sup>	0.134 <sup>-</sup>	0.577 <sup>-</sup>
TI duration	242.81	198.32	267.04	234.35	244.10	227.16	17.99	0.641 <sup>-</sup>	0.222 <sup>-</sup>	0.735 <sup>-</sup>

<sup>a,b,c</sup> Means with different superscript letters in the same row differ (P<0.05), -: Not significant, \*\*: P<0.01, \*\*\*: P<0.001, CL: Cooking loss (CL) (%), WHC: Water holding capacity (WHC) (%)

## Conclusion

Finally, this study has shown that visual contact by the human who wore the red, blue and gray coloured clothings was less stress to broilers than human who wore the green coloured clothing. It was revealed that low L\* value broiler breast meat as a result of stress in green colour clothing group. It was concluded that visual contact by the human, who wore the red, blue and gray coloured clothings were effective to increase body weight in broilers. Further studies should be arranged to investigate the aspects of the relations between human and chicken based on visual contact.

## References

- CAO, J., LIU, W., WANG, Z., XIE, D. and CHEN, Y. (2008). Green and blue monochromatic lights promote growth and development of broilers via stimulating testosterone secretion and microfiber growth. *Journal Applied Poultry Research* 17: 211-218.
- GROSS, W.B. and SIEGEL, H.S. (1983). Evaluation of the heterophil/lymphocyte ratio as a measure of stress in chickens. *Avian Disease* 27: 972-979.
- JONES, R.B. (1993) Reduction of the domestic chick's fear of humans by regular handling and related treatments. *Animal Behaviour* 46: 991-998.
- JONES, R.B. and FAURE, J.M. (1981) The effects of regular handling on fear responses in the domestic chick. *Behaviour Processing* 6: 135-142.
- LECUELLE, S., BOUVAREL, I., CHAGNEAU, A.M., LAVIRON, F., LESCOAT, P. and LETERRIER, C. (2011). Early visual experience of food does not appear to reduce subsequent feed neophobia in turkeys. *Poultry Science* 90: 1-9.
- ROZENBOIM, I., BIRAN, I., CHAISEHA, Y., YAHAV, S., ROSENSTRAUCH, A., SKLAN, D. and HALEVY, O. (2004). The effect of green and blue monochromatic light combination on broiler growth and development. *Poultry Science* 83: 842-845.
- ROZENBOIM, I., BIRAN, I., UNI, Z. and HALEVY, O. (1999). The involvement of monochromatic light in growth, development and endocrine parameters of broilers. *Poultry Science* 78: 135-138.
- WAIBLINGER, S., BOIVIN, X., PEDERSEN, V., TOSI, M.V., JANCZAK, A.M., VISSER, E.K. and JONES, R.B. (2006) Assessing the human-animal relationship in farmed species: A critical review. *Applied Animal and Behaviour Science* 101: 185-242.

- ZHANG, L., YUE, H.Y., ZHANG, H.J., XU, L., WU, S.G., YAN, H.J., GONG, Y.S. and QI, G.H. (2009) Transport stress in broilers: I. Blood metabolism, glycolytic potential, and meat quality. *Poultry Science* 88, 2033-2041.
- ZULKIFLI, I. and SITI NOR AZAH, A. (2004) Fear and stress reactions, and the performance of commercial broiler chickens subjected to regular pleasant and unpleasant contacts with human being. *Applied Animal and Behaviour Science* 88:77-87.

# **Uniformity and Welfare Problems at Broiler Houses and New Solution Approaches by Computer Modelling Programs**

**A. Bulancak, N. Özen**

Cyprus International University, Faculty of Agricultural Sciences and Technologies,  
Nicosia, North Cyprus.

## **Abstract**

This review was compiled to deal with the importance of uniformity and animal welfare problems at broiler houses and monitoring systems by computer modelling programs. For uniformity calculations it is important to predict weight of broilers. For this purpose new digital image processing technologies have been searching. Sensors and wearable technologies can be implanted on animals to measure body temperature, to observe behaviour and movement, to detect stress, presence of viruses and pathogens, and to analyze pH and sound. This study discusses the scope of different computer modelling programs and recent developments, and their application opportunities which can enhanced broiler welfare in the future.

***Key Words:** Broiler houses, modelling programs, uniformity, welfare*

## **Introduction**

For researchers and farmers it is not easy monitoring poultry houses by conventional methods such as writing notes, keeping a farm diary or using simple equipments without data sharing functions. Several studies have focused on detecting the behaviors of broilers by automatic monitoring techniques to measure broilers activities. Animal welfare farm monitoring can also be made by number of systems such as cell phones and hand held devices (1). Precious Livestock Farming (PLF) is a system which comes with many benefits and ensures maximum use of all resources, thus controlling the health status of animals. PLF works for animal welfare through a variety of devices including automated tools that integrate audio and video captured data for early disease detection and warning systems. The sound and image data analyzed by animal experts into database for creating suitable algorithms (2). Flockmann technology (3) is recent innovative feed control system for broiler chickens and also analyzes heat, ventilation and humidity factors of the environmental facility on the growth and health of chickens. Computational Fluid

Dynamics(CFD) is used to detect the influence of laying hen geometry, distribution and weight on airflow resistance (4) and for modelling heat and mass transfer of a broiler house(5). An environmental preference chamber (EPC) was designed, fabricated and commissioned to provide a means of investigating animal preference for, or a version to, alternative thermal and gaseous environments(6).

### **Materials and Methods**

For this review we have searched recent studies and try to summarize them mainly under three titles. House monitoring systems by digital image processing systems, welfare problems and data collection methods with sensors and wearable technologies and barn animal preference chamber monitoring systems and automations.

### **Results and Discussion**

Individual broiler weight was predicted by the method of Bayesian Artificial Neural Network (1), the system can predict broiler weight without using a weighing apparatus and predict which birds are ill. The objective of imaging systems was to explore the possibility of digital image analysis to predict live broiler weight at different stages of the growth (2). Although the precision of live weight estimation depends on many factors, the presented data indicated that the development of a practical imaging system for weighing broiler is feasible. At Computational Fluid Dynamics (CFD) the simulation was conducted using standing hens which were 6 cm above the floor (4). In practice, hens spend more time on sitting. The flow resistance for hens laying on ground should be further investigated. Although many studies had applied porous media assumption for animal occupant zone (AOZ) to model the livestock buildings, in some cases, it failed to characterize velocity and temperature distribution around AOZ in detail (5). Commissioning an animal preference chamber for behavioral studies with laying hens exposed to atmospheric ammonia study results (6) showed that EPC was capable of maintaining constant and distinctly different  $\text{NH}_3$  concentrations among compartments, ( $2.5 \pm 1.1$  ppmv,  $10.4 \pm 2.2$  ppmv,  $22.2 \pm 1.5$  ppmv, and  $37.9 \pm 1.4$  ppmv for nominal concentrations of 0, 10, 20, and 40 ppmv, respectively – note that the highest variation among compartments for a given nominal concentration was as small as 2.2 ppmv without birds in the EPC) with minimal infiltration from a compartment to adjacent ones (maximum of  $4.6 \pm 0.4$  ppmv of  $\text{NH}_3$  detected during cross-contamination testing, which has been considered acceptable by authors). Although relative humidity is also an important environmental parameter, it is not yet controlled in the

EPC, which relies solely upon laboratory moisture control system (a commercial humidification system for winter use). However, the EPC mixing box was designed to hold air conditioners such as an additional heating element, a cooling system, and a humidifier, which will be incorporated to the EPC in the future.

### **Conclusion and References**

Precision livestock farming techniques, which include a wide span of technologies, are being applied, along with advanced technologies like microfluidics, sound analyzers, image detection techniques, sweat and saliva sensing, serodiagnosis and others. However, there is a need to integrate all the available sensors and create an efficient online monitoring system, so that animal health can be monitored in real time, without delay (1). Further work is required on control of image quality by, for example, careful position of the camera (3-dimensional cameras), and lighting, and development of image analysis software to locate and measure the relevant areas of the broilers (2).

- SURESH NEETHIRAJAN, (2017). Recent advances in wearable sensors for animal health management. *Sensing and Bio-Sensing Research* 12:15–29
- BANHAZI, T.M., BABINSZKY, L., HALAS, V., TSCHARKE, M., (2012). Precision livestock farming: Precision feeding technologies and sustainable livestock production. *International Journal of Agricultural and Biological Engineering*, 5 (4), pp. 54-61.
- G. CORKERY, S. WARD, C. KENNY, P. HEMMINGWAY, (2013). Incorporating smart sensing technologies into the poultry industry, *J. World's. Poult. Res.* 3 (4) 106–128.
- QIONGYI CHENGA, WENTAOWUC, HAO LI, GUOQIANG ZHANG, BAOMING LI, (2018). *Science Direct* . Volume 144, Pages 181-189.
- FERNANDO ROJANO , PIERRE-EMMANUEL BOURNET , MELYNDA HASSOUNA , PAUL ROBİN, MURAT KACIRA , CHRISTOPHER Y. CHOI, (2015). Modelling heat and mass transfer of a broiler house using computational fluid dynamics *Biosystems Engineering*, ISSN: 1537-5110, Vol: 136, Page: 25-38.
- G.T. SALES, A.R. GREEN, R.S. GATES, (2013) Commissioning an animal preference chamber for behavioral studies with laying hens exposed to atmospheric ammonia. *Computers and Electronics in Agriculture* 95: 48–57.

# Chemical composition of breast meat from broilers affected by white striping myopathy<sup>a</sup>

Rodrigo Alves de Souza<sup>b\*</sup>, Juliana Lolli Malagoli de Mello<sup>c</sup>, Larissa Tátero Carvalho<sup>b</sup>, Aline Giampietro-Ganeco<sup>c</sup>, Rodrigo Fortunato de Oliveira<sup>c</sup>, Erika Nayara Freire Cavalcanti<sup>c</sup>, Marco Antonio Trindade<sup>b</sup>, Pedro Alves de Souza<sup>c</sup>, Hirasilva Borba<sup>c</sup>

<sup>a</sup>This study was financially supported by São Paulo Research Foundation (FAPESP, 2015/08471-8 and 2015/14584-0).

<sup>b</sup>School of Animal Science and Food Engineering. University of São Paulo. Pirassununga. SP. Brazil.

<sup>c</sup>Department of Technology. São Paulo State University. Jaboticabal. SP. Brazil.

\*Corresponding author: rodrigo.zootecnista@gmail.com

## Abstract

The aim of this study was to evaluate the influence of three lineages of broilers with different degrees of white striping myopathy on the chemical composition of breasts fillets. 180 breast samples from Cobb 500, Ross 308 AP and Hubbard broilers were used. Carcasses were acquired from commercial slaughterhouses inspected by the Brazilian Federal Inspection Service. Severe degrees make the breast meat fattier and less nutritional than normal fillets. This situation may influence the consumer to deny the severe degrees, once upon that, besides the visual aspect, the meat is not as nutritive as a normal one.

**Key words:** *chemical composition, Cobb, fillets, Hubbard, Ross, nutritional*

## Introduction

The evolution on poultry meat production allowed a great products diversification, with a bigger elaboration of convenience items, practicality and value-added product, due to detriment of whole carcasses. But, new barriers on the industry like like the appereance of white stripes in different degrees of severity, has increased the necessity of studies about the physical, chemical and histological modifications that the genetic progress can introduce the birds (Petracci e Cavani, 2011; Pereira et al., 2005).

According to Kennedy et al. (2004) the meat appearance (shows how fresh and healthy is the product, including the fat content) and the convenience (easy of cooking) are the most important attributes considered by the consumers, favoring the choice of birds meat. Some

researchers suggest that the intensive genetic selection of the birds to the weight gain at slaughter and, consequently, of breast yield can result in a reduction of the product quality offered in marketing (Pietrzak et al., 1997).

Any condition that affects negatively the visual appearance of the meat results in economic losses (Kuttapan et al., 2012). The huge visual change caused by myopathies on the breast meat appearance can turn the fresh meat and sub products not commercialized (Galipropopou, 2013), because the slaughterhouses work with carcasses condemnation politics with unknown etiology injuries.

We clarify that this topic has high relevance and there are few researches on Brazil related to the occurrence and characterization of white striping myopathy in poultry meat and what degrees of this myopathy can cause losses to the Brazilian industry, that is the worldwide largest exporter of poultry meat. We consider important studies that deepen the knowledges e clarifications about the physics, chemical, sensorial and histological modifications of the meat coming from birds in this conditions.

## **Materials and Methods**

This research was developed at the Laboratory of Animal Products Technology of the Faculty of Agricultural and Veterinary Sciences at UNESP, Jaboticabal Campus, São Paulo, Brazil (21°08'S, 48°11'W, 583 m altitude).

### *Sample collection and preparation*

180 breast samples from Cobb 500 (n=60), Ross 308 AP (AP95; n=60) and Hubbard (n=60) broilers, slaughtered at 42 days of age, were used. Carcasses were acquired from commercial slaughterhouses (São Paulo, SP, Brazil) inspected by the Brazilian Federal Inspection Service. Samples were classified at the slaughterhouse, after skin removal, according to the severity of the apparent stripes on the muscle surface as: normal - absence of stripe; moderate - stripe thickness less than 1 mm; severe - stripe thickness greater than 1 mm, easily visible on the surface of the muscle (Kuttapan *et al.*, 2012). Birds were slaughtered according to the slaughter plant routine and transferred to the laboratory in a refrigerated vehicle for cold-chain maintenance. After completion of *rigor mortis* (4 h after slaughter), each breast was manually deboned for obtaining the samples of the *pectoralis major* muscle from both sides of the breast.

### *Methods*

Protein, moisture and ash were determined as specified by the Association of Official Analytical Chemists (AOAC, 2005) methods 977.14, 950.46 and 920.153, respectively. Fat was determined according to Bligh and Dyer (1959). Samples were previously ground and placed in aluminum trays, weighed (initial weight) and lyophilized for 72 hours. After 72 hours the samples were weighed again (final weight) so that the moisture percentage could be calculated according to the formula:  $\text{Moisture} = 100 - (\text{Final Weight} \times 100 / \text{Initial Weight})$ . Subsequently, dried samples were ground to perform the other analyzes.

To determine protein concentration were used 0.1 g of dried and ground sample, weighed in digestion tubes, to which were added a digest mixture (sodium selenite, copper sulfate and sodium sulfate) and 4 mL of concentrated sulfuric acid for cold digestion; then, tubes were kept in digester block for approximately five hours (350 °C); samples were distilled in micro Kjeldahl, whose nitrogen was collected in boric acid solution (2%) containing indicator (bromocresol green and methyl red); the titration was performed with sulfuric acid solution (0.05 N). The protein percentage was calculated according to the formula:

$\text{Protein} = [(\text{Vol HCl spent in Titration} - \text{Vol HCl white tube}) \times (\text{HCl correction factor} \times 100) / \text{sample weight}] \times 6.25$

To evaluate fat concentration in chicken breast samples, 3 g (initial weight) of dry and ground samples were weighed in Erlenmeyer flasks in which were added 10 mL of chloroform, 20 mL of methanol and 8 mL of distilled water. The Erlenmeyer flasks were shaken for 45 minutes. Subsequently, another aliquot of 10 mL of chloroform and 10 mL of anhydrous sodium sulfate solution (1.5%) were added and the flasks were shaken for another 15 minutes. Samples were filtered in 50 mL falcon tubes for phase separation. From the fraction containing the solvents were pipetted aliquots of 5 mL to beakers with known weight. After evaporation in a forced ventilation oven (50 °C), beakers containing fat were weighed again. The fat percent was calculated following the formula:  $\text{Fat} = (\text{fat weight} \times 4 \times 100) / \text{initial weight}$ .

To evaluate the ash percent, 3 g of dried and ground samples (initial weight) were weighed in porcelain crucibles which were kept in an oven (105 °C) for 12 hours. Subsequently, the crucibles were kept in a muffle oven (600 °C) for five hours and weighed again (final weight) after cooling. The ash percentage was calculated according to the formula:  $\text{Ash} = \text{Final Weight} \times 100 / \text{Initial Weight}$ .

Results of chemical composition were expressed on a fresh matter basis.

## Results and Discussion

It's observed that the occurrence of white striping didn't influence ( $P>0.05$ ) the moisture percentage of samples from Cobb 500 poultry breast meat, that presented, an average, 74.22% of moisture (Table 1). With the increase of the stripes severity was verified, too, the increase ( $P=0.0030$ ) of protein percentage (from 21.41% to 23.55%). The increase ( $P=0.0003$ ) of fat percentage (2.37% to 3.06%) and the decrease ( $P<0.0001$ ) of ashes percentage (from 1.46% to 1.25%) of the breast meat coming from Cobb 500 poultry lineage.

Table 1. Protein, fat, moisture and ash concentration in breast meat from Cobb 500 broilers affected by different degrees of white striping (WS).

WS	Protein (%)*	Fat (%)*	Moisture (%)	Ash (%)*
Normal	21.41 B	2.37 B	74.39	1.46 A
Moderate	21.57 B	3.06 A	74.09	1.44 A
Severe	23.55 A	2.90 A	74.18	1.25 B
P-value	0.0030	0.0003	0.6119	<0.0001

<sup>A,B</sup>Means in the same column followed by different letters are significantly different by Tukey's test ( $P < 0.05$ ). \*Results expressed on a fresh matter basis.

In samples of breast meat coming from Ross AP95 lineage, was not observed effects ( $P>0.05$ ) of white striping in moisture and ashes percentages, which presented, the averages 75.96% of moisture and 1.42% of ashes (Table 2). Contrary of what was verified in the breast meat from Cobb 500 lineage, the meat of AP95 lineage presented a decrease ( $P=0.0109$ ) on the percentage of protein (from 22.92% to 21.30%) with the increase of white striping degrees. The breast meat of Ross AP95 lineage also presented an increase ( $P=0.0081$ ) of fat percentage (2.30% to 3.12%) with the severity of white striping.

Table 2. Protein, fat, moisture and ash concentration in breast meat from Ross 308 AP broilers affected by different degrees of white striping (WS).

WS	Protein (%)*	Fat (%)*	Moisture (%)	Ash (%)*
Normal	22.92 A	2.30 B	75.46	1.45
Moderate	22.99 A	2.37 B	75.49	1.43
Severe	21.30 B	3.12 A	76.93	1.39
P-value	0.0109	0.0081	0.1046	0.8840

<sup>A,B</sup>Means in the same column followed by different letters are significantly different by Tukey's test ( $P < 0.05$ ). \*Results expressed on a fresh matter basis.

Differently of was observed in samples of lineages Cobb 500 and Ross Ap95 breast meats, the meat of Hubbard poultries lineage presented variations on moisture and ashes, besides the protein and fat content (Table 3). It was verified increase ( $P<0.05$ ) of protein (22.73%

to 25.21%), fat (1.47% to 2.64%) and moisture (73.50 to 75.03%) percentages, but a decrease ( $P=0.0150$ ) on the ashes percentage of samples studied with the severity of white stripes presented on the surface of the fillets.

Table 3. Protein, fat, moisture and ash concentration in breast meat from Hubbard broilers affected by different degrees of white striping (WS).

WS	Protein (%)*	Fat (%)*	Moisture (%)	Ash (%)*
Normal	22.73 B	1.47 B	73.50 B	1.47 A
Moderate	23.80 AB	1.74 B	75.03 A	1.31 B
Severe	25.21 A	2.64 A	74.32 AB	1.29 B
P-value	0.0005	<0.0001	0.0013	0.0150

<sup>A,B</sup>Means in the same column followed by different letters are significantly different by Tukey's test ( $P < 0.05$ ). \*Results expressed on a fresh matter basis.

Like several studies of authors cited above, breasts with severe degree of white striping presents higher contents of fat and lower of protein and ashes. This way, the lineage Ross AP95 showed the same results. At the same time, the other two lineages (Hubbard and Cobb 500) presented a higher fat content than the normal degrees; on the other hand, they presented lower protein content, when compared to severe ones. The slaughter houses and the farms, that create the broilers, didn't give us the access to the nutritional management, as a privacy politic of the companies. So, it is not know the possibly causes that maid these two lineages different in this aspect; but the increase of protein on the feed, allied to the fast growth, feed conversion and presispotion of some birds of this lineage, could change this protein content, even as the fat content, in proportional levels, as the degrees increase from moderate to severe.

### Conclusion

As the degrees of myopathy become more severe, the fat content increases and the ashes decrease. These make the breast meat fattier and less nutritional than normal fillets. This situation may influence the consumer to deny the severe degrees, once upon that, besides the visual aspect, the meat is not as nutritive as a normal one.

### References

AOAC - Association of Official Analytical Chemists. Official Methods of Analysis of the AOAC.18th ed. Gaithersburg, M.D, USA. 2005.

- BLIGH, G.E., DYER, J.W. (1959) A rapid method of total lipid extraction and purification. *Canadian Journal of Biochemistry and Physiology* 37: 911–917.
- KUTTAPPAN, V., BREWER, V., APPLE, J., WALDROUP, P. and OWENS, C. (2012) Influence of growth rate on the occurrence of white striping in broiler breast fillets. *Poultry Science* 91: 2677-2685.
- PEREIRA, R. A.; RODRIGUES, L.B.; ALLGAYER, M.C.; DICKEL, E.L.; SANTOS, L.R.; GABRIELLI, E.; CARÍSSIMI, A.S. Miopatia Peitoral profunda em frangos de corte. In: *Veterinária em Foco*, v.3, n.1, maio/dez. 2005. p. 11-16
- PETRACCI, M; CAVANI C. (2011). Muscle Growth and Poultry Meat Quality Issues. *Nutrients* 4:1-12.
- PIETRZAK, M., GREASER, M. L.; SOSNICKI, A. A. (1997).Effect of rapid rigor mortis processes on protein functionally in Pectoralis major muscle of domestic turkeys. *Journal of Animal Science*: 75: 2106–2116.

# **The Effect of Conventional and Enriched Litter System upon Performance and Some Blood Parameters in Layer Breeder Hens**

**Bülent Tarım<sup>a,1</sup>, Murat Dođu<sup>a</sup>, Diydem Dođan<sup>a</sup>, Ayten Aşkın Kılınç<sup>a</sup>, Sunay Demir<sup>a</sup>, Hakan Öztürk<sup>b</sup>**

<sup>a</sup> Poultry Research Institute, Ankara, Turkey;

<sup>b</sup> Department of Physiology, Veterinary Faculty, Ankara University, Ankara, Turkey

## Abstract

This study was carried out to determine the effects of two different breeding systems as traditionally used and enriched of them on their performance and some blood parameters. In the study, 2400 Barred Rock Brown layer hens were used in the Ankara Poultry Research Institute. The animal material was divided into 4 treatment groups (Conventional and Enriched 2 / 3 Slatted Litter Floor System, Conventional and Enriched Deep Litter Floor Systems), and each group was divided into 5 replications. Each replication is arranged to be 120 chickens. The trial lasted up to 52 weeks of age. When the obtained results were analyzed by variance analysis technique and multiple comparison method, the difference between groups was found to be statistically significant ( $p < 0,05$ ) between laid on the ground ratio, dirty egg ratio, meat spot. In terms of dirty egg ratio, meat spot were obtained lowest value and the highest in terms of ground eggs ratio Enriched 2 / 3 Slatted Litter Floor System. The differences between groups in term of other performance and egg quality characteristic (except meat spot) were not statistically significant ( $p > 0,05$ ).

**Key Words:** *Conventional floor systems, alternative systems, egg production, blood parameters*

## Yumurta Tavuklarında Geleneksel ve Zenginleştirilmiş Sistemlerin Performans ve Bazı Kan Parametreleri Üzerine Etkisi

### Özet

Bu çalışma, yerde yetiştirmede geleneksel olarak kullanılan iki farklı yetiştirme sistemi ve bu yetiştirme sistemlerinin zenginleştirilmesi halinde performansa ve bazı kan parametrelerine etkilerini belirlemek amacıyla yapılmıştır. Araştırmada 2400 adet Ankara Tavukçuluk Araştırma Enstitüsünde bulunan Barred Rock hattı kahverengi yumurtacı tavuklar kullanılmıştır. Hayvan materyali 4 adet muamele

grubuna (Geleneksel ve Zenginleştirilmiş 2/3 Izgara Tabanlı Yer Sistemi ile, Geleneksel ve Zenginleştirilmiş Tamamı Altlıklı Yer Sistemleri) ayrılmış ve her grup 5 tekerrür olacak şekilde bölmeler yapılmıştır. Her tekerrür 120 tavuk olacak şekilde düzenlenmiştir. Deneme 52 haftalık yaşa kadar sürmüştür. Elde edilen sonuçlar varyans analiz tekniği ve çoklu karşılaştırma yöntemi ile analiz edildiğinde yere yumurtlama oranı, kirli yumurta oranı, yumurta verimi, tükü skorü, et lekesi arasında gruplar arasında görülen farklılık istatistik olarak önemli bulunmuştur ( $p < 0,05$ ). Kirli yumurta oranı, et lekesi açısından en düşük ve yere yumurtlama açısından da en yüksek değer zenginleştirilmiş 2/3 ızgara tabanlı gruptan elde edilmiştir. Diğer performans ve yumurta kalite özellikleri açısından (et lekesi hariç) gruplar arasındaki farklar istatistiksel olarak anlamlı değildir ( $p > 0,05$ ).

**Anahtar Kelimeler:** *Geleneksel yer sistemleri, alternatif sistemler, yumurta üretimi, kan parametreleri*

## **Introduction**

Today, with the formation of social awareness, new regulations on animal rights have been introduced. With increasing consciousness, consumers are looking at how they produce their products. Within these developments, poultry production takes place in an important place. In all countries, work is being done to ensure that the housing conditions are in accordance with the nature of the chickens. In the project prepared in the light of these studies, egg hatches are housed in traditional and enriched housing systems. The pen were prepared in accordance with the standards adopted by the European Union and welfare decisions. The effects on the egg production and quality of the housing systems have been determined with project. Compared to the efficiency obtained from the unit poultry floor area.

## **Material And Methods**

Barred chickens and Barred roosters were used as animal material in the study. After the breeding eggs from the hatchlings to be chickened are accepted in the egg acceptance section, the ones with breeding characteristics are selected and placed in the growth trays. The breeding eggs placed in the development vehicles were fumigated in the fumigation chamber before being placed in the development machine, free from harmful microorganisms that could be found on the egg shell surface. The breeding eggs placed in the development machines completed 18 days of 21 day incubation on these machines.

Eggs that have completed 18 days in the development machine were excluded from the embryo development in bright light under this light, and the live embryo eggs were placed in the exit cups with the vacuum egg transfer machine. The eggs completed the last three days of their 21 day development period in the exit machines and they performed incubation exits in these machines. The emerging chicks were transferred to the growth house, and the test materials reaching the gender maturity were then transferred from growth house with the standard cage to breeding house until the 52th age (until the end of the trial). Four treatment groups were used: a traditional deep litter system, an enriched deep litter system, a traditional 2/3 slatted floor system, an enriched 2/3 slatted floor system and a total of 20 groups of 5 replications per group. The sizes of the divisions are calculated to be equal for each treatment group. 8cm thick sawdust was laid on the floor as a base material, the nest made of galvanized material. The number of nest is calculated to be one to four to five chickens. Grid material is wood. A nipple was provided for every 4-6 chickens. Feeding ad- libitum and standard feeding program were applied. It is made on the basis of the poultry house with lighting windows. Observation data obtained as a result of the experiment were evaluated by variance analysis technique. When there is a difference between at least two means as a result of the variance analysis, when the result is obtained, the difference between the group averages is statistically significant.

## **Results**

Live weight and survival values of hens in order of group for Enriched 2/3 Slatted Floor System, Conventional 2/3 Slatted Floor System, Enriched Deep Litter System, Conventional Deep Litter System are  $1669 \pm 10.08$  and  $98.16 \pm 0.55$ ,  $1666.9 \pm 9.21$  and  $98.93 \pm 0.42$ ,  $1655.7 \pm 11.4$  and  $98.83 \pm 0.77$ ,  $1651.3 \pm 9.51$  and  $99 \pm 0.48$ . There was no statistically significant difference between the groups in terms of the obtained values ( $p > 0,05$ ).

Statistically significant differences were found between the groups ( $p < 0.05$ ). The lowest percentage of dirty eggs was obtained with a value of 5.823% for enriched slatted floor group. The highest percentage of contaminated eggs was also obtained from the traditional slatted floor group. There was no significant difference between the groups in terms of broken eggs ( $p > 0,05$ ) The difference between the groups in terms of laid on the floor was found to be statistically significant ( $p < 0.05$ ). The lowest value was obtained in the group with conventional

deep litter group. Compared to the enriched and conventional slatted floor groups, egg-laying rate was lower in the enriched group.

The results of the project with regard to dirty eggs, broken eggs and laid on the floor are given in the table below.

<i>Groups</i>	<i>Dirty Egg Ratio (%)</i>	<i>Broken Egg Ratio (%)</i>	<i>Laid on The Floor (%)</i>
Enriched 2/3 Slatted Floor System	5,82±0,36 <sup>b</sup>	0,66±0,122	10,10±0,88 <sup>ab</sup>
Conventional 2/3 Slatted Floor System	8,39±0,60 <sup>a</sup>	1,02±0,12	13,52±1,22 <sup>a</sup>
Enriched Deep Litter System	7,05±0,59 <sup>ab</sup>	0,86±0,31	10,01±1,02 <sup>ab</sup>
Conventional Deep Litter System	7,94±0,59 <sup>a</sup>	0,51±0,08	7,64±0,85 <sup>b</sup>
p	0,005	0,225	0,001

The results obtained in terms of egg yield\* (%) and egg weight average (gr) in order of group for Enriched 2/3 Slatted Floor System, Conventional 2/3 Slatted Floor System, Enriched Deep Litter System, Conventional Deep Litter System are 74.21±1.40 and 52.939±0.282; 74.49±1.42 and 52.779±0.311; 74.60±1.33 and 53.557±0.318; 74,75±1,29 and 53,256±0,308. There was no significant difference between the groups ( $p > 0.05$ ).

There was no significant difference between groups in terms of feed consumption ( $p > 0.05$ ).

The results obtained when analyzing the values obtained in terms of blood parameters. The difference between the groups was not significant ( $p > 0.05$ ).

The values obtained in terms of external quality characteristics. The difference between the groups was not statistically significant ( $p > 0.05$ ).

The results obtained in terms meat spot for Enriched 2/3 Slatted Floor System, Conventional 2/3 Slatted Floor System, Enriched Deep Litter System, Conventional Deep Litter System are respectively 3.81±0.93; 4.52±1.02; 8.57±1.49; 6.68±1.22. The difference between the groups was statistically significant ( $p < 0.05$ )

## Discussion

When the data obtained from the project is evaluated; as a result of conventionally 2/3 slatted floor system and conventionally deep litter systems are enriched; There were no differences in terms of live weight, viability, broken egg ratio, egg weight averages, feed consumption, blood parameters, egg internal and external quality characteristics (excluding meat stain), and egg yield. Dirty egg ratio, Laid on The Floor, and meat stalk were found to be different. In the enriched slatted floor group, the percentage of dirty eggs was statistically lower than that of the traditional group, and there was no statistically significant difference between the enriched deep litter system and the conventional group, but a lower percentage of dirty eggs was obtained in the numerically enriched deep litter system. Expected results have been achieved and recommended in systems enriched with dirty eggs. In terms laid on the floor, enriched systems were also taken high values. This is due to the laying of the sandbeds and can be considered as a disadvantage of these systems.

In terms of blood parameters; Similar to the results of the study, Davis et al. (2000) found that the two different settlement frequencies they apply to the cage do not affect the H / L ratio, which is the stress parameter. Nicol et al. (2006) reported that the settlement frequency had no effect on the H / L ratio.

When all these results are evaluated; The enriched slatted floor system can be recommended as a breeding system in terms of low meat stain, dirty egg ratio, nail length. But; In terms of laid on the floor, differences between enriched and traditional groups, Although not statically important and lowest value are found in the traditional deep litter system

## References

- Anonymous. 2011. Official newspaper. Regulation on the welfare of farm animals. 23.12.2011, sayı: 28151
- ABRAHAMSSON, P., TAUSON, R. And ELWINGER, K. 1996 b. Effects on production, health and egg quality of varying proportion of wheat and barley in diets for two hybrids of laying hens kept in different housing systems. *Acta Agric. Scand., Section A, Animal Science*, 46: 173-182.
- BLOKHUIS, H.J., JONES, R.B., GEERS, R., MIELE, M. and VEISSIER, I. (2003) Measuring and monitoring animal welfare: transparency in the food product quality chain. *Animal Welfare* 12, 445-455.

- BLOKHUIS, H.J., 2004., Recent development in European and International Welfare Regulation. 22 th World Poult. Sci. Congress, İstanbul, TURKEY
- CAMPO, J.L., GIL, M.G., DAVILA S.G. and MUNOZ I., 2005. Influence of perches and footpad dermatitis on tonic immobility and heterofil to lymphocyte ratio of chickens, *Poultry Science*, No: 84, pp: 1004-1009.
- DAVIS, G.S., ANDERSON, K.E. and CARROLL, A.S. 2000. The effects of long-term caging and molt of Single Comb White Leghorn hens on heterophil to lymphocyte ratios, corticosterone and thyroid hormones. *Poult. Sci.*, 79: 514-518
- DİKMEN, B.Y., İPEK, A., ŞAHAN, U., PETEK, M., SÖZCÜ, A. 2016. Egg production and welfare of laying hens kept in different housing systems (conventional, enriched cage, and free range). *Poultry Science* 95:1564–1572
- ELWINGER, K and TAUSON, R. 1999. Valj ratt honor vid glovinhysning. Fakta jordbruk 1999 I.SLU Publikationstjänst, Box, 7075, 750 07 UPPSLA, Sweden.
- GROSS, W. B. and P.B. SIEGEL, P.B., 1983. Evaluation of the heterophil/lymphocyte ratio as a measure of stress in chickens. *Avian Dis.*, 27: 972-979.
- KAHRAMAN, N.Ş., 2008. Yumurta üretim işletmelerindeki barındırma ve iç ayırntı sistemlerinin güncelleştirilme olanakları, Doktora Tezi, Akdeniz Üniversitesi Fen Bilimleri Enstitüsü, Antalya.
- KOELEBECK, K. W. and CAIN, J. R. 1984. Performance, behaviour, plasma corticosterone, and economic returns of laying hens in several management alternatives. *Poult. Sci.*, 63: 2123-2131.
- KONUĞ, T. 1975. Practical Physiology. Ankara University Veterinary Medicine Publication, Ankara University Press, Ankara, 250 pp
- NICOL, C. J., BROWN, S. N., GLEN, E., POPE, S. J., SHORT, F. J., WARRISS, P. D., ZIMMERMAN, P. H., WILKINS, L. J. 2006. Effects of stocking density, flock size and management on the welfare of laying hens in single-tier aviaries. *Brit. Poult. Sci.*, 47: 135-146
- SARICA M., CAMCI Ö., MIZRAK C., AKBAY R., TÜRKÖĞLU M., YAMAK UMU.S., (2012). Overview of Poultry Breeding Strategy in Turkey. Network access:(<http://www.organikpin.com/image/data/pdf/Turkiyede-kanatli-islah-stratejilerine-baki.pdf>)

- SHINI, S. 2003. Physiological Responses of Laying Hens to the Alternative Housing Systems. *Int. Journal of Poult. Sci.*, 2(5): 357-360.
- TAUSON,R., AMBBROSEN, T. and ELWINGER, K., 1984 'Evaluation of procedures for scoring the integument of laying hens: independent scoring of plumage condition', *Acta Agriculturae Scandinavica, Section A: Animal Science*, 34, pp. 400-408.
- TAUSON, R. and Holm, K.E. (1998) Evaluation of the Marielund Keeping System. Report 244, Swedish University of Agricultural Sciences, Dept. Animal Husbandry and Management, Funbolovsta research Centre. 755 97 UPPSALA, Sweden.
- TAUSON R., WAHLSTROM, A. and ABRAHAMSSON, P. 1999. Effect of two floor housing systems and cages on healt produntion and fear response in layers. *Journal of Applied Poultry Research*, 8: 152-159.

# **POSTER PRESENTATIONS**

## **SESSION-8**

### **PRODUCT QUALITY**

# The Role and Importance of Halal Food Certification in Turkish Republic's Broiler Exports

Sinan Duru<sup>a</sup>, Seyit HAYRAN<sup>a</sup>, Gökhan FİLİK<sup>b</sup>, Aykut GÜL<sup>a</sup>

<sup>a</sup>Cukurova University, Faculty of Agriculture, Department of Agricultural Economics, 01330, Adana, Turkey.

<sup>b</sup>Ahi Evran University, Agriculture Faculty, Agricultural Biotechnology Department, 40100, Kırşehir, Turkey

## Abstract

Poultry sector of Turkish Republic (TR) has shown great improvement with the investment after 2006 Avian Influenza. The poultry sector is at a level where it can compete with the installed capacity and technology in the international market as well as the domestic market. TR's broiler exports increased from \$ 1 million in 2000 to \$ 119 million in 2017. Islamic countries in the export of broiler have a great market potential because of their geopolitical proximity and production advantages in accordance with religious beliefs for TR. According to Islamic belief, the requirements of halal products to be consumed beliefs made that export products revealed the Halal Food Certificate a necessity. The main differences from other in the processing of suitable for halal foods are not to be introduced into the electric water before cutting, not to boil in hot water in the feather, and not to put in the medicinal water for prolonging the shelf life. Nowadays, halal food sector has a market share of \$ 2 trillion. Taking this potential into consideration, TR has accepted the Halal Food Certification procedures of the Turkish Standards Institute (TSE) in 2011, and the Halal Accreditation Authority (HAA) was established under the Ministry of Economy in 2017. In this study, we examined the development of broiler export to Iraq, United Arab Emirates, Saudi Arabia and Qatar countries where we have performed most broiler exports in the Islamic geography for 2007-2017 periods and evaluated the effects of Halal Food Certificate on the broiler sector.

**Keywords:** *Broiler Export, Halal Food Certification, Islamic Country, Turkish Republic*

## **Türkiye Etlik Piliç İhracatında Helal Gıda Sertifikasının Yeri ve Önemi**

### **Özet**

Türkiye tavukçuluk sektörü 2006 yılında yaşanan kuş gribi sonrası yatırımlarla büyük gelişme göstermiştir. Tavukçuluk sektörü iç pazarın yanı sıra yurt dışı pazarda teknoloji uygulamaları ve kurulu kapasite ile rekabet edebilecek düzeydedir. Ülkemizin etlik piliç ihracatı 2000 yılında 1 milyon dolar seviyesinde iken, 2017 yılında 119 milyon dolara yükselmiştir. Etlik piliç ihracatında İslam ülkeleri jeopolitik konum, yakınlığı ve dini inanışa uygun üretim avantajları nedeniyle pazar potansiyeli içermektedir. İslami inanışa göre tüketilecek ürünlerin helal olması zorunluluğu Helal Gıda Sertifikasını ortaya çıkarmış ve İslam ülkelerine ihraç edilecek ürünlerde aranması zorunlu hale gelmiştir. Helal gıda sertifikalı tavuk kesiminde temel farklılıklar tavuğun kesim öncesi başının elektrikli suya sokularak ani şok ile çırpınmadan kasabın keserek ölümünün gerçekleştirilmemesi, tüy yolumu öncesi uygulanan haşlama (54°C altında) sisteminde tutulmadan kuru yolum yapılması ve üstündeki kanın gitmesi amacıyla buzlu suya sokulması şeklindedir. Günümüzde helal sektörü 2 trilyon dolarlık bir pazara sahiptir. Ülkemizde bu potansiyeli göz önünde bulundurarak 2011 yılında Türk Standartlar Enstitüsünün (TSE) Helal Gıda Sertifikalama işlemlerini kabul etmiş, 2017 yılında ise Ekonomi Bakanlığı'na bağlı olarak Helal Akreditasyon Kurumu (HAK) kurarak adımlar atmıştır. Bu çalışmada İslam coğrafyasında en çok etlik piliç ihracatı gerçekleştirdiğimiz Irak, Birleşik Arap Emirlikleri (BAE), Suudi Arabistan ve Katar ülkelerine yapılan ihracatların 2007-2017 dönemi ortaya konarak etlik piliç ihracat gelişimi incelenecek, tavukçuluk sektöründe Helal Gıda Sertifikası bilincinin ne düzeyde olduğu ve ülkemizde Helal Gıda ile ilgili ne gibi gelişmeler olduğu üzerinde durulmuştur.

***Anahtar Kelimeler:** Kanatlı Et İhracatı, Helal Gıda Sertifikası, İslam Ülkeleri, Türkiye Cumhuriyeti*

### **Introduction**

Broiler due to the richness of nutritional value and affordability of the red meat according to the price it has become an accepted nutrient all over the world. Turkish Republic has establish to capacity and technology that can compete in poultry sector. Due to Islamic belief to Middle Eastern country must to submit halal food certificates that indicate that food export. In this study broiler export development to

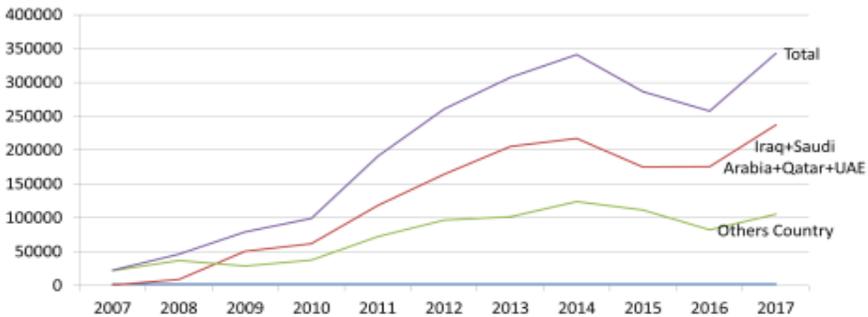
Iraq, UAE, Saudi Arabia and Qatar during the period fo 2007-2017, halal food certification in the Turkish Rebuplic by focusing on the developments in the export of solutions proposed to improve exports.

### Methodology

The main materyal of the study is world broiler product and export with Turkish Rebuplic broiler export from obtained TUIK, FAO ve other institutions and organization. In order to determine the place in exportation export role and importation of halal food certificate Turkish Republic most export countries among the Muslims of Iraq, UAE, Saudi Arabia and Qatar the level of development carried out between 2007-2017 period broiler exports were examined. In addition, articles, research, reports and related to the topic have been utilized and interpreted with improvement.

### Results and Discussion

World broiller production increased by %28 in 2007-2016 period (Trade Map, 2018). The USA and Brazil have contributed to the increase in production thanks to cheap input and become a promise. A chicken takes 2-2,5 kg weight in 40-45 days and contributed to the intensive production increase in unit area (Kahraman, 2013; FKA, 2015). During this period Turkish Republic broiler was achived to increase product %43,31, export 15 times. In 2007 the share of Iraq, UAE, Qatar and Saudi Arabia in total broiler export rose from %2.7 to %69 by the end of 2017. Turkish Rebuplic’s geopolitical position in the Middle East region, considers product is done according to Islamic belief, high competetion power and location proixmity due to advantages such as the low cost of broiler export has a serious market.



**Figure 1.** Turkish Rebuplic broiler export figure (Ton)

The necessity of halal products to be consumed according to Islamic belief has become mandatory for products which have revealed halal food certificate and which will be exported to Islamic countries. The main differences in halal food certified chicken cutting are the fact that before the chickens are cut into the electric water before cutting 54°C below system applied before the feather is made and it is a way of putting into the iced water in order to make the dry passage and the blood on the top. Halal food certification in the Middle Eastern countries is another standard and non-Muslim countries also have a strong competitive edge in halal food export market. Halal food certification process started in 2011 in Turkish Republic and in 2017 Halal Accreditation Institution was established to increase the competitive power.

The necessity of halal products to be consumed according to Islamic belief has become mandatory for products which have revealed halal food certificate and which will be exported to Islamic countries. The main differences in halal food certified chicken cutting are the fact that before the chickens are cut into the electric water before cutting 54°C below system applied before the feather is made and it is a way of putting into the iced water in order to make the dry passage and the blood on the top (Tekle, et al. 2013). Halal food certification in the Middle Eastern countries is another standard and non-Muslim countries also have a strong competitive edge in halal food export market (Ali et al., 2012). Halal food certification process started in 2011 in Turkish Republic and in 2017 Halal Accreditation Institution was established to increase the competitive power.

### **Conclusion**

Halal food certified broiler production is costly because it differs from other production methods. Halal certified poultry production by other non-Muslim countries and the willingness of consumers to make halal poultry production. Halal Accreditation Institution established in order to compete in halal food market ensuring the standardization of the institutions and establishing the standard in the halal certification markings will increase the competitive power in the halal food market in Turkish Republic.

## References

- ALI, M.E., KASHIF, M., UDIN, K., HASHIM, U., MUSTAFA, S. ve MAN, Y.B. (2012). Species Authentication Methods in Foods and Feeds: the Present, Past, and Future of Halal Forensics. Food Analytical Methods. 5: 935-955.
- FKA (FIRAT KALKINMA AJANSI). (2015). Kanatlı Hayvancılık Sektör Raporu.Malatya.
- KAHRAMAN, Z. (2013). Türkiye Beyaz Et Sektörü. Ziraat Mühendisleri Odası. Ankara.
- TEKLE, Ş., SAĞDIÇ, O., NURSAÇAN, Ş., YETİM, H. ve ERDEM, M. (2013). Ülkemizde ve Dünyada Helal Gıda Hususunda Karşılaşılan Problemler. European Journal of Science and Technology. 1(1): 1-6.
- TRADE MAP. (2018). [https://www.trademap.org/tradestat/Product\\_SelProduct\\_TS.aspx?nvpm=1||0207||4|1|1|2|2|1 1|2|1](https://www.trademap.org/tradestat/Product_SelProduct_TS.aspx?nvpm=1||0207||4|1|1|2|2|1 1|2|1).
- TÜİK (TÜRKİYE İSTATİSTİK KURUMU). (2018). <https://biruni.tuik.gov.tr/disticaretapp/menu.zul>

## ***Salmonella* resistant to extended-spectrum cephalosporin isolated from broiler chicken farms in Skikda**

**Djeffal Samia<sup>a</sup>, Mamache Bakir<sup>b</sup>, Elgroud Rachid<sup>a</sup>, Bouaziz Omar<sup>a</sup>,  
Jean-Marc Rolain<sup>c</sup>**

<sup>a</sup>GSPA research Laboratory (Management of Animal Health and Productions),  
Institute of Veterinary Sciences, University Frère Mentouri, Constantine, Algeria,

<sup>b</sup> Institute of Veterinary and Agronomic Sciences, University Hadj Lakhdar, Batna,  
Algeria,

<sup>c</sup> Unité de recherche sur les maladies infectieuses et tropicales émergentes  
(URMITE), UM 63, CNRS 7278, IRD 198, INSERM 1095, IHU Méditerranée  
Infection, Faculté de Médecine et de Pharmacie, Aix-Marseille-Université, Marseille,  
France.

### **Abstract**

35 *Salmonella* spp. isolates, recovered from 32 poultry, over the period of 2011-2013, were investigated in order to determine their serotype, susceptibility to 13 antimicrobials and the Presence of resistance determinants of extended-spectrum cephalosporins. Five different serotypes were found in animal isolates (mainly *Kentucky*) 11 multidrug resistant *S. Heidelberg* isolates (31,42%) were further characterized as extended-spectrum  $\beta$ - lactamase (ESBL). Producers Polymerase chain reaction and sequencing of the amplicons confirmed the presence of *bla*<sub>CTX-M-1</sub> (n= 11), and *bla*<sub>TEM-1</sub> genes were also detected in two isolates. Here, we report for the first time the presence of *bla* CTX-M and TEM genes in *Salmonella* isolates recovered from poultry in Skikda , northeast of Algeria.

**Keywords:** *Extended-Spectrum B- Lactamase, Poultry, Resistance Genes, Salmonella, Serotype.*

### **Introduction**

*Salmonella enterica* infections are one of the most important causes of food borne pathologies, the majority of these diseases are associated with the consumption of animal food products such as: meat, chicken, eggs, milk, fish and seafood. (Pui *et al.*, 2011)

*Salmonella* cause severe gastroenteritis to young and immunodeficient patients, which is treated mainly with antibiotics especially fluoroquinolones and extended-spectrum cephalosporins (Le Hello *et al.*, 2011).

$\beta$ - lactams represent one of the most considerable classes of antimicrobials in providing noticeable therapeutic benefits for treatment of bacterial infections. (Li *et al.*, 2007)

ESBLs were identified following introduction of Extended-spectrum oxyimino cephalosporins in 1980s for treatment of severe infections (Bradford, 2001). In Algeria ESBLs is detected in non typhoida *Salmonella* since 1994 (Rahal *et al.*, 1994), from humans isolate.

A variety of B- lactams are currently authorized for use in veterinary medicine which results an increasing number of antibacterial strains producing extended-spectrum  $\beta$ - lactamses (ESBLs), their predominant mechanism of resistance in Gram negative bacteria is the production of  $\beta$ - lactamases, wich are encoded chromosomally or by plasmids and inactivate  $\beta$ - lactams by hydrolyzing the four membreed  $\beta$ - lactams ring (Bush *et al.*, 1995; Livermore, 1995).

The aim of this study was to elucidate the prevalence of *Salmonella* serotypes in broiler chicken farms in the province of Skikda, to determine their antimicrobial resistance profiles and to characterize ESBL isolates by genotyping and antibio- resistance patterns.

## **Materials and Methods**

A total of 1194 samples were collected from poultry farms in Skikda regions. The study was carried out from December 2011 to May 2013. During two campaigns, each poultry house was visited twice at two different age periods (15-30 days and 45-60 days).

On each farm, samples of water from drinkers (using sterile syringes and conditioned in sterile bottles), feed from feeders (in stomacher bags), cloacal swabs and droppings (in sterile bottles) across the brooding surface and conserved in sterile containers) were collected. Surface wipes for microbiological control (25 cm  $\times$  25 cm, brand AES Chemunex, Combourg, France) were practiced at 30 cm height from the ground on a 400 cm<sup>2</sup> area of the four walls and placed in sterile stomacher bags (Table 1).

## ***Salmonella* isolation and identification**

All samples were examined according to ISO6579, 2002 applied to *Salmonella* detection in food and animal feeding stuffs, suspected colonies were further characterized by Api 20<sup>E</sup> stuffs (Biomérieux, France), After biochemical confirmation *Salmonella* isolates were sent to Pasteur Institut of Algeria (IPA), in conserved agar tubes (Biorad, France) for serotype characterization (Serotyping according to the Kauffmann-White-Le Minor's scheme (Guibourdenche *et al.*, 2010).

The identification of the strains was also identified by maldi-tof (Bruker,Allemagne) in the research unit Urmit, Université Aix Marseille,France.

### **Antimicrobial susceptibility testing and ESBL detection**

All *Salmonella* strains isolates were subjected to susceptibility testing against antibiotics of importance in human medicine by the disc diffusion method and the results were interpreted according to SFM/EUCAST recommendations ( EUCAST, 2015). Extended Spectrum  $\beta$ -lactamases production was detected by double-disc synergy test (DDST)(SAEN, 2005).

### **PCR detection of the $\beta$ - lactamase genes**

Genes encoding for the most prevalent  $\beta$ -lactamases were detected by PCR using specific primers (*bla*<sub>CTX-M-1</sub> group ( Roschanski *et al.*,2014) , *bla*<sub>CTX-M-9</sub> group ( Edelstein *et al.* ,2003), *bla*<sub>TEM</sub> group ( Kruger *et al.*,2004) and *bla*<sub>SHV</sub> (Yagi *et al.*,2015) ) and identified after sequencing using the ARG-ANNOT data base (Gupta *et al.*,2014).

## **Results and Discussion**

### **Prevalence of contamination of poultry farms:**

11 (34.37%) of the 32 poultry farms were contaminated by *Salmonella*. The isolation rates varied according to the sample origin: 6.25% (n = 64) for wipes, 4.24% for swabs (n = 330), 3.12% for droppings (n = 320), 2.18% for water samples (n = 320) and all feed samples were negative (n = 160). Samples taken at the age of three weeks were more contaminated than those collected at the end of the raising period.

### **Distribution and antimicrobial resistance of *Salmonella* serotypes**

The isolated avian *Salmonella* strains belonged mainly to two serovars: *S. Kentucky* and *S. Heidelberg* and the residual strains were of *S. Enteritidis*, *S. Virginia* and *S. Newport*.

### **Drug resistance of the isolated *Salmonella* strains**

A high resistance level to quinolones (51.1% to ciprofloxacin) was also in *Salmonella* isolates from both chicken farms and slaughterhouses. These strains were resistant to cephalosporins (26.6% to cefotaxim), aztereonam (26.6% %) and a reduced sensitivity to other antibiotics was also recorded: ticarcillin (46.6%) and gentamicin (22.2%). ESBL production was found in 26.6% of these avian isolates (11 *S. Heidelberg* and one *S. Newport*).

### **$\beta$ - lactamase genes**

Eleven of the *S. Heidelberg* strains harbored the *bla*<sub>CTX-M-1</sub> genes. The *bla*<sub>TEM</sub> group was identified in *S. Newport* isolate as well as in *S. Heidelberg* in which it was coupled with *bla*<sub>CTX-M-1</sub> gene.

## Discussion

This study provides epidemiological data on *Salmonella* contamination in poultry farms and slaughterhouses in Skikda region. The recorded prevalence rates are in accordance with those reported in Constantine and Batna provinces (Northeastern Algeria): 36.6% and 60% respectively (Elgroud *et al.*, 2009; Ayachi *et al.*, 2011).

This high prevalence can be attributed to the absence of *Salmonella* infection control plan (especially in healthy chickens) and to the poor hygiene in poultry farms where *Salmonella* can persist during several grow-outs. Furthermore, our findings are in accordance with those of Gardel *et al.* (2003) who found samples taken at the third week of the grow-out to be more contaminated by *Salmonella* infections than those collected at advanced ages .

Our *Salmonella* strains exhibited a high resistance rate to fluoroquinolones and interestingly, ciprofloxacin-resistant *S. Kentucky* was isolated in France from patients who had previously stayed in Algeria.

Table 1. Distribution of samples collected from the broiler farms

Campaign	Samples	15 – 30 days of age	45 – 60 days of age	Nbr of samples
1 (17 farms)	Cloacal swab	1 pool of 5 swabs	1 pool of 5 swabs	170
	Food	1 pool of food 5g x 5	-	85
	Water	1 pool 5x25 mL water	1 pool 5x25 mL water	170
	Wipes	1 pool of wipes	1 pool of wipes	34
	Feces	1 pool of 5 x 5 g feces	1 pool of 5 x 5 g feces	170
	Total	37 (9 pools)		629
2 (15 farms)	Cloacal swab	1 pool of 5 swabs	1 pool of 5 swabs	160
	Food	1 pool of food 5g x 5	-	75
	Water	1 pool 5x25 mL water	1 pool 5x25 mL water	150
	Wipes	1 pool of wipes	1 pool of wipes	30
	Feces	1 pool of 5 x 5 g feces	1 pool of 5 x 5 g feces	150
	Total	37 (9 pools) except for one farm 47 samples (10 pools of cloacal swabs)		565

In the present study, we report the presence of ESBLs in *S. Heidelberg* and *Newport*. CTX-M groups as the most prevalent. To our knowledge, this is the first report of *bla*<sub>CTX-M-1</sub> genes in avian *Salmonella* strains in Algeria. In fact, this group is the principal ESBLs type in human *Salmonella* encountered in Europe (Livermore, 2007).

We have also noted the presence of *bla*<sub>TEM</sub> genes in one avian *S. Newport*, another *S. Heidelberg* strain and all human ESBL-positive strains. In their study on *Salmonella* contamination in poultry meat and poultry products, Olesen *et al.*, (2004) reported, in Denmark, that the major recorded ESBL was the TEM group.

**Conclusion** The results of this study demonstrate that *Salmonella* contamination is highly prevalent in broiler poultry farms and slaughterhouses in Northeastern Algeria with an increasing resistance to critical medically important antibiotics. In addition and for the first time, the emergence of ESBL-producing *S. Enterica* isolates was reported in poultry in our region.

## References

- AYACHI A, ALLOUI N, BENNOUNE O, AND KASSAH-LAOUAR A. . (2010) Survey of *Salmonella* serovars in broilers and laying breeding reproducers in East of Algeria. *J Infect Dev Ctries*;4:103-106.
- BOUZIDI N, AOUN L, DEKHIL M, GRANIER SA, POIREL L, BRISABOIS A, NORDMANN P, and MILLEMANN Y. (2011) Co-occurrence of aminoglycoside resistance gene *armA* in non-Typhi *Salmonella* isolates producing CTX-M-15 in Algeria. *J Antimicrob Chemother.* 66:2180-2181.
- BRADFORD PA. (2001) Extended-spectrum beta-lactamases in the 21st century: characterization, epidemiology, and detection of this important resistance threat. *Clin Microbiol Rev*;14(4):933-51.
- BUSH K, JACOBY GA, and MEDEIROS AA. (1995) A functional classification scheme for beta-lactamases and its correlation with molecular structure. *Antimicrob Agents Chemother.*;39:1211-1233.
- ELGROUD R, ZERDOUMI F, BENAZZOUZ M, BOUZITOUNA-BENTCHOUALA C, GRANIER SA, FREMY S, BRISABOIS A, DUFOUR B, and MILLEMANN Y. (2009) Characteristics of *Salmonella* contamination of broilers and slaughterhouses in the region of Constantine (Algeria). *Zoonoses Public Health.*;56:84-93.

- GRADEL KO, RATTENBORG E. (2010) A questionnaire-based, retrospective field study of persistence of *Salmonella Enteritidis* and *Salmonella Typhimurium* in Danish broiler houses. *Prev Vet Med* 2003 Jan 15;56(4):267-84.
- GUIBOURDENCHE M, ROGGENTIN P, MIKOLEIT M, FIELDS PI, BOCKEMUHL J, GRIMONT PA, (2011) et al. Supplement 2003-2007 (No. 47) to the White-Kauffmann-Le Minor scheme. *Res Microbiol Jan*;161(1):26-9. Clinical and Laboratory Standard Institut. Performance standard for antimicrobial disk susceptibility tests approved standard-twentieth. ( Edition, M100 S20), CLSI Wayne, PA, USA.
- EDELSTEIN M, PIMKIN M, PALAGIN I, EDELSTEIN I, AND STRATCHOUNSKI L. (2003) Prevalence and molecular epidemiology of CTX-M extended-spectrum  $\beta$ -lactamase producing *Escherichia coli* and *Klebsiella pneumoniae* in Russian hospitals. *Antimicrobial Agents Chemotherapy*; Vol. 47, No. 12:3724-32.
- ISO (Comité international de normalisation AW/9 2002) ISO6579 Microbiology General Guidance on methods for the detection of *Salmonella* -Amendment 1, Annex D: Detection of *Salmonella spp.* in animal feces and in environmental samples from the primary production stage. 2002. Standardisation de l'antibiogramme à l'échelle nationale (médecine vétérinaire et humaine SAEN) . Sixième édition. Algérie. 2011.
- KRUGER T, SZABO D, KEDDY KH, DEELEY K, MARSH J W, and HUJER A M, (2004) et al. Infections with non typhoidal *Salmonella* species producing TEM-63 or a novel TEM enzyme, TEM-131, in South Africa. *Antimicrobial Agents Chemotherapy*; Vol.48, No.11:4263-70.
- GUPTA SK, PADMANABHAN BR, DIENE SM, LOPEZ-ROJAS R, KEMPF M, and LANDRAUD L.( 2014) ARG-ANNOT, a new bioinformatic tool to discover antibiotic resistance genes in bacterial genomes. *Antimicrob Agents Chemother*;58(1):212-20.
- LE HELLO S, HENDRIKSEN RS, DOUBLET B, FISHER I, NILSEN EM AND WHICHARD JM. (2011) International spread of an epidemic population of *Salmonella enterica* serotype Kentucky ST198 resistant to ciprofloxacin. *J Infect Dis Sep* 1;204(5):675-84.
- LIVERMORE DM. (1995)  $\beta$ -Lactamases in laboratory and clinical resistance. *Clin Microbiol Rev*.;8: 557-584.

- LIVERMORE DM, CANTON R, GNIADKOWSKI M, NORDMANN P, ROSSOLINI GM, ARLET G, AYALA J, COQUE TM, KERN-ZDANOWICZ I, LUZZARO F, POIREL L, and Woodford N. (2007) CTX-M: changing the face of ESBLs in Europe. *J Antimicrob Chemother.*;59:165-174.
- LI X ., PAYNE J.B., SANTOS F.B., LEVINE J.F., ANDERSON K.E., and SHELDON B.W.(2007) *Salmonella* populations and prevalence in layer feces from commercial high-rise houses and characterization of the *Salmonella* isolates by serotyping, antibiotic resistance analysis, and pulsed field gel electrophoresis; *Poultry Science*; 86: 591–597.
- OLESEN I, HASMAN H, (2004)AARESTRUP FM. Prevalence of beta-lactamases among ampicillin-resistant *Escherichia coli* and *Salmonella* isolated from food animals in Denmark. *Microb Drug Resist.*;10:334-340.
- PUI C.F., WONG W.C., CHAI L.C., TUNUNG R., JEYALETCHUMI P., NOOR HIDAYAH M.S., UBONG A., FARINAZLEEN M.G.,CHEAH Y.K., AND SON R. (2011) *Salmonella*: A foodborne pathogen. *International Food Research Journal*; 18: 465-473.
- RAHAL K, REGHAL A. (1994)A nosocomial epidemic of *Salmonella* mbandaka which produces various broad spectrum beta-lactamases: preliminary results. *Med Trop (Mars )*;54(3):227-30.
- ROSCHANSKI N, FISCHER J, GUERRA B, ROESLER U. (2014)Development of a Multiplex Real-Time PCR for the Rapid Detection of the Predominant Beta-Lactamase Genes CTX-M, SHV, TEM and CIT-Type AmpCs in Enterobacteriaceae, *PLOS ONE* . Volume9 No 7, e100956
- YAGI T, KUROKAWA H, SHIBATA N, SHIBAYAMA K, AND ARAKAWA Y,(2015). A preliminary survey of extended-spectrum -lactamases (ESBLs) in clinical isolates of *Klebsiella pneumoniae* and *Escherichia coli* in Japan. *FEMS Microbiology Letters*;Vol. 184, No.1:53-6.

# Effect of dietary supplementation with *Rosmarinus officinalis* powder on antioxidative potential and sensory and microbiological qualities of breast meat organic broilers

Essaidi Ismahen<sup>1,2</sup>, Hadj Ayed Mediha<sup>1,3</sup>, Mahmoudi Sarra<sup>1</sup>, Kebaili Safa<sup>3</sup> and Halouani Sonia<sup>4</sup>

<sup>1</sup>Higher Institute of Agricultural Sciences, Chott Meriem 4042. Sousse University, Tunisia

<sup>2</sup>Laboratory of Organic Structural Chemistry, Faculty of Sciences 2092, Tunis El Manar University, Tunisia

<sup>3</sup>Department of Animal Sciences. Higher Institute of Agricultural Sciences, Chott Meriem 4042, Sousse University, Tunisia

<sup>4</sup>Technical Center of Organic Agriculture. Chott Meriem 4042, Sousse,

## Abstract

The effect of *Rosmarinus officinalis* leaves' powder (ROP) on the antioxidative potential and quality of breast meat from broilers conducted in organic system was investigated. Two dietary treatments were received by 100 broilers (male and female) until 35 days of age, the control (commercial biological diet) and the experimental assay supplemented with 0.25% of ROP.

The total phenolic content (TPC) in the breast meat was quantified with folin-Ciocalteu method, the antioxidative potential was evaluated by the DPPH radical scavenging assay. A sensory analysis was conducted with an analytic assay based on intensity determination of color, odor, taste, chewiness, juiciness and global appreciation. Statistical analysis showed that the TPC, DPPH inhibition percentage and sensory quality were not significantly affected ( $P > 0.05$ ) by dietary treatment.

A storage assay was fulfilled during five days at 4°C to assess the oxidative and microbiological stability of the broilers breast meat. Results showed that the dietary ROP treatment was associated with a slight antimicrobial activity, a decrease of enumerated germs was observed ( $P < 0.05$ ) as well as an oxidative stability was detected; the TBARs values variation was reduced ( $P < 0.05$ ) on the experimental assay.

In conclusion, 0.25 % dietary supplementation of ROP improved significantly the oxidative stability of broilers meat and microbiological quality. Furthermore, it can slightly affect nutritional and functional qualities of broiler meat. Higher feed levels' inclusion

of ROP should be tested to investigate their effects on broiler meat quality.

**Keywords:** *Organic broiler meat, rosemary powder, antioxidative potential, oxidative stability, microbiological quality, sensory quality.*

## **Introduction**

Production of safe and high quality meat and meat products along with recent consumer's demand for all-natural and clean-label is challenging (Jayasena and JO, 2013). A significant level of spoilage of meat and meat products takes place at different levels of the production chain including the preparation, storage, and distribution. Besides lipid oxidation and autolytic enzymatic spoilage, microbial spoilage plays a significant role in this deterioration process leading to a substantial economic and environmental impact (Jayasena and JO, 2013). An alternative strategy to inhibit meat oxidation involves increasing the level of endogenous antioxidants through diet. Endogenous antioxidants are metabolized and deposited in muscle, especially tissue membranes in which their antioxidant actions are more effective (Nieto et al., 2011). Many of medicinal plants containing phytochemical feed additives have been considered as potential alternatives to antibiotics in poultry production. They are reported to contain aromatic properties that have an impact on gut micro-flora, nutrient digestibility, intestinal morphology and meat quality of poultry. The bioactive compounds which are often called phytochemicals or botanicals are secondary metabolites in medicinal plants with positive effects on animal health and productivity (Ghazaghi et al., 2014; Nkukwana et al., 2014).

Among medicinal plants, *Rosmarinus officinalis*, contains secondary metabolites with antioxidant and microbial activities (Türk et al., 2016) has been reported to improve refrigerated raw and cooked meat qualities (Nieto et al., 2011).

The present research considered the effects of herbal powder of *R. officinalis* leaves on the antioxidative potential, sensory quality, microbial population, and oxidative stability of broilers meat.

## **Materials and Methods**

### ***Animals and diet***

The experimental processing of this research was approved by the Agricultural Training Center (CFPA-Souassi) with the collaboration of the Technical Center of Organic Agriculture (CTAB) and the

Higher Institute of Agricultural Sciences (ISA) of Chott Meriem in Tunisia. A total number of 100 one-day-old Hubbard JV chicks were allotted in two homogenous groups: control (basal diet without ROP) and experimental (basal diet +0.25% ROP). Each lot is divided into 6 pens of 8 birds.

#### ***Total phenolic content and antioxidant potential of breast meat***

Phenolic extract was prepared from breast fillets (3 g) as described by Jung et al., 2010. The obtained supernatant was used for the measurement of total phenolic content using Folin-Ciocalteu reagent and 1,1-diphenyl-2-picrylhydrazyl (DPPH) was used for radical scavenging activity (Jung et al., 2010).

#### ***Sensory analysis***

A panel of 30 persons was invited to evaluate the sensory quality of broilers meat. Each taster must give a note from 1 to 10 for color, odor taste, after taste, chewiness, juiciness and global appreciation.

#### ***Broilers meat quality during storage***

Breast meat kept at refrigeration temperature (+4°C) for five days, pH color parameters oxidative stability and microbial population were evaluated at initial and final storage time.

#### ***pH***

pH values were measured according Triki et al., 2013.

#### ***Color parameters***

L\*, a\* and b\* Color parameters were evaluated using a chroma meter apparatus Minolta type CR-410.

#### ***Analysis of oxidative stability (thiobarbituric acid-reactive substances)***

Lipid oxidation was expressed as thiobarbituric acid-reactive substances “TBARs” (mg MDA kg<sup>-1</sup>), as determined by Erkan and Ozden 2008.

#### ***Microbiological analysis***

Plate Count Agar (PCA) and Milky medium bile with crystal violet and neutral red (VRBL agar) were used for the enumeration of the total aerobic bacteria and fecal and total coliform respectively.

#### ***Statistic analysis***

Analysis of variance was performed using the raw data, and the mean values and standard errors of the means were calculated by the Statistical Analysis System (SAS, 1990). Differences among the means were determined by the “Tukey” test with a significance defined at P<0.05.

## Results and discussion

### *Total phenolic content, antioxidant potential of breast meat*

The obtained results of total phenolic content and antioxidant potential of breast meat are displayed in table 1. No significant difference was found in the breast meat of the broilers fed either control or 0.25% ROP diets for DPPH and TPC ( $p>0.05$ ) which can be explained by the low dose of ROP supplementation used in this research.

**Table 1.** Total phenolic content, antioxidant potential of breast meat

Treatment	gender	Inhibition percentage of DPPH radical (%)	Total phenolic content (mg.g <sup>-1</sup> )
E	F	84.96 <sup>a</sup>	2.41 <sup>a</sup>
E	M	85.11 <sup>a</sup>	2.52 <sup>a</sup>
C	F	81.78 <sup>a</sup>	2.59 <sup>a</sup>
C	M	90.18 <sup>a</sup>	2.79 <sup>a</sup>
SEM		0.09	0.68

E: experimental; C: control; F: female; M: male

SEM: standard error of means (n=6)

<sup>a</sup> Means with the same superscript letter indicate non significant differences ( $P>0.05$ )

### *Sensory analysis*

Significant differences were observed for juiciness ( $p=0.02$ ) and global acceptability ( $p=0.009$ ) however all other sensory qualities were not affected. A previous research of Ghazalah and Ali, (2008) indicated that a 2% ROP supplementation affected negatively the sensory quality of broilers meat.

### *Broilers meat quality during storage*

#### *pH and color parameters*

The pH values of both control and experimental broilers meat showed no significant variation during refrigerated storage and the same observation was noticed for L\*,a\* and b\* color parameters ( $p>0.05$ ).

#### *Analysis of oxidative stability (thiobarbituric acid-reactive substances)*

A significant difference was recorded in MDA content variation between control and experimental broilers breast meat ( $p=0.01$ ) during storage. ROP supplementation improved the oxidative stability of broilers meat. This result is in agreement with Yesilbag et al., (2011) who confirmed that 0.5 and 0.75% ROP supplementation diet improved the oxidative stability of refrigerated meat. Reducing the meat oxidation can be explained by endogenous antioxidants through diet ((Nieto et al., 2011)

### *Microbiological analysis*

The enumeration result of bacterial population in broilers breast meat showed significant differences between initial and final analysis during storage, which was more apparent for the control. At the final storage day the total bacteria population was 3 times higher in the control lot likewise for fecal coliforms, those results are in agreement with Yesilbag *et al.*, (2011); Tolga *et al.*, (2015), who confirmed the positive effect of rosemary supplementation on microbiological stability of broilers meat.

### **Conclusion**

Results from the present study demonstrate that the 0.25% ROP supplementation improved the oxidative and microbiological stability of the breast meat from the broilers however sensory quality was not affected. A higher dose of ROP supplementation can be studied to further prove the beneficial effect of rosemary.

### **References**

- Erkan N., Özden, Ö. 2008. Quality assessment of whole and gutted sardines (*Sardina pilchardus*) stored in ice, *International Journal of Food Science & Technology*, 43, 1549-1559
- Ghazaghi M., Mehri M., Bagherzadeh-Kasmani F. 2014. Effects of dietary *Mentha spicata* on performance, bloodmetabolites, meat quality and microbial ecosystem of smallintestine in growing Japanese quail, *Animal Feed Science and Technology* 194, 89–98
- Ghazalah A.A., Ali A.M. 2008. Rosemary leaves as supplement for growth in broiler chickens. *Int. J. Poult. Sci.*, 7(3), 234-239
- Jayasena D. D. and JO C. 2013. Essential oils as potential antimicrobial agents in meat and meat products: A review, *Trends in Food Science & Technology*, 34, 96-108
- Jung S., Choe J. H., Kim B., Yun H., Kruk Z. A., Jo C.2010. Effect of dietary mixture of gallic acid and linoleic acid on antioxidative potential and quality of breast meat from broilers, *Meat Science* 86, 520–526
- Tolga, K., Ghassan I., Enver B.K., Beren B.K., Emek D. 2015. Effect of rosemary essential oil and modified atmosphere packaging (MAP) on meat quality and survival pathogens in poultry fillets, *Braz. J. Microbiol.* 46 (2), 591-599
- Nieto G., Estrada M., Jordan M. J., Garrido M. D., Banon S. 2011. Effects in ewe diet of rosemary by-product on lipid oxidation and the eating quality of cooked lamb under retail display conditions, *Food Chemistry*, 124, 1423–1429

- Nkukwana T.Ta, Muchenje V., Pieterse E., Masika P.J., Mabusela T.P., Hoffman L.C., Dzama K. Effect of *Moringa oleifera* leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens, *Live stock Science*, 161, 139–146
- Türk G., Çeribas A.O. , Simsek Ü.G., Çeribas S., Güvenç M., Kaya S.Ö., Çiftçi M., Sönmez M., Yüce A., Ali Bayrakdar A., Yaman M., Tonbak F. 2016. Dietary rosemary oil alleviates heat stress-induced structural and functional damage through lipid peroxidation in the testes of growing Japanese quail, *Animal Reproduction Science*, 164, 133–143
- Triki M., Herrero A.M., Colmenero F.J., Capillas C.R. 2013. Storage stability of low fat sodium reduced fresh merguez sausage prepared with olive oil in konjac gel matrix, *Meat Science*, 94, 438-446.
- Yesilbag D., Eren M., Agel H., Kovanlikaya A., Balci F. 2011. Effects of dietary rosemary, rosemary volatile and vitamin E on broiler performance, meat quality and serum SOD activity, *Br Poult Sci.*, 52(4):472-82

## **Attributes related to softness of breast meat from broilers affected by white striping myopathy<sup>a</sup>**

**Juliana Lolli Malagoli de Mello<sup>b</sup>, Rodrigo Alves de Souza<sup>b,c</sup>, Erika Nayara Freire Cavalcanti<sup>b</sup>, Aline Giampietro-Ganeco<sup>b</sup>, Rodrigo Fortunato de Oliveira<sup>b</sup>, Marcel Manente Boiago<sup>d</sup>, Pedro Alves de Souza<sup>b</sup>, Hirasilva Borba<sup>b</sup>**

<sup>a</sup>This study was financially supported by São Paulo Research Foundation (FAPESP, 2015/08471-8 and 2015/14584-0).

<sup>b</sup>Department of Technology. São Paulo State University. Jaboticabal. SP. Brazil.

<sup>c</sup>School of Animal Science and Food Engineering. University of São Paulo. Pirassununga. SP. Brazil.

<sup>d</sup>Department of Animal Science. University of State of Santa Catarina. UDESC. Chapecó. SC. Brazil.

### **Abstract**

The Brazilian poultry industry knows little about the myopathies that affect chicken carcasses produced and marketed in/from Brazil, which is the world's largest exporter and the second largest producer of chicken meat. We studied some characteristics related to softness of breast meat from Cobb 500, Ross AP95 and Hubbard chickens affected by white striping. White striping myopathy directly influences the variables that make up the breast meat softness and affects them differently depending on the broiler lineage. The occurrence of myopathy results in greater cooking loss and increased concentration of some types of collagen.

**Keywords:** *collagen, growth, meat quality, muscle disease, tenderness*

### **Introduction**

The Brazilian poultry industry knows little about the myopathies that affect chicken carcasses produced and marketed in Brazil, as well as people responsible for quality control and sanitary inspection in the slaughterhouses have no information on the occurrence and characterization of these myopathies, to be able to classify and separate the carcasses from those that are within the quality standards. Lesions caused in the breast muscle by White Striping myopathy, for example, can potentially affect consumer acceptance and intent to buy. If we consider that Brazil is the world's largest exporter (4.4 million tons) and the second largest producer (12.9 million tons) of chicken meat (ABPA, 2017), the financial loss may be incalculable if

are not identified the real causes and consequences of this problem. In this way, this study aimed to evaluate some characteristics related to breast meat softness from broiler chickens of three different lineages, raised and slaughtered in Brazil, affected by different degrees of severity of white striping myopathy.

## **Materials and Methods**

This research was developed at the Laboratory of Animal Products Technology of the Faculty of Agricultural and Veterinary Sciences at UNESP, Jaboticabal Campus, São Paulo, Brazil (21°08'S, 48°11'W, 583 m altitude).

### **Sample collection and preparation**

Were used 180 breast samples from Cobb 500 (n=60), Ross AP95 (n=60) and Hubbard (n=60) broilers, slaughtered at 42 days of age. Carcasses were acquired from commercial slaughterhouses (São Paulo, SP, Brazil) inspected by the Brazilian Federal Inspection Service. Samples were classified at the slaughterhouse, after skin removal, according to the severity of the apparent stripes on the muscle surface as: normal - absence of stripe; moderate - stripe thickness less than 1 mm; severe - stripe thickness greater than 1 mm, easily visible on the surface of the muscle (Kuttappan *et al.*, 2012a). Birds were slaughtered according to the slaughter plant routine and transferred to the laboratory in a refrigerated vehicle for cold-chain maintenance. After completion of *rigor mortis* (4 h after slaughter), each breast was manually deboned for obtaining the samples of the *pectoralis major* muscle from both sides of the breast.

### **Methods**

To determine cooking loss in *pectoralis major* samples, we used the method described by Honikel (1987). Samples with a minimum thickness of 3 cm and weighing 80 g, on average, were identified, weighed (initial weight), packaged in plastic bags (without vacuum) and cooked in a water bath (85° C) for 30 min. After cooking, samples were removed from the packages, dried with absorbent paper and weighed again (after cooling; final weight) to determine cooking loss, expressed in percentage terms, according to the following calculation:  $100 - (\text{Final weight} \times 100 / \text{Initial weight})$ . Three sub-samples with a cross-sectional area of 1 cm<sup>2</sup> and 3 cm in length were taken from each previously cooked sample, positioned with the fibers oriented perpendicularly, and subjected to three cuts in a Warner-Bratzler device (HDP/BSW Warner-Bratzler, 5 mm/s crosshead speed)

attached to a TA-XT2i Texture Analyzer (Stable Micro Systems, Ltd, Godalming, UK) (Lyon *et al.*, 1998). The force necessary to shear the samples was expressed in Newton (N). The concentrations of total collagen, thermosoluble collagen and insoluble collagen were quantified by the determination of hydroxyproline amino acid concentration, according to the methods proposed by Woessner Junior (1961) and Cross *et al.* (1973) and adapted by the Laboratory of Protein Biochemistry of the São Paulo State University - UNESP, Botucatu Campus, São Paulo, Brazil. Five grams of frozen raw meat were placed in falcon tubes (50 mL) containing 20 mL of distilled water. The tubes were taken in a water bath (80 °C) for two hours. Subsequently the samples were homogenized in UltraTurrax at 22,000 rpm for 1 minute and centrifuged at 4,000 rpm for 15 minutes (centrifuge at room temperature). Samples were transferred to autoclavable tubes, separating the sediment (solid fraction) from the filtrate (liquid fraction). To the filtrate was added 30 mL of 6N HCl and to the supernatant was added 50 mL of 6N HCl (Woessner Junior, 1961). The samples were hydrolyzed in an autoclave for 4 hours (120 °C, 1 atm) (Cross *et al.*, 1973). After hydrolysis, the pH of all samples was adjusted to 6.0 using 2N NaOH. Dilutions of sediment and filtrate were made. Subsequently, 2 mL aliquots of sediment and filtrate were pipetted into duplicate to which 1 mL of oxidation reagent and 1 mL of color reagent were added. To conclude, samples were kept in a water bath for 15 min at 60 °C. The readings were performed in a spectrophotometer with a wavelength set at 560 nm. Results for thermosoluble collagen concentration were obtained through the filtrate samples and results for insoluble collagen concentration were obtained through the sediment samples. The collagen concentration was estimated to be 7.14 times the hydroxyproline concentration.

### **Statistical analyses**

Results were analyzed using a completely randomized design comparing three severity degrees of white striping myopathy and 20 replicates (normal – n = 20, moderate – n = 20, severe – n = 20) for each studied lineage (Cobb 500, Ross AP95 and Hubbard). Results were analyzed by the one-way ANOVA procedure of SAS (SAS Institute Inc. 2002–2003). All data were subjected to analysis of variance and compared by Tukey's test with significance defined at  $P < 0.05$ .

## Results and Discussion

There was significant difference between white striping (WS) degrees regarding to cooking loss, shear force and collagen concentration of breast meat from Cobb 500 broiler chickens (Table 1). As the occurrence of myopathy became more severe, there was an increase in cooking loss ( $P < 0.0001$ ). Although samples affected by the severe degree of myopathy showed greater cooking loss ( $P < 0.0001$ ) and higher concentration of collagen ( $P \leq 0.0001$ ), the results for the shear force analyzes showed that meat affected by the severe degree of WS was more soft than the others, probably due to the higher concentration of thermosoluble collagen.

Related to breast meat from Ross AP95 broiler chickens, it was observed that there was no difference ( $P > 0.05$ ) between the WS levels in relation to the concentrations of total collagen and insoluble collagen (Table 2). Samples affected by the severe degree of WS showed higher cooking loss ( $P < 0.0001$ ), higher thermosoluble collagen concentration ( $P = 0.0001$ ) and higher softness ( $P = 0.0156$ ) as well as the samples from Cobb 500 broilers.

White striping myopathy did not influence ( $P > 0.05$ ) cooking loss, softness and total collagen concentration of breast meat from Hubbard broiler chickens (Table 3). Meat classified as severe WS showed lower ( $P < 0.0001$ ) thermosoluble collagen concentration, different of samples from Ross AP95, and higher ( $P = 0.0002$ ) insoluble collagen concentration.

The study of the characteristics of breast meat affected by WS showed that, besides the appearance, important technological characteristics for processing are also altered, which could be associated with compromised protein functionality (Petracci *et al.*, 2013). White striping myopathy could possibly be associated with some kind of degeneration, similar to muscular dystrophies (Petracci *et al.*, 2013; Kuttappan *et al.*, 2012b), that could result in decreased actin and myosin, for example, and would result in lower water holding capacity (Petracci *et al.*, 2013). So, it could be explained the result obtained in this research, which evidenced an increase in cooking loss and increased softness in meat from broilers of two strains, as the WS severity increased. We highlight that part of our research in Brazil is intended for histological analysis of affected muscles for investigation and confirmation of the real causes and consequences of myopathy.

Table 1. Mean values cooking loss (CL), shear force (SF) and collagen of breast meat from Cobb 500 broiler chickens affected by different degrees of white striping myopathy (WS).

WS (n=20)	CL (%)	SF Warner- Bratzler (N)	Collagen (%)		
			Total	Thermosoluble	Insoluble
Normal	20.98 B	23.68 A	0.19 C	0.11 B	0.08 B
Moderate	21.74 B	22.98 AB	0.31 B	0.13 B	0.18 A
Severe	27.71 A	18.65 B	0.37 A	0.16 A	0.21 A
P-value	<0.0001	0.0156	<0.0001	0.0001	<0.0001

<sup>A,C</sup>Means in the same column followed by different letters are significantly different by Tukey's test ( $P < 0.05$ )

Table 2. Mean values cooking loss (CL), shear force (SF) and collagen of breast meat from Ross AP95 broiler chickens affected by different degrees of white striping myopathy (WS).

WS (n=20)	CL (%)	SF Warner- Bratzler (N)	Collagen (%)		
			Total	Thermosoluble	Insoluble
Normal	21.68 B	23.19 AB	0.33	0.15 B	0.18
Moderate	21.28 B	28.05 A	0.36	0.15 B	0.21
Severe	24.91 A	22.33 B	0.37	0.19 A	0.17
P-value	0.0240	0.0272	0.5695	0.0130	0.2945

<sup>A,B</sup>Means in the same column followed by different letters are significantly different by Tukey's test ( $P < 0.05$ )

Table 3. Mean values cooking loss (CL), shear force (SF) and collagen of breast meat from Hubbard broiler chickens affected by different degrees of white striping myopathy (WS).

WS (n=20)	CL (%)	SF Warner- Bratzler (N)	Collagen (%)		
			Total	Thermosoluble	Insoluble
Normal	24.22	21.43	0.24	0.17 A	0.07 C
Moderate	27.89	22.53	0.28	0.18 A	0.11 B
Severe	23.16	19.56	0.25	0.10 B	0.15 A
P-value	0.0917	0.3738	0.0744	<0.0001	0.0002

<sup>A,C</sup>Means in the same column followed by different letters are significantly different by Tukey's test ( $P < 0.05$ )

## Conclusion

White striping myopathy directly influences the variables that make up the breast meat softness and affects them differently depending on the broiler lineage. The occurrence of myopathy results in greater cooking loss and softness and increased concentration of some types of collagen.

## References

- ABPA. Brazilian Association of Animal Protein (2017) Annual report (2017). Available at <[http://abpa-br.com.br/storage/files/final\\_abpa\\_relatorio\\_anual\\_2017\\_ingles\\_web.pdf](http://abpa-br.com.br/storage/files/final_abpa_relatorio_anual_2017_ingles_web.pdf)> [Verified 12 January 2018].
- CROSS, H.R., CARPENTER, Z.L. and SMITH, G.C. (1973) Effects of intramuscular collagen and elastin on bovine muscle tenderness. *Journal of Food Science* 38: 998-1003.
- HONIKEL, K.O. (1987) The water binding of meat. *Fleischwirtsch* 67: 1098-1102.
- KUTTAPPAN, V., BREWER, V., APPLE, J., WALDROUP, P. and OWENS, C. (2012a) Influence of growth rate on the occurrence of white striping in broiler breast fillets. *Poultry Science* 91: 2677-2685.
- KUTTAPPAN, V.A., GOODGAME, S.D., BRADLEY, C.D., MAUROMOUSTAKOS, A., HARGIS, B.M., WALDROUP, P.W. and OWENS, C.M. (2012) Effect of different levels of dietary vitamin E (dl- $\alpha$ -tocopherol acetate) on the occurrence of various degrees of white striping on broiler breast fillets. *Poultry Science* 91: 3230-3235.
- LYON, C.E., LYON, B.G. and DICKENS, J.A. (1998) Effects of carcass stimulation, deboning time, and marination on color and texture of broiler breast meat. *Journal of Applied Poultry Research* 7: 53-60.
- PETRACCI, M., MUDALAL, S., BONFIGLIO, A. AND CAVANI, C. (2013) Occurrence of white striping under commercial conditions and its impact on breast meat quality in broiler chickens. *Poultry Science* 92: 1670-1675.
- SAS INSTITUTE INC. (2002–2003) ‘SAS version 9.1.’ (SAS Institute Inc.: Cary, NC).
- WOESSNER JUNIOR, J.F. (1961) The determination of hydroxyproline in tissue and protein samples containing small proportions of this amino acid. *Archives of Biochemistry and Biophysics* 93: 440-447.

# The Effect of Production System and Slaughtering Age on Meat Quality of Guinea Fowls

Mehmet Akif Boz<sup>a</sup>, Umut Sami Yamak<sup>b</sup>, Musa Sarıca<sup>b</sup>, Fatih Öz<sup>c</sup>, Kadir Erensoy<sup>b</sup>

<sup>a</sup>Bozok University, Faculty of Agriculture, Department of Animal Science, Yozgat, Turkey

<sup>b</sup>Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun, Turkey

<sup>c</sup>Atatürk University Faculty of Agriculture, Department of Food Engineering, Erzurum, Turkey

## Abstract

In this study, the effect of production system and slaughtering age on the contents of breast and thigh meat nutrients and fatty acids of guinea fowls were determined. In intensive and free-range system, guinea fowls (male-female mixed) were used as animal material reared for 14, 16, 18 weeks in the study. C16, C18, C22:1n9 and total saturated fatty acids ratio in breast meat; C18:1n9c, C20:1 and total unsaturated fatty acids ratio in thigh meat in free-range system; whereas n9 was found higher in close system. C20:1 at 16 weeks of age, C22:1n9 and n3 were determined higher at 18 weeks of age in thigh meat. As a result of the effect of age and production system on breast and thigh meat quality traits of guinea fowls were found significant.

**Key words:** Guinea Fowl, Nutrient Content, Meat Quality, Fatty Acids

## Yetiştirme Sistemi ve Kesim Yaşının Beç Tavuklarının Et Kalitesi Üzerine Etkisi

### Özet

Bu çalışmada, yetiştirme sistemi ve kesim yaşının beç tavuklarının göğüs ve but eti besin madde ve yağ asitleri içeriği üzerine etkisi belirlenmiştir. Kapalı ve serbest gezinmeli sistemde 14, 16 ve 18 hafta yetiştirilen (erkek-dişi karışık) beç tavukları çalışmanın hayvan materyalini oluşturmuştur. Göğüs etinde C16, C18, C22:1n9 ve toplam doymuş yağ asitleri; serbest gezinmeli sistemde C18:1n9c, C20:1 ve toplam doymamış yağ asitleri oranı; kapalı sistemde ise n9 daha yüksek bulunmuştur. But etinde C20:1 16. haftada, C22:1n9 ve

n3 ise 18. haftada daha yüksek belirlenmiştir. Sonuç olarak; beç tavuklarının göğüs ve but etinde yaş ve yetiştirme sisteminin bazı et kalite özellikleri üzerine etkisinin önemli olduğu görülmüştür.

*Anahtar kelimeler: Beç tavuğu, besin madde içeriği, et kalitesi, yağ asitleri*

### **Introduction**

Guinea fowl is an essential animal for village poultry and lives in wild form in many African Countries (Champagne, 2003). In recent years it has begun to gain importance all over the world because it is an important alternative species that can be used in the developments of organic farming techniques (Sarica et al., 2003). While partly recognized in some parts of Asia and South America, guinea fowl production is very common in some European countries especially in France, Italy and Belgium (Champagne, 2003). This poultry species, which can be easily adapted to different climates, has developed lines of meat and eggs production in industrial production dimensions in Europe. These animals have maintained their characteristics such as rearing under different environmental conditions, reproducing and diseases resistant. They can be raised semi-intensively around the farm or village and low water requirements make up other advantageous. Guinea fowls are animals that respond to breeding positively, appropriate for organic production and important source of genes. These features demonstrate that the production of this animal can become widespread and requirement in the near future. In this study, some meat quality traits of guinea fowls reared in closed and free-range systems were determined until 14, 16 and 18 weeks of age.

### **Materials and Methods**

The material of the study was the skinless breast and thigh meat obtained from free-range and close systems (male and female mixed) guinea fowls reared for 14, 16 and 18 weeks. Analyzes were made on a total of 24 samples, 2 replicates of which were breast and thigh meat samples. Analyzes of nutrient and fatty acid contents were made according to Gökalp et al. (2010). The study was conducted according to the factorial trial plan (2 production systems, 3 slaughtering age, 2 replicates). In the evaluation of production system and slaughtering age datas were used variance analysis. The Duncan multiple comparison test was used to determine the differences between the averages (Özdamar, 2002).

## Results and Discussion

C16, C18, C22:1n9 and total saturated fatty acids ratio in breast meat; C18:1n9c, C20:1 and total unsaturated fatty acids ratio in thigh meat in free-range system; whereas n9 was found higher in close system ( $P < 0.05$ ). C20:1 at 16 weeks of age, C22:1n9 and n3 were determined higher at 18 weeks of age in thigh meat. The effects of the production system and slaughtering age on other meat quality traits were not found significant ( $P > 0.05$ ). In the close and free-range system, the breast meat dry matter ratio 26.52%-26.38%, the protein content was 22.26%-22.96%, the fat content ratio 0.24%-0.26% and the ash content ratio 1.06%-0.99% was determined respectively and in same order, the dry matter content of the thigh meat was 24.29%-24.62%, the protein ratio 20.10%-20.31%, the fat ratio 0.64%-0.67% and the ash ratio 0.92% -0.96%. The proportion of saturated fatty acids and total unsaturated fatty acids in breast and thigh meat were determined as 41.27%-45.41%, 58.73%- 54.59% in close system, 56.24%-44.63% and 43.76%-55.36% in free-range system, respectively. Higher total saturated fatty acids and lower total unsaturated fatty acids were found in this study compared with literature (Laudadio et al., 2012; Tejerina et al., 2009; Tlhong, 2008), while nutrient compositions were found similar with literature (Laudadio et al., 2012).

## Conclusion

The high proportion of saturated fatty acids in free-range systems is a negative result, because consumers tend to prefer products in this system. Feeding, production system and optimum environmental requirements and meat quality traits should be supported by more scientific studies. Since unsaturated fatty acids are high in the 16th and 18th weeks, it is thought that the slaughtering in these weeks will be better for optimum meat quality.

## References

- CHAMPAGNE, J. (2003) Evolution de la Filiere Pintade en France. *Journée Nationale Des Professionels de la Pintade*. ITAVI-CIP, Angers/France. 15 May, 1-14.
- GOKALP, H. Y., KAYA, M., TULEK, Y. and ZORBA, Ö. (2010) Et ve ürünlerinde kalite kontrolü ve laboratuvar uygulama kılavuzu. (V. Baskı), *Atatürk Üniv. Yayınları, Yayın No: 751, Ziraat Fak. Yayın No: 318, Ders Kitapları Seri No:69*, Atatürk Üniversitesi, Ofset Tesisi, Erzurum.

- LAUDADIO, V., NAHASHON, S.N. and TUFARELLI, V. (2012) Growth performance and carcass characteristics of guinea fowl broilers fed micronized-dehulled pea (*Pisum sativum* L.) as a substitute for soybean meal. *Poultry Science*, 91: 2988–2996. <http://dx.doi.org/10.3382/ps.2012-02473>
- ÖZDAMAR, K. (2002) Paket programlar ile istatistiksel veri analizi I., 4. baskı, *Kaan Kitabevi*, Eskişehir.
- SARICA, M., CAMCI, Ö. and SELÇUK, E. (2003) Bildircin, Sülün, Etçi Güvercin, Beç Tavuğu, ve Devekuşu Yetiştiriciliği. *Ondokuz Mayıs Üniv. Zir. Fak. Ders Kitabı*. 4. Baskı, Samsun.
- TEJERINA, D., LOPEZ-PARRA, M.M. and GARCIA-TORRES, S. (2009) Potential used of near infrared reflectance spectroscopy to predict meat physico-chemical composition of guinea fowl (*Numida meleagris*) reared under different production systems. *Food Chemistry*, 113: 1290–1296.
- TLHONG, T.M. (2008) Meat quality of raw and processed Guinea Fowl (*Numida meleagris*). *The master's thesis degree in consumer science at Stellenbosch University*.

# **Turi Duck Egg Quality In Kretek Sub District, Bantul Regency, Special Region Yogyakarta As Original Germplasm Of Indonesia**

**Fatah Nugroho<sup>a</sup>, Sukma Maharani<sup>a</sup>, Hanif Abdurrahman<sup>a</sup>,  
Abdurrahman Muhammad Fikri Rasdi<sup>b</sup>**

<sup>a</sup>Faculty of Veterinary Medicine, Universitas Gadjah Mada, Indonesia

<sup>b</sup>Faculty of Agriculture, Universitas Gadjah Mada, Indonesia

## **Abstract**

Turi duck is one of the potential germplasm of Bantul Regency. In addition to its high egg production, the characteristics of ducks that are not too large and its resistance to disease becomes its own attraction. This study aims to evaluate the condition of Turi Duck's breeding in Bantul District. The method used is direct survey to several turi duck farms. In addition quantitative data were collected through measurement of albumin index, yolk index, and Haugh Unit (HU) index value from duck samples taken from three randomly selected farms. The data is then processed by ANOVA analysis. The results of this study indicate that there is a significant difference ( $P < 0.05$ ) on the yolk index of each farm. In addition, the albumin and HU index values showed no significant difference ( $P > 0.05$ ). The conclusions show that there is an influence between the management of farms that are run with the quality of the eggs produced.

*Key words: Bantul Regency, Germplasm, Turi duck egg*

## **Introduction**

Eggs are one of the popular sources of protein in Indonesia because it is cheap and easy to be processed to various dishes. Eggs could be made as an appetizer, the main dishes, and the dessert dishes. There are three variations of eggs, which is commonly consumed by Indonesian such as chicken eggs, duck eggs, and quail eggs.

Duck eggs are known to have higher protein content than chicken eggs. It is considered to have better taste when cooked, although it tends to be fishier. Usually, duck eggs are sold more expensively than chicken eggs. All of the mentioned things before become the reason for the breeders to develop laying duck business. In Indonesia, the population of breeding duck increases by 0.04% per year with the production reached 308,550 tons of eggs by 2017 (Anonim, 2017).

Turi duck is one of the original germplasm in Bantul which is widely developed in the southern coastal area of Java Island. This type of duck is much preferred because the body is not too large, but its production is quite optimal (Wardhani, 2001; Dewanti, et al., 2009). Levels of duck growth rate are also considered good enough and resistant to some disease. However, the genetic potential of this genetic germplasm of Indonesia needs to get supported from the aspect of feed and the environment to maximize the production from the quality or quantity aspect.

Kretek subdistrict, Bantul regency, Yogyakarta, is one area with quite a lot of laying ducks. Patterns of maintenance in this area are closed cage pattern and open cage pattern with varied feeding. Different duck breeding systems also cause differences in the quality of the eggs produced. On the close cage pattern farm system, all its needs are met and served by breeders (Rasyaf, 1993). While on semi-intensive farms, ducks when released in the rice fields will find its own food without arranged by the farmer. (Susilorini et al., 2008) The number of ducks maintained ranges about 100-500 ducks per breeder with varying density. Some of these parameters are considered to affect the production and quality of duck eggs produced both internally and externally.

External egg quality can be done by organoleptic testing, which includes shape, color, smoothness, thickness, wholeness, and egg hygiene. Organoleptic testing uses a qualitative descriptive method. Meanwhile, the internal quality of the egg is measured through the Haugh Unit measurement limits, the egg yolk index, and the albumin index. (North and Bell, 1990) The specific characteristics of albumins are protein content (lysosomes) that contribute to the quality of albumins. When the egg is broken down on the glass, it is seen that the thick egg white attached to the yolk and cover all the surface of the yolk (Yuwanta, 2007). To determine the quality of albumins, criteria haugh unit is used. Haugh unit is the unit value of the albumin by calculating logarithmically to the height of the thick albumin and then transforming it into the correction value of the egg weight function (Yuwanta, 2007).

This study aims to determine the quality of Turi duck breeder eggs in Kretek subdistrict. The results of the research would be expected as the duck farm management evaluation, mainly to maximize this original germplasm of Indonesia.

## Materials and Methods

The materials used are duck eggs taken from three farms in Kecamatan Kretek, Bantul regency. The farms were randomly selected from several farms in Kretek sub-district, and the selected ones were Mr. Sutijo's farm (Farm A), Mr. Madiyo (Farm B), and Mr. Tuwal (Farm C). The tools used to assess the quality of eggs were the slide, the glass table, and the calculator.

Qualitative data was collected by conducting field observation, questionnaires, and direct interviews with turi duck breeders in Kretek Subdistrict, Bantul Regency, Yogyakarta. Meanwhile, quantitative data was collected by conducting external quality examination in the form of egg organoleptic test and egg quality examination in the form of egg freshness calculation (Haugh Unit / HU), egg yolk index calculation, and albumin index calculation.

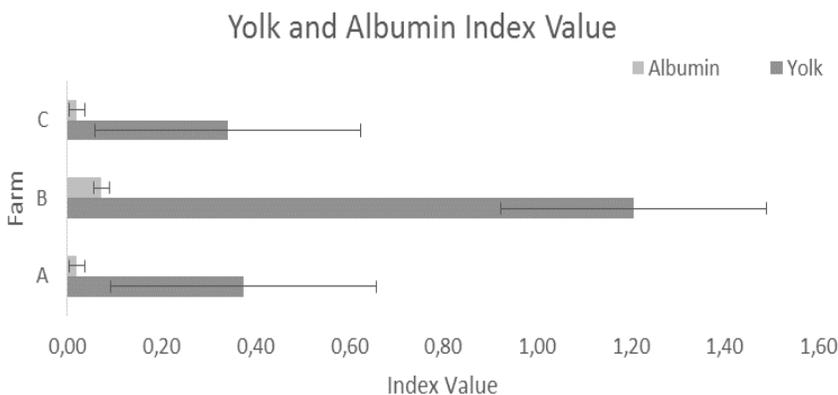
## Result and Discussion

The results of egg quality assessment based on yolk index parameters, albumin index are as listed in Table 1 and Figure 1. The highest yolk and albumin index values were obtained from eggs produced in Farm B. Similarly, the HU value of duck eggs produced by Farm B also had the highest value compared to other farms. The result of ANOVA analysis showed that there were significant differences ( $P < 0,05$ ) on the parameter of yolk between Farm B with Farm A and Farm C. Meanwhile, albumin index parameter and HU value were not significantly different ( $P > 0,05$ ).

**Table 1.** Average egg quality parameters taken from three farms in Bantul District

<i>Indice</i>	<i>Egg Quality Parameter</i>		
	Yolk Index *	Albumin Index	HU
Farm A	0,38±0,03 <sup>a</sup>	0,02±0,08	74,23±4,03
Farm B	1,21±0,03 <sup>b</sup>	0,07±0,01	77,59±11,19
Farm C	0,34±0,05 <sup>a</sup>	0,02±0,05	64,72±12,00

Information : \* Different notations in the same column show significant differences ( $P < 0.05$ )



**Figure 1. Diagram of egg quality parameter values taken at A farm, B farm, and farm C.**

The yolk index obtained differs significantly ( $P < 0.05$ ) and is in the range of 0.34 to 1.21 with the best index being the Farm B. Srigandono (1991) indicates that the normal duck egg index is in the range of 0.6 to 0.8 which means only Farm B whose index can be said to be normal. When viewed from several supporting parameters collected from interviews and fill questionnaires in general there are differences in management carried out on each farm such as feed composition and density of the cage. Farm B (owned by Mr. Madiyo), which has an average yolk index, albumin index, and HU is higher than that of other farmers, feeding the composition of bark: bran: concentrate of 2: 3: 1 and density ratio of 2.2. Meanwhile, on farm A (owned by Mr. Sutijo) with a cage density ratio of 5.6 is not given bran and a comparison of stems: the concentrate given is 2: 1. While on farm C (owned by Mr. Tuwal) has a cage density ratio of 2.2 and the feed given is factory feed (pellets) with additional bark: bran: concentrate 3: 1: 3. Differences in feed and different cage densities are likely to affect significant yolk index differences in the resulting eggs. The higher ratio of bran on the farm B is an indication of why the egg yolk index is also higher. In addition, other factors are quite influential also is the existence of sanitation management in the cage and vaccine on farm B although not yet periodically. As for the farm C given feed is commercial feed, according to Harmayanda et. al. (2016) may not

necessarily produce optimal egg quality as it depends on the quality of the feed itself.

The results of HU parameters and albumin index did not differ significantly ( $P > 0.05$ ) but it was generally seen that farm B was the highest value of the farm. HU value with good quality has a range of more than 72 (Alfiyah et al., 2015) which means only farm C with a value of HU 64.72 is still less quality. Meanwhile, the index value of albumin is quite low on farms A and C. According to Roesdiyanto et. al. (2001) that factors that also affect the egg index are the nation, production status, genetic, individual and group variations.

### **Conclusion**

Turi duck is a very potential source of genetic germplasm of Indonesia. The quality of egg production of Turi Duck in Kecamatan Kretek of Bantul Regency differs mainly from the yolk index because it is influenced by management which includes feed, cage, and health applied by farmers. Improvements in management such as balanced feeding of quality and quantity, density and vaccine considerations can improve the quality of eggs produced.

### **References**

- Alfiyah, Y., Praseno, K., Mardiyati, S.M. Indeks Kuning Telur (IKT) dan Haugh Unit (HU) Telur Itik Lokal dari Beberapa Tempat Budidaya Itik di Jawa. *Buletin Anatomi dan Fisiologi* Vol. XXIII, No. 2, pp. 7-15.
- Anonim. 2017. *Statistik Peternakan dan Kesehatan Hewan*. Direktorat Jenderal Peternakan dan Kesehatan Hewan Kementerian Pertanian.
- Dewanti, R., Sidadolog, J. H. P. and Zuprizal (2009) 'Pengaruh pejantan dan pakan terhadap pertumbuhan itik turi sampai umur delapan minggu', *Buletin Peternakan*, 33(2), pp. 88-95.
- Harmayanda, P.O.A., Rosyidi, D., Sjoftjan, O. 2016. Evaluasi Kualitas Telur Dari Hasil Pemberian Beberapa Jenis Pakan Komersial Ayam Petelur. *J-PAL*, Vol. 7, No. 1, pp. 25-32.
- North, M.O and D.D. Bell. 1990. *Commercial Chicken Production Manual Fourth Edition*. An Avi Book Published by Van Nostrand Reinhold, New York.
- Rasyaf, M. 1993. *Beternak Itik Komersial*. Edisi ke-2. Kanisius. Yogyakarta.
- Roesdiyanto, Rosidi, Suswoyo, I. 2001. Kualitas Telur Itik Tegal yang Dipelihara secara Intensif dengan Berbagai Tingkat Kombinasi Metionin-Lancang dalam Pakan. Lokakarya Nasional Unggas Air. Purwokerto: Universitas Jendral Soedirman, pp. 11-117.

- Srigandono, B . 1991 . *Unggas Air* . Gadjah Mada University Press . Yogyakarta .
- Susilorini T.E., Sawitri M. E dan Muharliien. 2008. *Budi Daya Ternak 22 Ternak Potensial*. Penebar Swadaya. Jakarta.
- Wardhani, N. K. (2001) 'Potensi Produksi Itik Turi Di Wilayah Pantai Selatan ( Production Potential of Turi Duck at South Coastal Area of Yogyakarta Special Province )', *Seminar Nasional Teknologi Peternakan dan Veteriner 2001*, pp. 655–660.
- Yuwanta, T. 2007. *Telur dan Produk Telur*. UGM Press. Yogyakarta.

# Effective Approaches to The Biofortification of Eggs With $\Omega$ -3 Polyunsaturated Fatty Acids, Selenium, And Vitamin E

Kavtarashvili A.Sh., Stefanova I.L., Svitkin V.S., Novotorov E.N.,  
Andrianova E.N.

<sup>a</sup>Federal Scientific Center “All-Russian Research and Technological Poultry Institute”  
of Russian Academy of Sciences; Ptitsegradskaya Str., 10, Sergiev Posad, Moscow  
Province, 141311 Russia

## Abstract

The possibility of biofortification of eggs with a complex of  $\omega$ -3 polyunsaturated fatty acids (PUFAs), inorganic and organic forms of selenium (Se) and vitamin E (VE) via supplementation of diets for laying hens without rise in feed costs was studied. It was found that the substitution of “DAFS-25” and sodium selenite for a half of dietary Sel-Plex® and organic VE (preparation “Fatty Acids”) for a synthetic form decrease feed cost by 0.2-1.2% in compare to control. Experimental treatments had better parameters of egg productivity and feed efficiency. The content of  $\omega$ -3 PUFAs (per 100 g of edible egg parts) in experimental groups was 3.4-5.0 times higher compared to control (with  $\omega$ -6/ $\omega$ -3 ratio 2.3-2.9:1 vs. 14.2:1 in control); Se 2.2-2.3 times higher, VE 2.0-2.8 times. The best results were found in the treatment fed a mixture of Sel-Plex® plus sodium selenite (1:1) as Se source, and preparation “Fatty Acids” as VE source.

**Keywords:** *laying hens, egg production, feed conversion ratio, biofortified eggs,  $\omega$ -3 polyunsaturated fatty acids, selenium, vitamin E.*

## Introduction

The improvement of functional nutritional value of table eggs can be limited by certain problems of health and well-being of hens fed diets supplemented with the target functional ingredients, and by the resulting production costs and consumer affordability of the functional eggs. Consumer prices of these functional eggs can be higher by 15-20% in compare to non-functional analogues [1]; this difference is primarily related to higher feed costs and can limit consumption of these eggs especially by low-income population segments [2].

The increased unsaturation of lipids (including increase in  $\omega$ -3 polyunsaturated fatty acids (PUFAs)) in diets for laying hens and

resulting increase in lipid unsaturation in liver and eggs decrease oxidative stability of the lipids. In the cases of feed and liver it can lead to the formation of toxic and/or harmful oxidation products subsequently transferred into eggs; in the case of eggs it can promote faster degradation of egg quality during storage or cooking [3].

Biofortification of eggs with  $\omega$ -3 PUFAs decreasing the oxidative stability of lipids, therefore, requires concurrent supplementation of diets for layers with antioxidants, selenium (Se) and vitamin E (VE) being the most effective antioxidant supplements [4, 5, 6]. The aim of the trial presented was to check the efficiency of concurrent supplementation of layer diets with  $\omega$ -3 PUFAs, Se, and VE (together with enzymatic preparation) for the production of functional eggs with high levels of these target nutrients, and to check these diets for cost efficiency and negative effects on egg quality, viability, productivity, and feed conversion ratio in layers.

### **Materials and Methods**

The possibility of biofortification of eggs with a complex of  $\omega$ -3 polyunsaturated fatty acids (PUFAs), inorganic and organic forms of selenium (Se) and vitamin E (VE) via dietary supplementation without rise in feed costs was studied on commercial “SP-789” layers (White Leghorn) kept in cage batteries in the Institute’s vivarium from 140 to 200 days of age (7 groups, 30 birds per group).

Control treatment 1 was fed standard commercial wheat-based diet (basic diet BD) containing wheat 57.2%, wheat bran 4.7%, soybean meal 10.36%, sunflower cake 8.56%, corn gluten 3%, sunflower oil 3%. The dietary contents of  $\omega$ -6 and  $\omega$ -3 PUFAs were 3.69 and 0.12%, respectively,  $\omega$ -6/ $\omega$ -3 ratio 30.8:1; VE content 10 ppm, Se 0.2 ppm (as sodium selenite). Treatments 2-4 were fed BD with the substitution of flaxseed oil for the sunflower oil (3%) and supplemented with flaxseed cake (5%). The contents of  $\omega$ -6 and  $\omega$ -3 PUFAs were 2.49 and 2.16%, respectively,  $\omega$ -6/ $\omega$ -3 ratio 1.15:1; VE content 150 ppm, Se 0.5 ppm. Treatments 5-7 were fed the same diet as groups 2-4 supplemented with “Fatty Acids” preparation (1.5%). The contents of  $\omega$ -6 and  $\omega$ -3 PUFAs were 2.50 and 2.23%, respectively,  $\omega$ -6/ $\omega$ -3 ratio 1.12:1; VE content 150 ppm, Se 0.5 ppm. In treatments 1-4 VE source was synthetic DL- $\alpha$ -tocoferylacetate, in treatments 5-7 preparation “Fatty Acids” (an organic form of VE as D- $\alpha$ -tocopherol). Se source in treatments 2 and 5 was Sel-Plex®, in treatments 3 and 6 Sel-Plex® + “DAFS-25” (1:1), in treatments 4 and 7 Sel-Plex® + sodium selenite (1:1). All diets were supplemented with enzyme preparation “Fecord” (100 ppm).

## Results and Discussion

The main results of the trial are presented in Table 1. Mortality in all treatments was 0%. The best egg production and egg mass output (per initial or average hen) during 60 days of the trial were found in treatment 7, higher by 2.4-10.1 and 3.0-13.2%, respectively, in compare to all other treatments. These parameters were the lowest on control treatment 1.

Table 1. Main results of the trial

Parameters	Treatments						
	1(c)	2	3	4	5	6	7
Mortality, %	0	0	0	0	0	0	0
Eggs per hen during the trial	46.5	48.6	49.0	49.2	49.6	50.0	51.2
Avg. egg weight, g	54.9	55.5	55.6	55.7	56.1	56.2	56.5
Egg mass laid, kg/hen	2.555	2.691	2.725	2.757	2.784	2.808	2.893
Feed expense, kg:							
per 10 eggs	1.44	1.38	1.37	1.37	1.39	1.37	1.33
per 1 kg of egg mass laid	2.62	2.50	2.46	2.45	2.47	2.44	2.36
Feed costs, rubles/t	14863	14965	14878	14855	14827	14711	14688
In 100 g of edible egg parts:							
Se, µg	27.1	61.1	61.2	60.3	61.5	59.3	60.9
Vitamin E, mg	3.10	6.16	7.04	7.95	8.19	8.59	8.82
ω-6 PUFAs, mg	2717	2385	2312	2445	1915	2035	2148
ω-3 PUFAs, mg	192	881	790	960	655	778	949
including ω-3 PUFAs:							
α-linolenic	77	618	502	581	400	490	544
eicosapentaenoic	11	25	19	26	15	19	20
docosapentaenoic	17	36	26	45	34	33	55
docosahexaenoic	87	202	243	308	206	236	330
ω-6/ω-3	14.2:1	2.7:1	2.9:1	2.5:1	2.9:1	2.6:1	2.3:1

The substitution of the organic VE form (preparation “Fatty Acids”) for the synthetic one (treatments 5-7) improved average egg weight by 0.6-0.8 g or 1.1-1.4%, the highest egg weight being found in treatment 7. The lowest egg weight was found in control (lower by 0.6-1.6 g or 1.1-2.8% in compare to all other treatments). The differences in egg weight between control treatment 1 and treatments 5-7 were significant ( $P < 0.05$ ).

The best feed conversion ratios per 10 eggs laid or per 1 kg of egg mass laid were found in treatment 7 (lower by 2.9-7.6 and 3.3-9.9% in compare to all other treatments), the worst was found in control.

The partial (50%) substitution of “DAFS-25” for Sel-Plex® in treatments 3 and 6 lowered feed cost by 87 and 116 rubles/t, or 0.58 and 0.78% in compare to treatments 2 and 5, respectively; similar substitution of sodium selenite for Sel-Plex® in treatments 4 and 7 lowered feed cost by 110 and 139 rubles/t, or 0.74 and 0.94%. The substitution of organic VE for the synthetic one in treatments 5-7 lowered feed cost by 67-138 rubles/t, or 0.92-1.12% in compare to treatments 2-4. The lowest feed cost was in treatment 7: lower by 175 rubles/t, or 1.18% in compare to control treatment 1 and by 23-277 rubles/t, or 0.16-1.85% in compare to treatments 2-6.

Se content per 100 g of edible egg parts in experimental treatments 2-7 was 2.2-2.3 times higher compared to control, VE content 2.0-2.8 times higher. Se content in eggs of all experimental treatments differed insignificantly. The highest VE content in eggs from layers fed synthetic VE was found in treatment 4, from layers fed organic VE in treatment 7. In these diets Se source was the mixture of Sel-Plex® and sodium selenite.

Average  $\omega$ -3 PUFAs content during the trial in eggs from experimental treatments 2-7 was 3.4-5.0 times higher in compare to control, including  $\alpha$ -linolenic – 5.2-8.0 times higher, eicosapentaenoic 1.4-2.4 times, docosapentaenoic 1.5-3.2 times, docosahexaenoic 2.3-3.8 times higher. The  $\omega$ -6/ $\omega$ -3 ratio in treatments 2-7 was 2.3-2.9:1 vs. 14.2:1 in control.

## Conclusions

The results of the trial proved high efficiency of concurrent biofortification of eggs with  $\omega$ -3 PUFAs and different sources of Se and VE. Experimental diets for layers were found to improve egg productivity, feed costs, and feed conversion ratios. The best results were found in treatment 7 fed a mixture of Sel-Plex® plus sodium selenite (1:1) as Se source, and preparation “Fatty Acids” as VE source.

## Acknowledgements

The study was financed by Russian Science Foundation, grant 16-16-04047.

## References

1. SIRÓI., KAPOLNA E., KAPOLNA B., LUGASI A. Functional food. Product development, marketing and consumer acceptance – A review. *Appetite*, (2008), 51:456-467. doi: 10.1016/j.appet.(2008).05.060

2. RODIĆ V., PERIĆ L., PAVLOVSKI Z., VLAHOVIĆ B. , (2010 ) Consumers' perception and attitudes towards table eggs from different housing systems: the case study from Serbia. Proc. XIII European Poultry Conf., Tour, France, August 23-27 (CD).
3. SCHEIDELER S.E., FRONING G.W. (1996) The combined influence of dietary flaxseed variety, level, form and storage conditions on egg production and composition among vitamin E-supplemented hens. *Poultry Sci.*, 75(10):1221–1226.
4. KAVTARASHVILI A.SH., STEFANOVA I.L., SVITKIN V.S., NOVOTOROV E.N. (2017) Functional egg production. I. The role of  $\omega$ -3 polyunsaturated fatty acids - A review. *Agricultural Biology* (Moscow), , 52(2):349-366. (doi: 10.15389/agrobiology.2017.2.349rus).
5. KAVTARASHVILI A.SH., STEFANOVA I.L., SVITKIN V.S., NOVOTOROV E.N. Functional egg production. II. The roles of selenium, zinc, and iodine - A review. *Agricultural Biology* (Moscow), 52(4):700-715. (doi: 10.15389/agrobiology.2017.4.700rus).
6. KAVTARASHVILI A.SH., NOVOTOROV E.N., STEFANOVA I.L., SVITKIN V.S.(2017) The effective technology of functional eggs. *Ptitsevodstvo* (Moscow), , No 2:6-10.

# Alterations in Proteins and Functional Characteristics of Chicken Breast and Thigh Meats with Microwave Cooking

Melike Taşkıran<sup>a</sup>, Emine Olum<sup>b</sup>, Kezban Candoğan<sup>b</sup>

<sup>a</sup>Ministry of Food, Agriculture and Livestock, Sakarya Directorate of Provincial Food Agriculture and Livestock, Department of Food and Feed, Sakarya, Turkey

<sup>b</sup>Ankara University, Faculty of Engineering, Department of Food Engineering, Ankara, Turkey. Corresponding author E-mail: candoğan@eng.ankara.edu.tr

## Abstract

Alterations in proteins and functional properties of chicken breast and thigh meats with microwave (MW) cooking were investigated when compared to electric oven (EO) cooking. There was a significant decrease in sarcoplasmic protein solubility of thigh meats with MW ( $p<0.05$ ) while for breast meats both methods resulted in reduction in sarcoplasmic and myofibrillar protein solubility ( $p<0.05$ ). In both thigh and breast meats, water holding capacity decreased with MW and EO cooking. In SDS-PAGE sarcoplasmic and myofibrillar protein profiles of chicken thigh and breast meats, decreases in the intensity of specific bands were observed after cooking with slightly more intense bands as a result of EO cooking than MW.

**Key Words:** Chicken meat, Microwave, Cooking, Proteins, Functional Properties, SDS-PAGE

## Mikroalgada Pişirilen Tavuk Etlerinin Sarkoplazmik ve Miyofibrillar Proteinlerindeki Değişimler

### Özet

Mikroalga (MD) ile pişirilen tavuk but ve göğüs eti proteinlerinde ve bazı fonksiyonel özelliklerde oluşan değişimler elektrikli fırında (EF) pişirmeye karşılaştırılarak belirlenmiştir. MD pişirme but etlerinde yalnızca sarkoplazmik protein çözünürlüğünde azalmaya ( $p<0.05$ ) neden olmuş, göğüs etlerinde ise her iki pişirme yöntemi sarkoplazmik, miyofibrillar ve toplam protein çözünürlüğünde önemli ölçüde ( $p<0.05$ ) azalmaya yol açmıştır ( $p<0.05$ ). EF ile pişirilen etlerde su tutma kapasitesi, MD ile pişirilenlere göre daha düşük olmuştur ( $p<0.05$ ). Pişirmeden sonra SDS-PAGE sarkoplazmik ve

miyofibrilar protein bantlarında azalmalarla birlikte, EF'nın MD'ye göre daha fazla bant yoğunluğu gözlenmiştir.

**Anahtar Kelimeler:** Tavuk eti, Mikroalga; Pişirme, Proteinler, Fonksiyonel özellikler, SDS-PAGE

### **Introduction**

The main purpose of cooking meats is to render them digestible, to enhance flavor, and to ensure microbiological safety (Tornberg 2005). Heat-induced changes in meat components, mainly in proteins and lipids influence yield, texture, color and flavor characteristics of muscle foods. The most important changes during thermal processing occur in muscle proteins which impact bioavailability, digestibility, and also water holding capacity, particularly due to thermal degradation of myofibrillar proteins and collagen shrinkage (Bircan and Barringer 2002, Bindu et al., 2004).

There are a number of conventional cooking methods such as grilling, frying, boiling and oven cooking applied to meats for decades that have some drawbacks such as high energy consumption, nonhomogeneous cooking with undesirable changes in physical, chemical and nutritional properties of the product (Khan et al. 2014). In order improve the quality, alternative energy efficient new approaches to cooking meat and meat products have been explored. Microwave cooking is one of these emerging heating techniques, which has advantages such as cooking time reduction and decrease in energy consumption. The purpose of the present study was to evaluate changes in proteins and functional properties of chicken breast and thigh meats after cooking by microwave or electric oven.

### **Materials and Methods**

Chicken thigh and breast meats were purchased from a local supermarket in Ankara, Turkey in different weeks for the three replications on the day cooking was conducted. Chicken thigh and breast meats were separately placed in plastic oven bags, tied with plastic tie, and placed in a tray to cook either in microwave or in electric oven. Electric oven cooking was performed at 200 °C for 20 min in pre-heated oven and microwave cooking at 180 W for 10 minutes. Proximate composition (moisture, protein, fat and ash contents) and the pH value were determined by standard AOAC methods (Anonymous, 2000). Cooking loss was evaluated by the method reported by Cong-Gui *et al.* (2006), and calculated as a percentage based on the initial weight. For water holding capacity, 15

g samples were placed into centrifuge tubes with absorbent cotton on the bottom, and centrifuged at 10780 rpm at 4°C for 30 min (Lorenzo et al. 2015). Water holding capacity was expressed as the ratio of centrifuged weight to the initial weight. Total, sarcoplasmic or myofibrillar protein solubility was determined by Bradford method as indicated by Warner et al. (1997). Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) for sarcoplasmic and myofibrillar protein profiles was performed according to the method by Laemmli (1970). Data from three replications were analyzed with analysis of variance procedure of SAS system 9 (SAS, 2002) and mean separation was conducted using Duncan's Multiple Comparison test at  $p < 0.05$ .

## Results

Microwave cooking did not exhibit any changes in moisture, protein and fat contents (data not shown) of chicken breast and thigh meats ( $p > 0.05$ ) in comparison to EO cooking. Breast meats cooked in MW possessed higher ash content than EO cooking ( $p < 0.05$ ). While both cooking methods did not affect pH value of breast meat ( $p > 0.05$ ), in thigh meat MW cooking increased pH value ( $p < 0.05$ ) when compared with raw meat.

For breast meats, protein solubility values decreased in both cooking methods (Table 1). In thigh meats, there was no significant difference in myofibrillar and total protein solubility values between the two cooking methods, whereas, MW cooking resulted in significantly lower sarcoplasmic protein solubility values in comparison to EO cooking ( $p < 0.05$ ).

Table 1. Protein solubility, cooking loss and water holding capacity values (%) of chicken thigh and breast meat cooked by EO and MW\*

G	SPS	MPS	TPS	CL	WHC
<b>BM</b>					
RM	6.63±0.58 <sup>a</sup>	8.25±1.05 <sup>a</sup>	14.89±0.56 <sup>a</sup>	-	89.13±1.94 <sup>a</sup>
EO	4.36±1.11 <sup>b</sup>	3.72±0.52 <sup>b</sup>	8.08±0.88 <sup>b</sup>	24.09±1.86 <sup>a</sup>	46.02±3.80 <sup>b</sup>
MW	2.75±0.25 <sup>b</sup>	5.54±0.80 <sup>b</sup>	8.30±0.73 <sup>b</sup>	23.83±1.01 <sup>a</sup>	46.86±1.88 <sup>b</sup>
<b>TM</b>					
RW	5.68±0.46 <sup>a</sup>	11.55±2.31 <sup>a</sup>	17.24±1.97 <sup>a</sup>	-	88.88±0.38 <sup>a</sup>
EO	5.28±0.55 <sup>a</sup>	11.14±3.02 <sup>a</sup>	16.43±2.85 <sup>a</sup>	30.83±1.57 <sup>a</sup>	31.86±2.10 <sup>c</sup>
MW	3.66±0.38 <sup>b</sup>	9.70±2.66 <sup>a</sup>	13.36±2.57 <sup>a</sup>	27.49±1.83 <sup>a</sup>	38.55±2.71 <sup>b</sup>

G: Groups, BM: Breast meat, RM: Raw material, TM: Thigh meat, SPS: Sarcoplasmic protein solubility, MPS: Myofibrillar protein solubility, TPS: Total protein solubility, CL: Cooking loss, WHC: Water holding capacity, \* Means±Standard error. <sup>a-b</sup>: For each attribute, means within a column (between groups in each meat type) not having a common superscript letter are statistically different ( $p < 0.05$ ).

Cooking loss was not affected by cooking methods ( $p>0.05$ ) for both thigh and breast meat (Table 1). Water holding capacity values of chicken thigh and breast meat decreased by cooking (Table 1). This decrease was much higher in EO cooking than that of MW in thigh meat ( $p<0.05$ ).

In SDS-PAGE sarcoplasmic and myofibrillar protein profiles, there were decreases in the intensity of specific bands after cooking with the two methods (Figure 1). Slightly more intense bands were observed as a result of electric oven cooking than microwave oven for both thigh and breast meats indicating that cooking with MW caused less denaturation in a group of proteins in comparison to EO cooking.

### Conclusions

Microwave heating is a time and energy efficient technique that can be replaced by conventional cooking techniques as an alternative. In the light of the findings obtained from the present study, microwave cooking could be recommended as a substitute for conventional electric oven cooking which favored functional properties without adversely affecting protein quality.

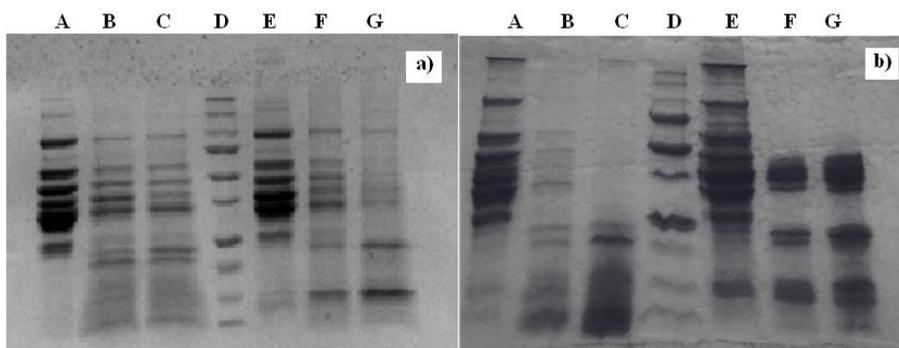


Figure 1. SDS-PAGE profile of sarcoplasmic (a) and myofibrillar (b) proteins. \*A: raw breast meat, B: MW cooked breast meat, C: EO cooked breast meat, D: Protein standard, E: Raw thigh meat, F: MW cooked thigh meat, G: EO cooked thigh meat

### References

- ANONYMOUS. 2000. *Official Methods of Analysis of Association of Official Chemists* (15 ed.). Arlington, VA: AOAC Inc.
- BINDU, J., GOPAL, T. K. S., & Nair, T. S. U. 2004. Ready-to-eat mussel meat processed in retort pouches for the retail and export market. *Packaging Technology and Science*, 17(3), 113-117.

- BIRCAN, C. and BARRINGER, S. (2002) Determination of protein denaturation of muscle foods using the dielectric properties. *Journal of Food Science*, 67(1), 202-204.
- CONG-GUI, C., GERELT, B., SHAO-TONG, J., NISHIUMI, T. and SUZUKI, A. (2006) Effects of high pressure on pH, water-binding capacity and textural properties of pork muscle gels containing various levels of sodium alginate. *Asian-Australasian Journal of Animal Sciences*, 19(11), 1658-1664.
- CHOUDHURY, S.D., HAINES, S., HARLAND, D., CLERENS, S., KOTEN, C. and DYER, J. (2014) Effect of cooking on meat proteins: mapping hydrothermal protein modification as a potential indicator of bioavailability. *J. Agriculture Food Chemistry*, 62, 8187-8196.
- KHAN, M.A., ALI, S., ABID, M., AHMAD, H., ZHANG, L., TUME, R.K. and ZHOUOU, G. (2014) Enhanced texture, yield and safety of a ready-to-eat salted duck meat product using a high pressure-heat process. *Innovative Food Science and Emerging Technologies*, 21, 50-57.
- LAEMMLI, U.K. (1970) Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature*, 227, 680-685.
- LORENZO, J.M., CITTADINI, A., MUNEKATA, P.E. and DOMÍNGUEZ, R. (2015) Physicochemical properties of foal meat as affected by cooking methods. *Meat Science*, 108, 50-54.
- TORNBERG, E. (2005) Effects of heat on meat proteins-implications on structure and quality of meat products. *Meat Science*, 70, 493-508.
- WARNER R. D., KAUFFMAN R. G. and GREASER M. L. (1997) Muscle protein changes post mortem quality traits relation to pork quality traits. *Meat Sci.* 45, 339-352.

# **A study on incorporation of sweet potato powder in model system turkey emulsions**

**Merve Karabıyıkoglu, Burcu Öztürk, Meltem Serdaroğlu**

Ege University Engineering Faculty Food Engineering Department Bornova  
Izmir

## **Abstract**

In this study, it was objected to investigate physical, chemical and technological quality characteristics of model system turkey meat emulsions formulated with different levels of sweet potato powder (SPP). Three different emulsions were formulated where turkey meat was replaced with SPP as 0% (C), 3% (P3) and 6% (P6). Incorporation of SPP resulted in decreased moisture and protein content. Increased levels of SPP caused decrements in pH values. Lightness and yellowness were decreased, while redness was increased by addition of SPP. Although P6 samples had the lowest expressible fluid, increased levels of SPP lead increment in expressible fat. Utilization of both levels of SPP was effective to increase cooking yield. It was concluded that utilization of SPP in model turkey emulsion systems had considerable changes in physical and chemical characteristics and improved emulsion features.

**Key words:** *model system meat emulsion, sweet potato powder, turkey meat*

## **Özet**

### **Model sistem hindi eti emülsiyonlarında tatlı patates tozu kullanımı üzerine bir araştırma**

Bu çalışmada, farklı oranlarda tatlı patates tozu (TPT) ile formüle edilen model sistem hindi eti emülsiyonlarının fiziksel, kimyasal ve teknolojik kalite karakteristiklerinin incelenmesi amaçlanmıştır. TPT, emülsiyonlarda et yerine %0 (C), %3 (P3) ve %6 (P6) oranında kullanılarak üç farklı formülasyon hazırlanmıştır. TPT kullanımı nem ve protein miktarının azalmasına neden olmuştur. Artan oranlarda TPT ilavesi pH değerlerini düşürmüştür. Formülasyonlara TPT ilavesi sonucunda emülsiyonlarda parlaklık ve sarılık değerlerinin düştüğü, kırmızılık değerlerinin ise yükseldiği tespit edilmiştir. En düşük

toplam ayrılan sıvı miktarı P6 örneklerinde ölçülmesine rağmen, artan miktarda TPT kullanımı toplam ayrılan yağ miktarını yükseltmiştir. TPT'nin her iki oranı da pişirme veriminin artması üzerinde etki göstermiştir. Sonuç olarak, model hindi eti emülsiyon sistemlerinde TPT kullanımı kimyasal ve fiziksel karakteristikler üzerinde önemli değişimlere neden olmuş ve emülsiyon özelliklerini geliştirmiştir.

## **Introduction**

Sweet potato (*Ipomoea batatas* L.), the seventh largest crop in the world, is an inexpensive and readily available vegetable that is becoming popular due to its unique nutritional and functional properties. Sweet potato is a vegetable that highly contains bioactive carbohydrates, proteins, lipids, carotenoids, anthocyanins, conjugated phenolic acids and minerals (Alotaibi and Tahergorabi, 2018; Luo et al., 2018; Wang et al., 2016). Since there is a strong evidence that high consumption of meat products is related to serious diseases, it is important to investigate the incorporation opportunities of healthier ingredients to develop healthier meat product formulations as well as to improve technological quality and to reduce costs. In this study, we aimed to determine the quality of model system turkey meat emulsions formulated with different levels of sweet potato powder (SPP) as meat replacers.

## **Materials and Methods**

Three different model system meat emulsions were produced by using 0% SPP (C), 3% SPP (P3) and 6% SPP (P6). Fresh boneless post-rigor turkey breast muscles and beef fat were minced through 3 mm plate. Minced meat was homogenized for 1 min by using a food processor (Thermomix, Spain). Beef fat, half of the ice, sodium chloride, sodium tripolyphosphate and sodium nitrite were then added and mixed for 1 min. SPP (for P3 and P6 treatments) and the rest of the ice were finally added and mixing was continued for 2 min. Emulsions were centrifuged at 3100 g force at 4°C for 1 min, heat-treated in 70°C for 30 min and cooled to room temperature. Samples were stored at 4°C prior to analysis. Total moisture and ash content was determined according to AOAC (2012), fat content was analyzed according to Flynn and Bramblett (1975), protein content was determined by an elemental analyzer (LECO, USA). pH value was measured by using a pH-meter with penetration electrode (WTW, Germany). Colour (L\*, a\*, b\*) was measured with a portable colorimeter (Konica Minolta,

CR-200, Japan). Emulsion stability (ES) as total expressible fluid (TEF) and expressible fat (EFAT) was analyzed according to Hughes et al. (1997). Cooking yield (CY) was calculated according to Murphy et al. (1975) by using the equation below:

$$CY (\%) = [(Cooked\ sample\ weight) / (Raw\ sample\ weight)] \times 100$$

Data was statistically analyzed by ANOVA and Duncan Post-Hoc tests using SPSS software.

## Results and Discussion

Chemical composition, pH values and colour parameters of model system turkey emulsions are presented in Table 1. Total moisture, protein, fat and ash content were between 70.81-73.98%, 13.50-15.19%, 9.55-11.29%, 1.66-1.78%, respectively. The highest moisture content was recorded in C samples, increased levels of SPP resulted in decreased moisture content ( $P<0.05$ ), which might be due to increment in dry matter. Use of SPP lead to decrement in protein content regardless of the added amount ( $P<0.05$ ). Although P6 samples had higher fat content than P3 samples ( $P<0.05$ ), both emulsions with SPP had similar fat content to C samples. Even so it was noted that fat content might increase with increased levels of SPP. P6 samples had higher ash values compared to C samples ( $P<0.05$ ), probably due to high mineral content of SPP. pH values of the samples were between 6.37-6.47, where C samples had the highest pH values among treatments and increased levels of SPP caused decrements in pH values ( $P<0.05$ ). Conversely, Verma et al. (2015) reported that pH value of cooked low-fat pork patties prepared with SPP was higher than control samples without SPP.  $L^*$ ,  $a^*$  and  $b^*$  values were between 57.08-76.75, 5.06-14.09 and -0.39-10.47, respectively. It was found that the highest  $L^*$  values were measured in C samples and emulsions became darker with increasing levels of SPP ( $P<0.05$ ). A significant increasing trend was recorded in  $a^*$  values with the use of SPP and a decreasing trend was detected in  $b^*$  values with increasing levels of SPP ( $P<0.05$ ). Colour results showed that incorporation of SPP in turkey meat systems resulted in considerable changes in visual quality. Verma et al. (2015) did not find any significant differences in lightness and redness values of pork patties formulated with SPP, but they reported that yellowness was increased with added SPP. The differences in our study could be attributed to the variances in the types and inclusion levels of SPP.

Table 1. Chemical composition, pH values and colour parameters of model system turkey emulsions

Treatments	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	pH	L*	a*	b*
C	73.98 <sup>a</sup> ±0.29	15.19 <sup>a</sup> ±0.52	9.86 <sup>ab</sup> ±0.06	1.66 <sup>b</sup> ±0.06	6.47 <sup>a</sup> ±0.01	76.75 <sup>a</sup> ±0.21	5.06 <sup>c</sup> ±0.10	10.47 <sup>a</sup> ±0.09
P3	72.22 <sup>b</sup> ±0.19	14.01 <sup>b</sup> ±0.64	9.55 <sup>b</sup> ±0.32	1.70 <sup>ab</sup> ±0.03	6.39 <sup>b</sup> ±0.00	63.09 <sup>b</sup> ±0.28	10.92 <sup>b</sup> ±0.21	1.73 <sup>b</sup> ±0.28
P6	70.81 <sup>c</sup> ±0.25	13.50 <sup>b</sup> ±0.14	11.29 <sup>a</sup> ±1.35	1.78 <sup>a</sup> ±0.03	6.37 <sup>c</sup> ±0.00	57.08 <sup>c</sup> ±0.59	14.09 <sup>a</sup> ±0.10	-0.39 <sup>c</sup> ±0.12

\*Data are presented as mean±standard deviation. a, b, c, ...: means with the different letters in the same column are significantly different ( $P<0.05$ ).

ES, in terms of TEF and EFAT, and CY of the samples are given in Figure 1. TEF and EFAT of the samples were between 4.16-6.17% and 6.68-9.80%, respectively. Although P3 samples had higher TEF compared to C samples, P6 samples had the lowest TEF among samples ( $P<0.05$ ). Thus it was showed that higher concentrations of SPP was effective to decrease fluid leakage and thereby increase emulsion stability in terms of water retention. On the other hand, the highest EFAT values were recorded in P6 samples ( $P<0.05$ ), which could be due to higher fat content of this group leading more fat loss during heat treatment. Previously, emulsion stability of low-fat pork patties was reported to increase in products formulated with SPP irrespective of the level of incorporation (Verma et al., 2015). CY of the samples were between 90.58-93.28%. Utilization of both ratios of SPP lead to significant increment in cooking yield of turkey emulsions ( $P<0.05$ ), which could be a result of the ability of dietary fibers in SPP to retain water upon cooking. Verma et al. (2015) reported that cooking yield was higher in pork patties produced with SPP than patties without SPP, which might be due to water holding capacity and water retention properties attributed to SPP. Muthia et al. (2010) reported no significant differences in cooking yield of duck sausages formulated with tapioca, wheat, sago or potato flours.

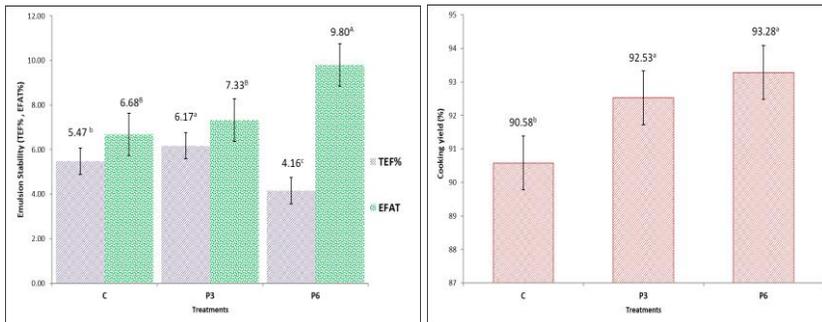


Figure 1. Emulsion stability and cooking yield of model system turkey emulsions

\* a, b, c /A, B, C,...: means with the different letters indicate significant difference ( $P < 0.05$ ).

## Conclusion and References

The results of the study indicated that chemical composition and pH values of model system turkey meat emulsions were highly affected by SPP incorporation. Depending on emulsion characteristics, it was concluded that use of 6% SPP was effective to decrease expressible fluid, however expressible fat was increased with increased levels of SPP. Therefore, strategies should be planned to determine the optimum amounts of SPP in meat emulsion systems to maintain overall stability. It was concluded that since colour parameters were highly affected by SPP inclusion, evaluation of sensory acceptability should be necessary for poultry products manufactured with SPP. Further study should be performed with different levels of SPP in formulation of various types of poultry products.

ALOTAIBI, S. and TAHERGORABI, R. (2018) Development of a sweet potato starch-based coating and its effect on quality attributes of shrimp during refrigerated storage. *LWT- Food Science and Technology*, 88: 203-209.

AOAC (2012) Official Methods of Analysis, 19th ed., Association of Official Analytical Chemists, Gaithersburg, MD, USA.

FLYNN, A.W. and BRAMBLETT, V.D. (1975) Effects of frozen storage, cooking method and muscle quality on attributes of pork loins. *Journal of Food Science*, 40: 631-633.

HUGHES, E., COFRADES, S. and TROY, D.J. (1997) Effects of fat level, oat fibre and carrageenan on frankfurters formulated with 5, 12 and 30% fat. *Meat Science*, 45: 273-281.

- LUO, C.L., ZHOU, Q., YANG, Z.W., WANG, R.D. and ZHANG, J.L. (2018) Evaluation of structure and bioprotective activity of key high molecular weight acylated anthocyanin compounds isolated from the purple sweet potato (*Ipomoea batatas* L. cultivar Eshu No.8). *Food Chemistry*, 242: 23-31.
- MURPHY, E.W., CRINER, P.E. and GREY, B.C. (1975) Comparison of methods for calculating retentions of nutrients in cooked foods. *Journal of Agricultural and Food Chemistry*, 23: 1153-1157.
- MUTHIA, D., NURUL, H. and NORAYATI, I. (2010) The effects of tapioca, wheat, sago and potato flours on the physicochemical and sensory properties of duck sausage. *International Food Research Journal*, 17: 877-884.
- VERMA, A.K., CHATLI, M.K., KUMAR, D., KUMAR, P. and MEHTA, N. (2015) Efficacy of sweet potato powder and added water as fat replacer on the quality attributes of low-fat pork patties. *Asian-Australasian Journal of Animal Sciences*, 28(2): 252-259.
- WANG, S., NIE, S. and ZHU, F. (2016) Chemical constituents and health effects of sweet potato. *Food Research International*, 89: 90-116.

# Proteomics Approach for Poultry Meat Quality Assessment

Esin alk, Kezban Candoęan

Ankara University, Faculty of Engineering, Department of Food Engineering, Ankara, Turkey

## Abstract

In the competitive poultry meat industry, maintaining meat quality is essential for the survival of producers as well as to guarantee consumer satisfaction. Proteomics has emerged as a robust and reliable tool in meat quality assessment which could give information about the structures and functions of proteins involved in several mechanisms that play important role in determining quality of the product. Proteome analyses to evaluate biochemical basis of poultry meat color, water-holding capacity, and texture traits, proteome based characterization of meat quality defects, and the proteome profiles for meat authentication for species identification are emphasized in this study.

**Keywords:** *Proteomics, Poultry meat, PSE, Woody breast, Authenticity testing*

## Özet

Kanatlı et endüstrisinde iyi kalitede et temini, üretici ve tüketici memnuniyeti açısından büyük önem taşır. Proteomik, son ürünün kalite özelliklerinin belirlenmesinde önemli rol oynayan ve birçok biyokimyasal mekanizmada yer alan proteinlerin yapıları ve fonksiyonları hakkında bilgi sağlayan, et kalitesinin değerlendirilmesinde güvenilir bir yöntem olarak ortaya çıkmıştır. Bu çalışmada, kanatlı etlerinin renk, su tutma kapasitesi, tekstür gibi özelliklerinin biyokimyasal yönden incelenmesinde proteom analizlerin kullanımı, kanatlı et kalite kusurlarının proteom esaslı karakterizasyonu ve farklı et türlerine yönelik et gerçeklik tayininde proteom profillerinin önemi gibi konular irdelenmiştir.

**Anahtar kelimeler:** *Proteomik, Kanatlı eti, PSE, Odunsu göęüs eti, Gerçeklik tayini*

## **Introduction**

Proteomics can be defined as the large scale study of a proteome expressed from a genome (Arihara, 2013). It is considered revolutionary since, unlike traditional biochemical methods, it can analyze hundreds of proteins at once (Hollung et al. 2007). The proteome which indicates all proteins in a certain place and at a specified time is analyzed to obtain data on structures and functions of these proteins, and is interpreted as the molecular bound between functional quality characteristics of the meat and the genome (Remignon et al. 2006). A bottom-up or peptide-based approach, is the most common one used in proteomics. In this approach, proteins are separated according to their molecular weight and isoelectric point by a 2-DE gel-based approach. The proteins of interest are then identified in order to get a protein mass finger print via Mass spectrometer as MALDI-TOF (Matrix-Assisted Laser Desorption Ionization Time-of-Flight) or ESI-MS (Electro spray Ionization / Mass Spectrometry) Technologies (Remignon et al. 2006, Gallardo et al. 2013, Schilling et al. 2017). In meats, the relationship between several quality characteristics and the muscle proteome has been elucidated by using these new methods (Schilling et al. 2017). In this review, proteomic tools applied in poultry research to evaluate the biochemical basis of meat quality characteristics such as color, water-holding capacity and texture; proteome based characterization of PSE meats; analysis of poultry breast myopathies such as woody breast meat; and the proteome profile for meat authentication for species identification are highlighted.

## **Evaluation of the biochemical basis of meat quality parameters by proteomics**

There have been several studies on utilization of proteomics approach for evaluation of meat quality characteristics such as color, water-holding capacity, and texture, in beef, lamb and pork; however, in poultry, research, analyzing the relationship between proteome changes and quality traits is scarce (Schilling et al. 2017). Mollet et al. (2005) studied the relationship between meat quality traits and protein changes of fast glycolyzing and normal glycolyzing turkey breast meats pointing out the importance of proteome in distinguishing meat quality characteristics such as yield, texture, drip, thaw and cook loss. In another study, Mekchay et al. (2010) investigated association of tenderness with protein markers of Thai native and commercial broiler chicken meats by analyzing the proteome of the muscle with high and low-shear force values with 2D- gel electrophoresis and MALDI-

TOF/MS, and noted that enzymes of the glycolytic pathway such as pyruvate kinase, triose phosphate isomerase and phosphoglycerate mutase were associated with tenderness. There is no research directed to the proteomic approach in evaluating color in poultry meats.

### **Proteomic analysis of pale, soft, and exudative (PSE) and woody breast meats incidence in poultry**

Biochemical pathways and mechanisms for the PSE and woody breast meats have been investigated with the use of proteomics approach (Schilling et al. 2017). Desai et al. (2016) determined muscle proteome in normal and PSE-like broiler chicken to characterize proteome basis of PSE by evaluating whole muscle proteome. In the whole muscle proteome profiling, proteome abundance differed between normal and PSE-like breast meats which could be related to the quality differences between the samples. Xing et al (2017) studied the alterations in protein profiles of PSE like breast meats during transportation under high-temperature conditions, and reported that there were proteomic variations in breast meats with severe stress suggesting that the proteins involved in glycolysis pathway, calcium signaling, and molecular chaperones could have an impact on the post-mortem meat quality development. Another defect in poultry breast meats, WB has also been examined based on biochemical and proteomic differences. In a recent study, Cai et al. (2017) characterized muscle proteome profiles of woody and normal broiler breast meats indicating a higher oxidative stress and a lower the abundance of some glycolytic enzymes, important in the regeneration of ATP in postmortem muscles, in woody breast meat than normal meat. The need for proteomic and genomic analysis for elucidating biochemical pathways related to PSE and WB incidences to prevent these defects and to improve quality was emphasized in all of the recent studies.

### **Testing the authenticity of poultry meats using proteomics**

Proteomic based methods have been applied in detecting different meat species in meat mixtures. Sentandreu et al. (2010) developed a simple robust procedure for detection of chicken meat in mixed meats. Orduna et al. (2017) conducted a systematic proteogenomic-based in-silico analysis to determine meat species adulteration, and identified a species-specific tryptic peptide mass lists and theoretical MS/MS spectra suggesting that the four proteotypic peptides could be successfully used discriminating meat species including chicken. Potential markers such as hemoglobin subunits and the ones similar to

myosin-binding protein C were also determined to identify mechanically deboned chicken meat for possible use in detecting these low-cost meat material in processed meat based on key proteins (Surowiec et al. 2011). Another important issue in food authenticity is halal meat authentication. Salwani et al. (2016) investigated the differences in quality characteristics and proteome profile of broiler breast meats exposed to halal slaughtering (slaughtering without stunning) and gas stun-to-kill prior to neck cut. Gas stunning triggered the expression of beta-enolase, pyruvate kinase and creatine kinase as compared to slaughtering without stunning.

### **Conclusions**

Proteomics is a promising approach in identifying poultry meat defects and authenticating meat products. The information obtained by proteome analysis of the existing products would help identify major cause factors, and thereby reduce the severity of losses due to major defects such as PSE and woody breast meats in poultry processing industry. Furthermore, with the level of accuracy in authenticating meat mixtures by proteomics tools, products safety and quality would be ensured due to reduction of testing time since it evaluates multiple proteins simultaneously, but also adds substantial economic and social value to all stakeholders involved in the poultry industry.

### **References**

- ARIHARA, K. (2013) Relevance of peptide bioactivity in foods. In *“Proteomics in Foods: Principles and Applications”*. Edts: Toldrá, F. and Nollet, L. M. L. pp: 447-164. Springer, New York.
- CAI, K., SHAO, W., CHEN, X., BEACH, C.M., GUYTON, M.C. and SCHILLING, M.W. (2017) Meat quality traits and proteome profile of woody broiler breast (pectoralis major) meat. *Poultry Science* 97: 337–346.
- Desai, m.a., Jackson, W., Zhai, W., Suman, S.P., Nair, M.N., Beach, C.M. and Schilling, M.W. (2016) Proteome basis of pale, soft, and exudative-like (PSE-like) broiler breast (*Pectoralis major*) meat. *Poultry Science* 95:2696–2706.
- Gallardo, J.M., Ortea, I. and Carrera, M. (2013) Proteomics and its applications for food authentication and food-technology research. *Trends in Analytical Chemistry* 52:135–141.
- HOLLUNG, K., VEISETH, E., JIA, X., FÆRGESTAD, E.M. and Hildrum, K.I. (2007) Application of proteomics to understand the molecular mechanisms behind meat quality. *Meat Science* 77:97-104.

- MEKCHAY, S., TELTATHUM, T., NAKASATHIEN, S. AND PONGPAICHAN, P. (2010). Proteomic analysis of tenderness trait in Thai native and commercial broiler chicken muscles. *The Journal of Poultry Science*, 47(1), 8–12.
- ORDUNA, A.R., HUSBY, E., YANG, C.T., GHOSH, D. and BEAUDRY, F. (2017) Detection of meat species adulteration using high-resolution mass spectrometry and a proteogenomics strategy. *Food Additive and Contaminants: Part T A*, Vol. 34, NO. 7, 1110–1120.
- REMIGNON, H., MOLETTE, C., BABILE, R. AND FERNANDEZ, X. (2006) Current advances in proteomic analysis and its use or the resolution o poultry meat quality problems. *World's Poultry Science Journal*, Vol. 62.
- SALWANI, M.S., ADEYEMI, K.D., SARAH, S.A., VEJAYAN, J., ZULKIFLI, I. AND SAZILI, A.Q. (2016). Skeletal muscle proteome and meat quality of broiler chickens subjected to gas stunning prior slaughter or slaughtered without stunning. *Cyta – Journal of Food*, 14(3), 375–381.
- SCHILLING, M.W., SUMAN, S.P., ZHANG , X., NAÏR, M.N., DESA, M.A., CAI, K., CIARAMELL, M.A. and ALLEN, P.J. (2017) Proteomic approach to characterize biochemistry of meat quality defects. *Meat Science* 132:131–138.
- SENTANDREU, M.A., FRASER, P.D., HALKET, J., PATEL, R. AND BRAMLEY, P.M. (2010) A proteomic-based approach for detection of chicken in meat mixes. *J. Proteome Res.* 9(7), pp 3374–3383.
- SUROWIEC, I ., KOISTINEN, K.M., FRASER, P.D. and BRAMLEY, P.M. (2011) Proteomic approach for the detection of chicken mechanically recovered meat. *Meat Sci.* 89(2):233-237.
- XING, T., WANG, C., ZHAO, X., DAI, C., ZHOU, G. and XU, X. (2017) Proteome Analysis Using Isobaric Tags for Relative and Absolute Analysis Quantitation (iTRAQ) Reveals Alterations in Stress-Induced Dysfunctional Chicken Muscle. *J. Agric. Food Chem.* 65: 2913–292.

# Liquid Egg White Enzyme Modification Using Protease: Effects on Physio-Chemical Characteristics

Muhammed Yüceer<sup>a</sup>, Cengiz Caner<sup>b</sup>

<sup>a</sup>Department of Food Processing, Canakkale Onsekiz Mart University, Turkey,  
017020;

<sup>b</sup>Department of Food Engineering, Canakkale Onsekiz Mart University, Turkey,  
017020.

## Abstract

Egg are used as raw materials in the production of different food products. Pasteurization of liquid egg white (LEW) is commercially performed in high-temperature-short-time equipment. In the U.S., pasteurization requirements for LEW are 55.6°C for a minimum holding time of 6.2 min. This heat treatment affects the functional and physio-chemical properties of LEW. Yolk contamination is also a critical issue since it affects white form stable and voluminous foams. In this study, physio-chemical properties of LEW treated with protease enzyme with different concentrations (0,5%; 1% and 1.5%) at 45°C with 2 hours duration were evaluated.

**Key words:** *enzymatic modification, egg quality, egg white, liquid egg, protease*

## Sıvı Yumurta Akının Modifikasyonunda Proteaz Enzimi Kullanımı: Fiziko-Kimyasal Özelliklerine Etkisi

### Özet

Yumurta birçok gıda ürünlerinin imalatında hammadde olarak kullanılmaktadır. Sıvı yumurta akının pastörizasyonu ticari olarak yüksek sıcaklık-kısa süreli olarak yapılmaktadır. ABD’de sıvı yumurta akı 6,2 dakika süre ile 55,6°C’de pastörize edilmektedir. Bu işlem ise sıvı yumurta akının gerek fonksiyonel ve gerekse fiziko-kimyasal özelliklerini etkilemektedir. Ayrıca yumurta akına sarı kontaminasyonu ile yumurta akının fonksiyonel özellikleri olumsuz açıdan etkilenmektedir.

Bu çalışmada %0,5; 1; 1,5 proteaz enzimi ile 45°C’de 2 saat süre ile muamele edilen sıvı yumurta akının fiziko-kimyasal özellikleri araştırılmıştır.

**Anahtar kelimeler:** *enzim modifiye, yumurta kalitesi, yumurta akı, sıvı yumurta, proteaz.*

## **Introduction**

Egg is a foodstuff, which is the foundation of the human diet after breastfeeding, in terms of functional properties and nutrients with excellent quality; it has an important place in the economy of the country. Egg is a functional basic foodstuff, which include for adult needs of essential nutrients on a daily basis (Açıkgöz ve Önenç, 2006; Anton ve Nau, 2006; Yüceer, ve ark., 2012).

Egg are used as raw materials or auxiliary components in the production of different products such as bakery and pastry industry with freezed, dried (powder) or pasteurized (Muthukumarappan, ve ark.). Among food products prepared with eggs; mayonnaise, sauces, cakes, decorations, sports products, pasta, ice cream, baby biscuits, soups, sports drinks, nougat, halva, Turkish ravioli, noodles, makaron, waffles, chocolate and cream varieties are existing. Egg is used extensively in the food production for the purpose of gelation, foaming, crystallization retardants, binders, colorants, flavour-giving volume receive, blistering or emulsifier thanks to its functional features <sup>2,8-10</sup>. Therefore; in several food products, foaming, foam stability as functional properties, which make eggs significant, are affected by high temperature (Kuropatwa, ve ark., 2009; Mine, 2007; Van der Plancken, ve ark., 2007).

Nowadays for the purpose of the preservation of quality and increase the shelf life of eggs and egg products pasteurization technique is utilized. However, because of heat treatment can damage the functional properties, flavour and structure of egg; the development of method which could be an alternative to this method, and their optimization and studies about treating with the enzyme, for recovery damages caused by heat treatment on the structure of the eggs has gained momentum. Liquid egg white due to its protein content is pasteurized at lower temperature compared to whole eggs and egg yolks. It is also known that there is loss on the functional properties of the egg product due to pasteurization (McCluskey, 2007; Tan, ve ark., 2012; Unluturk, ve ark., 2010). Because of this limitation in the industry, there is increasing interest to alternative methods, especially in the processing of egg albumin. Many studies have been carried out for the combination of new techniques. For the improvement, the

quality and extend the shelf life of liquid egg, effective new methods are needed. Nowadays, along with the new method enzymes used as processing aids holds an important place. It has been observed a limited number of publications upon the processing eggs the use of new method, especially upon improving the quality of liquid egg and the extension of shelf life (Arzeni, ve ark., 2011; Huang, ve ark., 2006). We are important producer in the region about eggs and we have a fast development especially in recent years, so this situation shows there is need to detailed study in the egg processing industry which their number reach to 10 recently. Therefore, with using new methods improving of quality and functional characteristics of liquid egg (increasing the shelf life of the final product) and protection of consumer confidence in commercial liquid egg sector will be important.

To increase the added value and improving the quality of eggs; simple, do not require investment and without increasing the cost to very high value, to provide high quality and increasing the functional properties, there is a need for new methods and applications. In recent years, enzymatic modification of liquid egg with enzymes such as phospholipase, lipase and proteaz has become very important. Enzyme modified egg products technology gives chance to produce special product with high added value which cannot be produce with conventional techniques. It is possible that to produce functional final product by egg product obtained cheap and easily. Optimizations can be made in the process in terms of maintaining the functional quality of egg products during the production process can take some precautions, but there is no method that can be applied to improve its functional properties, it can only provide the expected functional recovery from enzymes as processing aids in this regard. Today, the use of enzymes in the food industry is growing rapidly and functional and structural recovery is recorded in enzyme modified liquid egg products. The use of the enzyme becomes widespread in the egg products industry. With the rheological data obtained in the study results, in the industry in pipelines equipment such as pumps, agitators, heat exchangers and homogenizers or engineering calculations which are necessary for the design of processes associated with this equipment, component specifications in the product development process and determining the functional effect, quality control in process phase, shelf-life tests are needed regarding the structural evaluation of the egg.

In this study, determination of the rheological properties of liquid egg whites treated with different concentrations of protease enzyme. The effects of enzyme concentration on physio-chemical properties were investigated.

## **Materials and Methods**

### **Liquid Egg Albumen**

The commercial pasteurized liquid egg white (*Gallus domesticus*) samples were provided directly from the processing line of Keskinoglu egg processing plant (Akhisar, Manisa, Turkey) without any additives. Liquid egg samples transported between 0-4°C in cold chain to laboratory.

### **Enzyme Preparation and Treatment**

In this study, a commercial protease produced from microbial fermentation techniques supplied from Biocatalysts Ltd. (Promod 194SP, Wales, UK). All the liquid egg albumen samples were prepared under the conditions proposed by the manufacturer (time, pH and temperature) and incubated with the protease enzyme at different concentrations (%1.5; 1 and 0.5 v/v) at 45°C with 3 hours in a with the aid of magnetic stirrer and special unit (heating and water circulation) made for minimizing the protein denaturation. The concentrations of all enzymes used during experimentation were determined through trial and error.

The study was guided by the following test pattern.

- a) Control (untreated liquid egg albumin)
- b) Protease enzyme 1.5% treated liquid egg albumin,
- c) Protease enzyme 1% treated liquid egg albumin,
- d) Protease enzyme 0.5% treated liquid egg albumin.

### **Albumen pH Analysis**

pH values of enzyme treated and untreated liquid egg albumen was determined at 20±1°C using Ohaus Starter 3100 pH meter (Caner ve Yuceer, 2015).

### **Total Soluble Solids (Dry Matter)**

Dry matter (brix°) of enzyme treated and untreated liquid egg albumen was determined at 20±1°C by refractometer Atago Pal-1 (Atago Co. Ltd. Tokyo, Japan) after setting to zero with pure water (Caner ve Yuceer, 2015; Caner ve Yuceer, 2015)

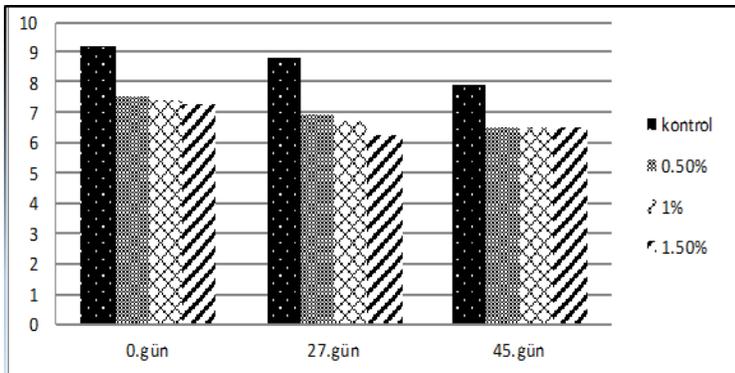
## Color Properties

Color analysis was carried out directly with Minolta colorimeter (Chroma Meter CR-400, Konica Minolta Sensing, Inc., Osaka, Japan), using the CIE color space  $L^*$ ,  $a^*$ ,  $b^*$  values and previously instrument calibrated with the white calibration plate. Color of treated and untreated liquid egg albumen was determined and expressed as  $L^*$  (lightness),  $a^*$  (green to red; higher positive  $a^*$  values indicate red color) and  $b^*$  (blue to yellow; higher positive  $b^*$  values indicate a more yellow color) chromaticity (Yüceer, ve ark., 2015).

## Results and Discussion

### Albumen pH

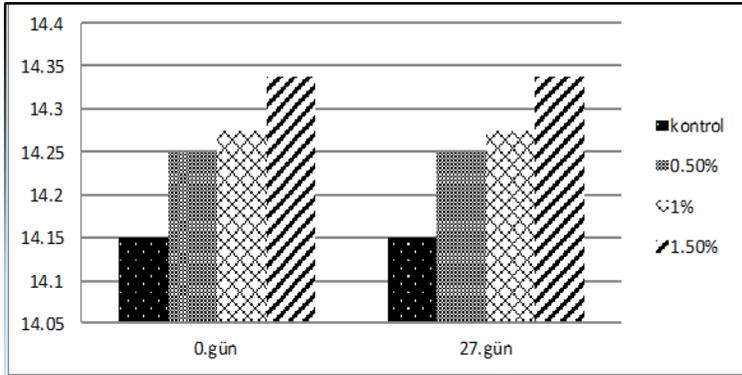
Protease enzyme modified liquid egg whites pH values shown in Table 1. The pH of the egg white was about 9.0. The pH of freshly laid eggs may be less than 8.0, and as the egg ages, the pH may rise to 9.0. As an egg ages, its pH increases by the loss of  $CO_2$  through the shell (Caner ve Yüceer, 2015). The pH of egg white from a newly laid egg is approximately 8.0 and increases to 8.6 and 9.1 after being stored for 24 and 72 h, respectively. As transportation from the farm to the breaking plant and processing are becoming more efficient within the egg industry, the pH of liquid egg white has trended downward over the past few decades (Geveke, 2008). The pH of liquid egg whites reduced after protease enzyme treatments. The reason for this is unclear but may be related to the fact that most egg white proteins attain maximum stability at near-neutral pH.



**Table 1.** Protease enzyme modified liquid egg whites pH change during storage

### Total Soluble Solids

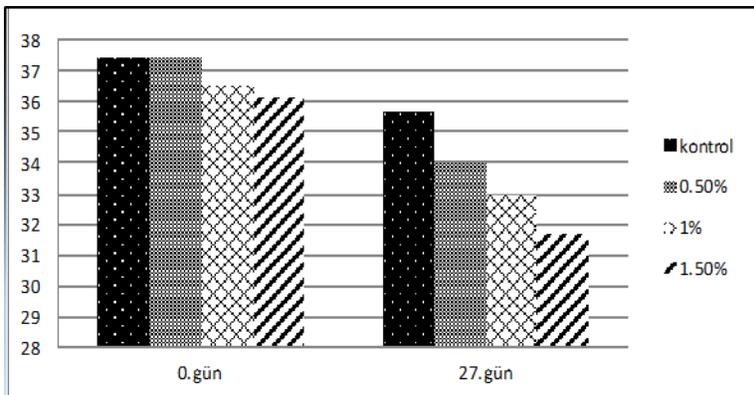
Protease enzyme modified liquid egg whites dry matter values are given in Table 2. Dry matter of enzyme treated LEW samples increase due to form (powder) of protease enzyme used in experiment. The effectiveness depends on protease enzyme dose.



**Table 2.** Protease enzyme modified liquid egg whites dry matter change during storage

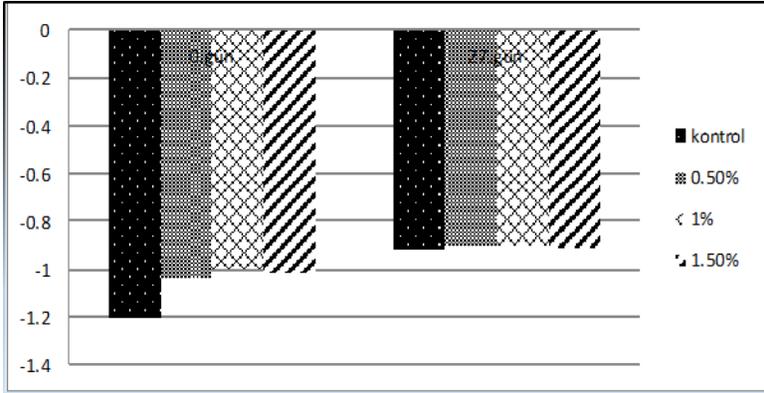
### Color Properties

Protease enzyme modified liquid egg whites  $L^*$  values are shown in Table 3. Enzyme treated LEW samples  $L^*$  values were stable for 0.5 % and reduced for treatment of 1 and 1.5%. However  $L^*$  values of LEW reduced during storage. The color pigments of liquid white during storage are subjected to the structural changes.



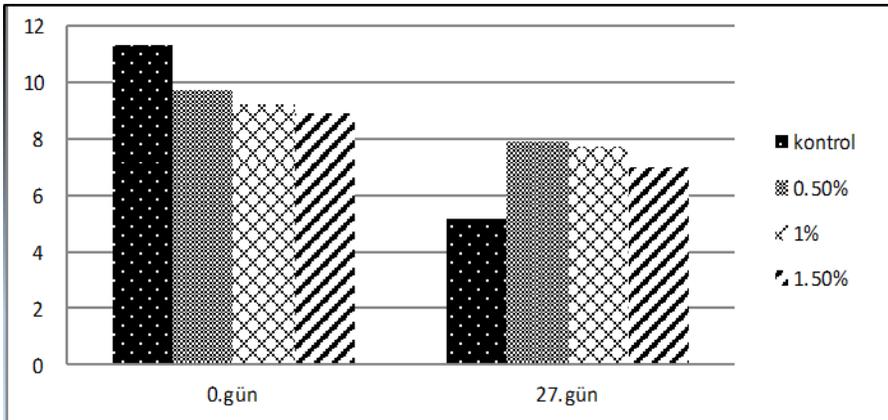
**Table 3.** Protease enzyme modified liquid egg whites  $L^*$  value change during storage

Enzyme modified liquid egg whites  $a^*$  values are shown in Table 4. Enzyme treated LEW samples  $a^*$  values were increased. However  $a^*$  values of LEW were similar during storage.



**Table 4.** Protease enzyme modified liquid egg whites  $a^*$  value change during storage

Protease enzyme modified liquid egg whites  $b^*$  values are shown in Table 5. Enzyme treated LEW samples  $b^*$  values were decreased. However enzyme treatments prevent the decrease of  $b^*$  values during storage and for 0.5; 1 and 1.5% enzyme concentrations the  $b^*$  values remained stable during storage.



**Table 5.** Protease enzyme modified liquid egg whites  $b^*$  value change during storage

## Conclusion and References

The results from such analysis were examined in order to investigate the effect of protease treatments on the pH, dry matter and color properties of egg white. Protease enzyme has potential to become significant breakthrough in the industry and in preserving egg proteins deformation during processing stages. As a result of this study, enzyme modified LEW's physio-chemical properties was concluded that the enzyme concentration rate is important to determine the process conditions and in terms of quality control criteria's in egg processing plants.

In conclusion, it was determined that a positive effect on the physio-chemical properties of the modified liquid egg albumen after treatment and during storage. The stability of the foam enhanced, as a result of the reduction in gas pressure in the foam. It was concluded that protease enzyme is useful for improving the stability of egg-white proteins during storage. Enzyme treatments may be used to reduce adverse effects of heat, egg yolk contamination. Protease may also be used in egg powder processing to increase functional properties of egg white powder.

1. Açıkgöz, Z., and Önenç, S. S. (2006). Fonksiyonel Yumurta Üretimi. *Hay. Üret.* 47:36-46
2. Anton, M., and Nau, F. (2006). Bioactive Egg Components and their Potential Uses. *World's Poultry Sci. J.* 62:429-438
3. Arzeni, C., Pérez, O. E., and Pilosof, M. R. 2011. Aggregation and Gelation Properties of Egg White Proteins as Affected by High Intensity Ultrasound in 11th International Congress on Engineering and Food, Athens, Greece.
4. Caner, C., and Yuceer, M. (2015). Maintaining functional properties of shell eggs by ultrasound treatment. *J Sci Food Agric* 95:2880-2891
5. Caner, C., and Yüceer, M. (2015). Efficacy of various protein-based coating on enhancing the shelf life of fresh eggs during storage. *Poult Sci* 94:1665-1677
6. Geveke, D. J. (2008). UV Inactivation of E. coli in Liquid Egg White. *Food and Bioprocess Technology* 1:201-206
7. Huang, E., Mittal, G. S., and Griffiths, M. W. (2006). Inactivation of Salmonella enteritidis in Liquid Whole Egg using Combination Treatments of Pulsed Electric Field, High Pressure and Ultrasound. *Biosys. Eng.* 94

8. Kuropatwa, M., Tolkach, A., and Kulozik, U. (2009). Impact of pH on the interactions between whey and egg white proteins as assessed by the foamability of their mixtures. *Food Hydrocol.* 23:2174-2181
9. McCluskey, V. K. K. (2007). *Microbial Analysis of Shelled Eggs and Chemical and Functional Analysis of Liquid Eggs*. PhD Dissertation (Doktora Tezi). Auburn University, Auburn, Alabama, USA.
10. Mine, Y. (2007). *Egg Bioscience and Biotechnology*. Wiley-Interscience & Sons, Inc., Publication, Hoboken, New Jersey, USA.
11. Muthukumarappan, K., O'Donnell, C. P., and Cullen, P. J. (2010). Ozone Utilization in Encyclopedia of Agricultural, Food, and Biological Engineering. Muthukumarappan, K., O'Donnell, C. P., and Cullen, P. J. eds. Taylor & Francis.
12. Tan, T. C., Kanyarat, K., and Azhar, M. E. (2012). Evaluation of functional properties of egg white obtained from pasteurized shell egg as ingredient in angel food cake. *International Food Research Journal* 19:303-308
13. Unluturk, S., Atilgan, M. R., Baysal, A. H., and Unluturk, M. S. (2010). Modeling inactivation kinetics of liquid egg white exposed to UV-C irradiation. *Int J Food Microbiol* 142:341-347
14. Van der Plancken, I., Van Loey, A., and Hendrickx, M. E. (2007). Foaming properties of egg white proteins affected by heat or high pressure treatment. *J. of Food Eng.* 78:1410-1426
15. Yüceer, M., Temizkan, R., and Caner, C. (2012). Fonksiyonel Gıda Olarak Yumurta: Bileşenleri ve Fonksiyonel Özellikleri. *Akademik Gıda* 10:70-76
16. Yüceer, M., Temizkan, R., and Caner, C. 2015. Evaluation of Color Changes in Various Edible Coated Eggs during Storage in XVI. European Symposium on the Quality of Eggs and Egg Products, Nantes, France.

### **Acknowledgements**

This work was supported by The Scientific and technical Council of Turkey (TÜBİTAK), Contract Number 214O376, project title 'Functional and Rheological Characteristics of Enzyme Modified Egg Products'. The authors are grateful to support of Dr. Riza Temizkan, Hatice Aldemir and Mustafa Atak for the laboratory measurements.

# Color traits, pH and water holding capacity of breast meat from broiler chickens affected by white striping myopathy<sup>a</sup>

Hirasilva Borba<sup>b</sup>, Juliana Lolli Malagoli de Mello<sup>b</sup>, Rodrigo Alves de Souza<sup>b,c</sup>, Erika Nayara Freire Cavalcanti<sup>b</sup>, Aline Giampietro-Ganeco<sup>b</sup>, Rodrigo Fortunato de Oliveira<sup>b</sup>, Pedro Alves de Souza<sup>b</sup>

<sup>a</sup>This study was financially supported by São Paulo Research Foundation (FAPESP, 2015/08471-8 and 2015/14584-0).

<sup>b</sup>Department of Technology. São Paulo State University. Jaboticabal. SP. Brazil.

<sup>c</sup>School of Animal Science and Food Engineering. University of São Paulo. Pirassununga. SP. Brazil.

## Abstract

The evolution of poultry meat production has allowed the diversification of products, however, new barriers to the industry have increased the need for studying how the genetic progress affects the meat quality. Lesions such as white striping represent potential disadvantages to consumer's acceptance and any condition that negatively affects the visual appearance of the meat results in economic loss. The occurrence of white striping has no effect on exudation of breast meat from the studied strains. White striping does not alter the pH of Cobb 500 and Ross AP95 breast meat, but alters the color of the breast muscle, regardless of the chicken lineage.

**Keywords:** *growth, juiciness, meat quality, muscle disease, rigor mortis*

## Introduction

Brazil is the second largest producer and first exporter of chicken meat in the world. In 2016, the Brazilian production of chicken meat reached 12.9 million tons and the consumption of chicken meat was approximately 41.1 kg/person (ABPA, 2017). The evolution in the poultry meat production has allowed the intense diversification of products to the detriment of commercialization of whole carcasses. However, new barriers to the industry, such as the appearance of white stripes in varying severity degrees, have increased the need for studies on the modifications that genetic progress may promote in the birds (Petracci and Cavani, 2011). Lesions such as white striping myopathy represent potential disadvantages to the consumer's acceptance and purchase intent of poultry meat (Kuttappan *et al.*, 2012b), and any condition that negatively affects the visual

appearance of the meat results in economic loss (Kuttappan *et al.*, 2012b). The visual change caused by myopathies on the appearance of chicken breast meat may turn fresh meat and derivate products into non-tradable goods (Galiropoulou, 2013), as slaughterhouses follow the policy of condemning carcasses with lesions of unknown etiology. Thus, the aim of this study was to evaluate some characteristics related to the appearance, pH and water holding capacity of breast meat from broiler chickens, raised and slaughtered in Brazil, that were affected by white striping myopathy.

## **Materials and Methods**

This research was developed at the Laboratory of Animal Products Technology of the Faculty of Agricultural and Veterinary Sciences at UNESP, Jaboticabal Campus, São Paulo, Brazil (21°08'S, 48°11'W, 583 m altitude).

### **Sample collection and preparation**

180 *pectoralis major* muscles from Cobb 500 (n=60), Ross AP95 (n=60) and Hubbard (n=60) broilers, slaughtered at 42 days of age, were collected. Carcasses were acquired from commercial slaughterhouses (São Paulo, SP, Brazil) working under inspection of Brazilian Federal Inspection Service. At the slaughterhouse, samples were classified according to the severity of the apparent stripes on the muscle surface after skin removal as: normal - absence of stripe; moderate - stripe thickness less than 1 mm; severe - stripe thickness greater than 1 mm, easily visible on the surface of the muscle (Kuttappan *et al.*, 2012a). Birds were slaughtered according to the slaughter plant routine and transferred to the laboratory in a refrigerated vehicle for cold-chain maintenance. After completion of *rigor mortis* (4 h after slaughter), each breast was manually deboned for the obtainment of samples from its both sides. The colorations of breast surface (without skin) and inner part of *pectoralis major* muscle were evaluated, as well as pH and water holding capacity.

### **Methods**

Color traits ( $L^*$  - lightness,  $a^*$  - redness and  $b^*$  - yellowness) were determined through the use of a Minolta CR-400 colorimeter (Konica Minolta Sensing Inc., Osaka, Japan) (settings: diffuse illumination/0° viewing angle, illuminant D65, specular component included), at three different positions on the surface (which was in contact with the skin) and on the inner part of the *pectoralis major* muscle (which was in contact with the bone) immediately after deboning. Meat pH was

determined in triplicate with a digital pH meter (Testo 205, Testo Inc., Sparta, NJ, USA), equipped with a penetration electrode for direct insertion into the samples. The water-holding capacity was determined, in triplicate, according to the method described by Hamm (1961), using 2 g of raw sample (initial weight) placed between two qualitative filter papers and acrylic plates. The set was subjected to a pressure of 10 kg for 5 min. Afterwards, samples were weighed once more (final weight) for the determination of water-holding capacity in percentage terms, according to the following formula: (Final weight x 100)/Initial weight.

### **Statistical analyses**

Results were analyzed through a completely randomized design comparing three severity degrees of white striping myopathy and 20 replicates (normal – n = 20, moderate – n = 20, and severe – n = 20) for each studied lineage were performed (Cobb 500, Ross AP95 and Hubbard). Results were analyzed through one-way ANOVA test of SAS (SAS Institute Inc. 2002–2003). All data were subjected to analysis of variance and compared by Tukey's test with significance defined at  $P < 0.05$ .

### **Results and Discussion**

In this study, we evaluated the color in different parts of the breast muscle, pH and water holding capacity of meat from Cobb 500, Ross AP95 and Hubbard broilers. We observed that the occurrence of white striping (WS) myopathy did not influence ( $P > 0.05$ ) the yellowness ( $b^*$ ) on the muscle surface, the lightness ( $L^*$ ) on the inner part of muscle, the pH and the water holding capacity of breast meat from Cobb 500 broilers (Table 1). Along with the increase of white stripes (moderate and severe degrees, respectively), there was an increase ( $P < 0.0001$ ) in lightness and redness ( $a^*$ ) on the muscle surface and also an increase in redness ( $P = 0.0058$ ) and yellowness ( $b^*$ ) ( $P = 0.0076$ ) on the inner part of samples.

Table 1. Lightness (L\*), redness (a\*) and yellowness (b\*) of the surface and the inner portion of the muscle, pH and water holding capacity (WHC) of pectoralis major from Cobb 500 broiler chickens affected by different degrees of white striping myopathy (WS).

WS (n=20)	Color of muscle surface			Color of the inner part of muscle			pH	WHC (%)
	L*	a*	b*	L*	a*	b*		
Normal	60.31 B	0.54 C	4.99	55.81	1.40 B	5.91 B	5.91	69.41
Moderate	58.92 B	1.27 B	5.09	55.79	1.95 AB	6.79 AB	5.91	69.91
Severe	63.20 A	2.07 A	6.05	56.01	2.23 A	8.33 A	5.98	68.61
P-value	<0.0001	<0.0001	0.2376	0.9660	0.0058	0.0076	0.0828	0.1549

<sup>A-C</sup>Means in the same column followed by different letters are significantly different by Tukey's test (P < 0.05)

Regarding the meat from Ross AP95 broiler chickens, we also verified that there was no effect (P>0.05) of WS myopathy on the pH, water holding capacity and redness on the inner part of the breast muscle (Table 2). Along with the increase of white stripes, there was an increase of lightness (P=0.0080), redness (P<0.001) and yellowness (P=0.0010) on the muscle surface and lightness (P=0.0103) and yellowness (P=0.0004) on the inner part of the muscle.

Table 2. Lightness (L\*), redness (a\*) and yellowness (b\*) of the surface and the inner portion of the muscle, pH and water holding capacity (WHC) of pectoralis major from Ross AP95 broiler chickens affected by different degrees of white striping myopathy (WS).

WS (n=20)	Color of muscle surface			Color of the inner part of muscle			pH	WHC (%)
	L*	a*	b*	L*	a*	b*		
Normal	59.16 B	0.32 C	1.27 B	58.50 B	0.52	2.22 B	5.98	71.41
Moderate	61.22 A	1.43 B	3.31 A	60.88 A	0.59	3.95 A	5.96	69.38
Severe	60.90 A	2.33 A	3.38 A	61.11 A	0.40	4.51 A	6.02	71.41
P-value	0.0080	<0.0001	0.0010	0.0103	0.7457	0.0004	0.2368	0.1962

<sup>A-C</sup>Means in the same column followed by different letters are significantly different by Tukey's test (P < 0.05)

In breast samples from Hubbard broilers, we also verified that there was no effect (P>0.05) of WS on the lightness and yellowness on the inner part of muscle and water holding capacity (Table 3). Along with the increase of the myopathy severity, there was an effect on the color variables of the muscle surface (increase of L\*, a\* and b\*), an increase of redness on the inner part of muscle and increase of pH.

Table 3. Lightness (L\*), redness (a\*) and yellowness (b\*) of the surface and the inner portion of the muscle, pH and water holding capacity (WHC) of pectoralis major from Hubbard broiler chickens affected by different degrees of white striping myopathy (WS).

WS (n=20)	Color of muscle surface			Color of the inner part of muscle			pH	WHC (%)
	L*	a*	b*	L*	a*	b*		
Normal	59.78 B	0.78 B	-1.00 B	60.98	0.43 B	2.53	5.82 B	69.00
Moderate	59.96 AB	1.03 B	-0.23 B	61.54	0.42 B	3.35	5.87 AB	70.74
Severe	61.87 A	1.87 A	1.20 A	61.19	1.32 A	3.34	5.97 A	70.61
P-value	0.0253	<0.0001	0.0002	0.8315	0.0036	0.0988	0.0129	0.3436

<sup>A-B</sup>Means in the same column followed by different letters are significantly different by Tukey's test (P < 0.05)

The literature highlights that hybrids producing higher proportion of breast muscle present higher incidence of WS (Petracci *et al.*, 2013). The consumer detects WS as a negative attribute often associated with marbling or some other abnormality, resulting in poor acceptability and possible rejection of the product, depending on the concentration of stripes on the breast surface. In addition to the appearance, WS also affects important technological traits for the processing of breast meat, such as the water holding capacity (Petracci *et al.*, 2013). In this study, the presence of WS influenced the color on the breast surface, directly visualized by the consumer at the time of purchase, and the color on the inner part of the breast muscle in samples from broilers of the three strains. The effect of WS on the color of chicken breast varies greatly, as it is shown by different authors (Petracci *et al.*, 2013; Kuttappan *et al.*, 2009; Bauermeister *et al.*, 2009) who found different results. As for pH, we observed an increase as a result of WS severity in samples from Hubbard broilers, but the results are still normal. In contrast with this research, Petracci *et al.* (2013) state that the presence of WS determines the reduction of the ability to hold and bind water, turning the meat more exudative.

### Conclusion

The occurrence of WS myopathy has no effect on juiciness and exudation of breast meat from Cobb 500, Ross AP95 and Hubbard broilers. White striping does not alter the pH of Cobb 500 and Ross AP95 breast meat to the point of decreasing its shelf life. The white striping myopathy alters the color on the surface and on the inner part of the breast muscle, regardless of the chicken lineage.

## References

- ABPA. Brazilian Association of Animal Protein (2017) Annual report (2017) Available at <[http://abpa-br.com.br/storage/files/final\\_abpa\\_relatorio\\_anual\\_2017\\_ingles\\_web.pdf](http://abpa-br.com.br/storage/files/final_abpa_relatorio_anual_2017_ingles_web.pdf)> [Verified 12 January 2018].
- BAUERMEISTER, L.J., MOREY, A.U., MORAN, E.T., SINGH, M., OWENS, C.M. and MCKEE, S.R. (2009) Occurrence of white striping in chicken breast fillets in relation to broiler size. *Poultry Science* 88(Suppl. 1): 33. (Abstr.)
- GALIROPOULOU, S. (2013) Effect of wooden breast disorder on protein oxidation in *Pectoralis major* muscle. *Master Thesis*. University of Helsinki.
- HAMM, R. (1961) Biochemistry of meat hydration. *Advances in Food Research* 10: 355-463.
- KUTTAPPAN, V.A., BREWER, V.B., CLARK, F.D., MCKEE, S.R., MEULLENET, J.F., EMMERT, J.L. and OWENS, C.M. (2009) Effect of white striping on the histological and meat quality characteristics of broiler fillets. *Poultry Science* 88(E-Suppl. 1): 136-137. (Abstr.)
- KUTTAPPAN, V., BREWER, V., APPLE, J., WALDROUP, P. and OWENS, C. (2012a) Influence of growth rate on the occurrence of white striping in broiler breast fillets. *Poultry Science* 91: 2677-2685.
- KUTTAPPAN, V., LEE, Y., ERF, G., MEULLENET, J., MCKEE, S. and OWENS, C. (2012b) Consumer acceptance of visual appearance of broiler breast meat with varying degrees of white striping. *Poultry Science* 91: 1240-1247.
- PETRACCI, M. and CAVANI, C. (2011) Muscle growth and poultry meat quality issues. *Nutrients* 4: 1-12.
- PETRACCI, M., MUDALAL, S., BONFIGLIO, A. AND CAVANI, C. (2013) Occurrence of white striping under commercial conditions and its impact on breast meat quality in broiler chickens. *Poultry Science* 92: 1670-1675.
- SAS INSTITUTE INC. (2002–2003) ‘SAS version 9.1.’ (SAS Institute Inc.: Cary, NC)

# Quality Characteristic of Fresh Poultry Sausages Formulated with Linseed/Black Cumin O/W Gelled Emulsions as Fat Replacer

Meltem Serdaroğlu<sup>a</sup>, Hülya Serpil Kavuşan<sup>a</sup>, Gamze İpek<sup>a</sup>, Berker Nacak<sup>a,b</sup>

<sup>a</sup>Ege University, Engineering Faculty, Food Engineering Department, Bornova, İzmir, Turkey

<sup>b</sup>Usak University, Engineering Faculty, Food Engineering Department, Usak, Turkey

## Abstract

The aim of the present study was to investigate the effects of using gelled emulsions (GE) as beef fat replacer on some quality characteristics of fresh poultry sausages. For this purpose, GE, prepared with linseed oil, black cumin seed oil was replaced with beef fat at a level of 0%, 50%, 75%, 100% (C, GE50, GE75, GE100) in fresh chicken sausage formulation. Chemical composition, technological parameters (cooking yield, water holding capacity, total expressible fluid, emulsion stability) and color parameters were evaluated. The addition of GE in sausages increased the moisture and protein contents while decreasing the fat content. Increasing the GE addition levels negatively affected cooking yield and WHC of fresh sausages while C samples and GE100 samples showed similar emulsion stability. In addition to these results, using GE in fresh sausage formulations caused darker products.

**Keywords:** fat replacement, gelled emulsion, fresh sausage, beef fat, emulsion

## Taze Kanatlı Sosislerinde Keten Tohumu ve Çörek Otu Yağı İle Hazırlanan O/W Jel Emülsiyonların Sığır Yağı Yerine Kullanımının Bazı Kalite Karakteristiklerine Etkileri

### Özet

Bu çalışmanın amacı, taze kanatlı sosisformülasyonunda sığır et yağı yerine farklı oranlarda keten tohumu yağı ve çörek out yağı ile hazırlanan jel emülsiyonları (GE) kullanımının bazı kalite parametreleri üzerine etkilerinin araştırılmasıdır. Bu amaçla % 0 GE ( %100 sığır et yağı, C), %50 GE (GE 50), %75 GE (GE75) ve %100

GE (GE100) olmak üzere yağ girdisi olarak farklı oranlarda jel emülsiyon kullanılan dört farklı taze sosis formülasyonu hazırlanmıştır. Jel emülsiyonların sosis formülasyonunda sığır et yağı yerine kullanılması örneklerin yağ miktarını azaltırken nem ve protein miktarını arttırmıştır. Artan oranlarda GE eklenmesi, taze sosislerin pişirme verimi ve su tutma kapasitesini olumsuz etkilemiştir. C örnekleri ve GE100 örnekleri benzer emülsiyon stabilitesi göstermiştir.

**Anahtar kelime:** yağ ikamesi, jel emülsiyon, taze sosis, sığır yağı, emülsiyon

## **Introduction**

Recently poultry meat has become very popular owing to its high biological value contains essential amino acids, has more unsaturated fatty acids, vitamins and other nutrients as well as it is cheaper than red meat ( Mulla et al., 2017). Sausage is one of the most popular food product consumed worldwide. Fresh sausages are meat products sold fresh without any heat treatment and cooking procedure is applied before consumption (Feiner, 2006). Fat is very important raw material in sausage formulation since it provides textural, and sensory characteristics of the products (Backes et al., 2013). However, in recent years, consumers believe the consumption of meat and meat products is unhealthy because of their high saturated fat and cholesterol content, thus developing healthier lipid profile is became one of the most important goals in meat industry. For this purpose using pre-emulsions prepared with healthy oils could be a good option to achieve nutritionally improved meat products (Pintado et al., 2015; Serdaroğlu et al., 2016). Previous studies have shown the potential of gelled emulsions (GE) containing a variety of bioactive compounds and healthy oils to use as healthier fat replacers (Serdaroğlu et al., 2016; Poyato et al., 2014; Pintado et al., 2015). In this study it was aimed to investigate the effects of replacing animal fat with gelled emulsions prepared with linseed and black cumin oil in the fresh chicken sausage formulation on some quality parameters.

## **Materials and Methods**

Gelled emulsion was prepared according to the method described by Poyato et al.,2014, and Paradiso et al., 2015 with modifications. Four different chicken fresh sausages were formulated.; In in control samples (C) 10 g/100 g of beef fat was added to formulation, whereas in the three experimental batches different percentages 50% (GE50),

75% (GE75), and 100% (GE100), of beef fat were substituted with GE. All subcutaneous fat and skin fat was removed from chicken thighs. Meat and beef fat were minced through a 3 mm plate grinder (Arnica, Turkey), separately. Ground meat, fat source (beef fat and/or GE), salt, ice and other ingredients mixed in cutter (Alpina, Schweiz) for 8 minutes. Sausage doughs were stuffed into natural casings using a hydraulic sausage filling machine (Alpina, Schweiz). Total moisture, ash (AOAC, 2012) and fat (Flynn and Bramblett, 1975) contents were determined. Protein content was analyzed by using Kjeldahl method (Anonymous, 1979). Color parameters were measured with a portable colorimeter (Konica Minolta, CR-200, Japan), cooking yield (Murphy et al., 1975), water holding capacity (Hughes et al. 1997) and emulsion stability (ES) as total expressible fluid (TEF) and the expressible fat (EFAT) and were analyzed.

### **Results and Discussion**

Chemical composition of uncooked and cooked, sausages were given at Table 1. GE addition showed increasing effect on moisture content of uncooked samples ( $P<0.05$ ) all GE added groups had higher moisture content than the controls. Fat content was decreased with the addition of GE both in uncooked and cooked samples ( $P<0.05$ ). Protein content of uncooked sausages were higher in GE75 and GE100 samples than the control samples, this could be explained by using sodium caseinate as an emulsifying agent in gelled emulsion. Serdaroğlu et al., 2017, reported that protein content of raw chicken patties formulated with gelled emulsions prepared with olive oil did not change however in cooked samples %100 replacement of beef fat with GE increased the protein content of patties. Protein content was found similar in cooked sausages, this could be the result of the different cooking losses of sausage samples. No significant differences were found in ash content of cooked sausages. Color is one of the most essential factors on consumer's attitude toward meat and meat products. The color parameters of the samples were shown in Table 1. GE addition significantly effected color parameters of sausages due to the different color of beef fat and GE. Increasing levels of GE decreased  $L^*$  values of sausages ( $P<0.05$ ). Higher  $L^*$  values of C samples could be due to the color of animal fat.  $a^*$  and  $b^*$  values were found lower in GE75 samples than other treatments ( $P<0.05$ )  $a^*$  values of control samples were lower than GE samples however control and GE75 had  $a^*$  values ( $P<0.05$ ).  $b^*$  values of GE50 and GE100 were found similar to C samples, however GE75 had lower  $b^*$  values. Similar to our results Serdaroğlu et al., 2016, also

found that addition of GE increases the lightness of model system meat emulsions. Poyato et al., 2014, reported that  $L^*$ ,  $a^*$  and  $b^*$  were significantly higher in the emulsion containing products compared to control ones.

Technological properties such as cooking yield, emulsion stability and water holding capacity are some of the most important factors for food industry to predict the behavior of products during cooking. Technological properties of fresh sausages could be seen in Table 1. The highest cooking yields were observed in C and GE50 samples, while GE75 and GE100 had lower cooking yields than these samples ( $P < 0.05$ ). It can be recognized that GE resulted a decrement in WHC of samples when replacement ratio is more than 50%. GE75 samples had the lowest emulsion stability between the treatments while C and GE100 had the highest emulsion stability. The reason decrease in emulsion stability could be type of fat or ratio of protein. Similar to our results, Serdaroglu et al., 2016, indicated that replacing beef fat completely with GE can have negative impacts on the cooking yield and WHC.

Table 1. Chemical composition, color (L\*, a\*, b\*), CY, WHC and ES of fresh chicken sausages

	Moisture %		Fat %		Protein %		Ash %		L*	a*	b*	CY	WHC	ES	
	U	C	U	C	U	C	U	C						TEF %	EFAT%
	C	66.41 <sup>b</sup> ±0.50	60.98 <sup>b</sup> ±0.26	15.51 <sup>a</sup> ±0.64	16.79 <sup>a</sup> ±0.17	15.26 <sup>b</sup> ±0.34	21.24 ±0.27	2.82 <sup>ab</sup> ±0.03						3.13 ±0.21	62.29 <sup>a</sup> ±0.34
GE50	69.33 <sup>a</sup> ±0.05	64.68 <sup>a</sup> ±0.76	12.53 <sup>b</sup> ±0.14	13.09 <sup>c</sup> ±0.52	15.29 <sup>b</sup> ±0.25	19.98 ±0.76	2.62 <sup>c</sup> ±0.006	3.16 ±0.15	61.39 <sup>b</sup> ±0.52	3.76 <sup>a</sup> ±0.15	18.84 <sup>a</sup> ±0.37	84.40 <sup>b</sup> ±4.62	71.13 <sup>ab</sup> ±3.11	13.27 <sup>ab</sup> ±2.91	18.32 <sup>b</sup> ±3.11
GE75	69.47 <sup>a</sup> ±0.08	61.06 <sup>b</sup> ±1.26	10.86 <sup>c</sup> ±0.10	14.37 <sup>b</sup> ±0.61	17.35 <sup>a</sup> ±0.28	21.33 ±1.33	3.10 <sup>a</sup> ±0.24	3.29 ±0.24	60.30 <sup>c</sup> ±0.53	3.28 <sup>b</sup> ±0.27	16.68 <sup>b</sup> ±0.84	75.90 <sup>d</sup> ±0.43	67.57 <sup>b</sup> ±1.34	17.53 <sup>a</sup> ±1.67	25.45 <sup>a</sup> ±5.33
G100	68.88 <sup>a</sup> ±0.61	61.87 <sup>b</sup> ±0.91	9.97 <sup>d</sup> ±0.59	14.69 <sup>b</sup> ±0.62	18.31 <sup>a</sup> ±1.05	20.62 ±0.42	2.90 <sup>ab</sup> ±0.02	3.09 ±0.16	60.10 <sup>c</sup> ±0.53	3.99 <sup>a</sup> ±0.23	18.07 <sup>a</sup> ±0.60	80.24 <sup>c</sup> ±0.67	69.35 <sup>b</sup> ±1.43	11.48 <sup>b</sup> ±2.21	14.81 <sup>b</sup> ±1.82

a, b, c, d: means with the different letter in the same column are significantly different (P<0.05), all values are mean ±standard deviation of three replicates, \*U: uncooked, C: cooked samples

## Conclusion

The results of our study pave the way to manufacture healthier meat products in terms of reduced fat content. However researches should be continued on the gelled emulsions and their effects on the different meat products.

## References

- ANONYMOUS. (1979) Tekator Manual Kjeltec System 1002, Sweden
- AOAC. (2012) Official Methods of Analysis, Latimer, G.W., 19th ed. Gaithersburg, MD, USA.
- BACKES, Â. M., NASCIMENTO TERRA, N., GUIDOLIN MILANI, L. I., DE SOUZA REZER, A. P., LUDTKE, F. L., PASQUALIN CAVALHEIRO, C. and MARTINS FRÊS, L. L. (2013) Características físico-químicas e aceitação sensorial de salame tipo Italiano com adição de óleo de canola. *Semina: Ciências Agrárias*, 34(2): 3709-1719.
- FEINER, G. (2006) Meat products handbook: Practical science and technology. *Elsevier*, pp. 297-309.
- FLYNN, A. W. and BRAMBLETT, V. D. (1975) Effects of frozen storage, cooking method and muscle quality on attributes of pork loins. *Journal of Food Science* 40: 631-633.
- HUGHES, E., COFRADES, S. and TROY D. J. (1997) Effects of fat level, oat fibre and carrageenan on frankfurters formulated with 5, 12 and 30% fat. *Meat Science* 45: 273-281.
- MULLA, M., AHMED, J., AL-ATTAR, H., CASTRO-AGUIRRE, E., ARFAT, Y. A. and AURAS, R. (2017) Antimicrobial efficacy of clove essential oil infused into chemically modified LLDPE film for chicken meat packaging. *Food Control* 73: 663-671.
- MURPHY, E. W., CRINER, P. E. and GREY, B. C. (1975) Comparisons of methods for calculating retention in cooked foods. *Journal of Agricultural and Food Chemistry* 23: 1153-1157.
- PARADISO, V. M., GIARNETTI, M., SUMMO, C., PASQUALONE, A., MINERVINI, F. and CAPONIO, F. (2015) Production and characterization of emulsion filled gels based on inulin and extra virgin olive oil. *Food Hydrocolloids* 45: 30-40.
- PINTADO, T., HERRERO, A. M., JIMÉNEZ-COLMENERO, F., CAVALHEIRO, C. P. and RUIZ-CAPILLAS, C. (2018) Chia and oat emulsion gels as new animal fat replacers and healthy bioactive sources in fresh sausage formulation. *Meat science*, 135, 6-13.

- PINTADO, T., HERRERO, A. M., RUIZ-CAPILLAS, C., TRIKI, M., CARMONA, P. and JIMENEZ-COLMENERO, F. (2015) Effects of emulsion gels containing bioactive compounds on sensorial, technological and structural properties of frankfurters. *Food Science and Technology International* 22(2): 132-145.
- POYATO, C., ANSORENA, D., BERASATEGI, I., NAVARRO-BLASCO, Í., and ASTIASARAN, I. (2014) Optimization of a gelled emulsion intended to supply u-3 fatty acids into meat products by means of response surface methodology. *Meat Science* 98: 615-621.
- SERDAROĞLU, M., NACAĞ, B. and KARABIYIKOĞLU, M. (2017) Effects of Beef Fat Replacement with Gelled Emulsion Prepared with Olive Oil on Quality Parameters of Chicken Patties. *Korean journal for food science of animal resources* 37(3): 376-384.
- SERDAROĞLU, M., NACAĞ, B., KARABIYIKOĞLU, M. and KESER, G. (2016) Effects of partial beef fat replacement with gelled emulsion on functional and quality properties of model system meat emulsions. *Korean journal for food science of animal resources* 36(6): 744-751.

## The Edible Coatings for Maintaining Eggs Quality and Minimize Eggshell Breakage: A-Review

Muhammed Yüceer<sup>1\*</sup> And Cengiz Caner<sup>2</sup>

<sup>1</sup>Department of Food Processing, Canakkale Onsekiz Mart University, Turkey, 017020;

<sup>2</sup>Department of Food Engineering, Canakkale Onsekiz Mart University, Turkey, 017020.

### Abstract

Eggs are one of the finest food that offering human the complete balance of essential nutrients. The egg-shell, a thin mineral structure, is a porous and breathable material which allowed movement of moisture and CO<sub>2</sub> and protects the egg contents against mechanical-impact, dehydration, and microorganism contamination. *During transport, eggs with poor-shell strength can become cracked* increasing the opportunity for microbial contamination and making the *eggs* unmarketable. Edible films can be used as a “skin”, providing a partial barrier to moisture, O<sub>2</sub> and CO<sub>2</sub>, improving egg’s mechanical handling. Coating eggs may increase shell-strength and potentially decrease the number of cracked eggs.

**Key words:** coating, egg, egg quality, shelf life, shell strength.

### Yumurta Kalitesinin Korunması ve Kabuk Kırılmalarının Azaltılması için yenilebilir Kaplamalar: Derleme

#### Özet

Yumurta, insana günlük tüketilmesi gerekli olan besin öğelerinin tamamını dengeli bir şekilde sunan en iyi besindir. Yumurta kabuğu, ince mineral yapısı ile gözenekli ve nefes alabilen, nem ve CO<sub>2</sub> geçişine izin veren, yumurta içeriğini mekanik etkilere, dehidrasyon ve mikrobiyel kontaminasyona karşı koruyan bir malzemedir. Nakliye esnasında zayıf kabuk yapısına sahip yumurtalar kırılarak mikrobiyal kontaminasyona yola açabilmekte ayrıca yumurtanın pazarlanmasını önlemektedir. Yenilebilir filmler “skin” olarak kullanılabilenlerde böylelikle rutubet, O<sub>2</sub> ve CO<sub>2</sub> geçişine karşı bariyer görevi görmektedir. Ayrıca yumurtanın elleçleme (sınıflandırma, aktarma, paketleme, paletleme, etiketleme, nakliye, vd.) sürecinde

mukavemetini de arttırmaktadır. Kaplamalar yumurtanın kabuk dayanıklılığını arttırabilmekte ve olası kırık sayısının azaltılmasında kullanılabilir.

*Anahtar kelimeler:* kaplama, yumurta, yumurta kalitesi, raf ömrü, kabuk mukavemeti.

## **Introduction**

Eggs are one of the few foods that are widely consumed throughout the world; thus, eggs represent an important segment of the world food industry and an important commodity in international trades. Eggs are one of the finest food that offering human the complete balance of essential nutrients with proteins, vitamins, minerals and fatty acids with great biological value and the lowest cost. A hen egg is composed of three main parts: shell, albumen (egg white) and yolk, and their distributions out of the total egg weight are 9-11%, 60-63%, and 28-29%, respectively. The egg shell is composed of a thin film of cuticle, a calcium carbonate layer (composed by a vertical crystal layer, palisade layer, and mammillary knob layer), and two shell membranes (inner and outer membranes). Moreover, egg shells contain a large number of pores (in excess of 7.500 per egg) that allow permeation of water and gases (Zeidler, 2002). The cuticle protects the egg from moisture loss and invasion of microorganisms to a certain extent but it can be easily removed by washing with water in industrial processes. The egg albumen occurs in four layers: the chalaza, inner thick white, the inner. The main components of a hen egg are lipids (12%), proteins (12%) and water (75%) with additional small amounts of carbohydrates and minerals thin white (inner liquid), the outer thick white (dense) and the outer thin (outer liquid) layer. Eggs are highly susceptible to internal quality deterioration and microbial contamination since the moment of lay. During storage, a thinning of the albumen and an increase in the size of the air cell is observed mainly due to water loss. Carbon dioxide (CO<sub>2</sub>) migration throughout the egg shell leads to an increase in albumen pH and a decrease in the vitelline (yolk) membrane strength, thus causing interior quality deterioration. During the storage of shell eggs, changes in physical, chemical, biological, and functional characteristics of egg albumen constituents may occur principally due to storage conditions such as time, temperature, and relative humidity (Caner and Cansız, 2007, 2008). The albumen pH can be used as an indicator of the albumen quality of (Scott and Silversides, 2000). Freshly laid eggs contain

1.44-2.05 mg CO<sub>2</sub>/g of albumen (Biladeau and Keener, 2009) and have an albumen pH value of 7.6-8.7. During storage, carbon dioxide escapes via eggshell pores, resulting in increased albumen pH value up to 9.6-9.7.

The egg shell, a thin mineral structure, is a porous and breathable material which allowed movement of moisture and carbon dioxide and protects the egg contents against mechanical impact, dehydration, and microorganism contamination. This mass transfer may cause physical and chemical changes in albumen and yolk while at the same time increase the vulnerability of pathogens contamination and rate of egg deterioration. They undergo chemical and microbial contamination, highly reducing their shelf life. Increasing the shelf-life of eggs may increase export sales. *During transport* and marketing, *eggs* with poor-shell strength can become *cracked* increasing the opportunity for microbial contamination and making the *eggs* unmarketable. The eggshell is the natural packing material for the egg contents, and as a result, it is important to obtain high shell strength, to resist all impacts an egg is subjected to during the production chain (Stadelman and Cotterill, 1995). Factors associated with the level of quality loss are time, temperature, humidity, air movement, and handling. Coating materials are effective methods to preserve the internal quality of eggs and prevent microbial contamination. Thin layer or a coating, is an integral part of a food and may be eaten with the food, it qualifies as 'edible' packaging. Coatings are either applied to or formed directly on foods, while films are self-supporting structures that can be used to wrap food products (Figure 1).

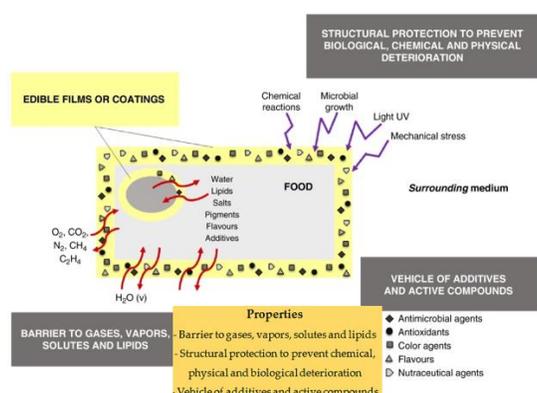


Figure 1. Main functions of edible films and coatings in food packaging applications (Salgado et al., 2015).

Coating of eggs is thus an alternative and effective way to preserve the internal quality. Various coating materials have been applied to the surface of egg shells for preserving the internal quality of eggs. These include synthetic polymers, polysaccharides, proteins and oils. The physical and chemical characteristics of these components are very different; therefore, they would influence the functionality of the materials formed (Figure 2).

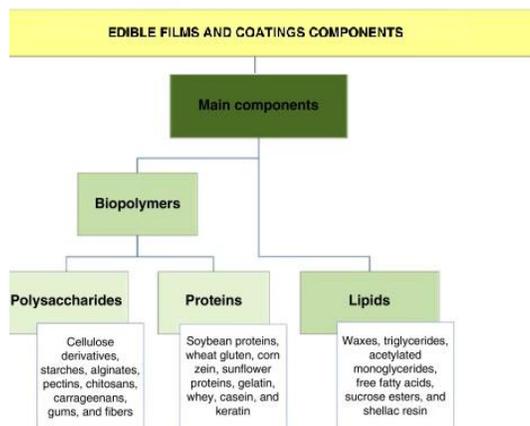


Figure 2. Edible films and coatings compositions (Salgado et al., 2015).

One of the approach to preserving eggs shell has been directed to the development of coating materials, made of lipid, carbohydrate and proteins to protect eggs shell cuticle. Edible film also has the potential to act as a skin to protect mass transfer and mechanical damage to shell. Edible films can be used as a “skin” for fresh eggs of food products, providing a partial barrier to moisture, oxygen and carbon dioxide, improving mechanical handling properties. Coating eggs increases the shell strength and potentially decrease the number of cracked eggs. With the large number of eggs produced, even a small percentage improvement in the overall quality of eggs shell and egg shells could result in minimizing cracked or broken percentage lead to significant savings to the commercial egg industry. The goal of this review discusses the use of different edible coatings (polysaccharides, proteins, lipids and composite) on fresh eggs to minimize shell’s breakage and sealing pores (moisture loss, oxygen) for increasing shelf life. Estimates are that more than 10% of eggs produced in the

hen house are uncollectible or break before intended use. The first 2-5 percent is lost simply, due to from which may be shell less, cracked or broken (unsuitable for collection). Another 3-8 percent is lost during collection, moving through the belts, cleaning, packing and transportation to the end user (Gupta, 2008). Therefore, every effort must be directed towards improving shell quality and reducing egg breakage. Consequently, improving shell strength of eggs will potentially decrease the number of cracked eggs while resulting in significant savings to the industry. Shell eggs also undergo a sequence of considerable interior (functional) quality changes and microbial contamination during the storage (Jones et al., 2004). The eggshell, with porous structure, allows carbon dioxide and moisture to escape while allowing contaminants such as bacteria and odours to enter the egg (Berrang et al., 1999; De Reu et al., 2006; Leleu et al., 2011). They are highly perishable and can rapidly lose their internal qualities via the loss of moisture and carbon dioxide through the pore during storage (Caner and Cansız, 2007, 2008; Yuceer and Caner, 2014).

It is proven that some protection methods such as eggshell coating minimize deterioration in interior egg quality. The edible films, which are not detrimental to human health, have a barrier property against oxygen, carbon dioxide and humidity movement from eggs. Some conservation methods including oil coating, dipping in low temperature, freezing, high temperature and drying and also the coating of egg shell with chitosan, whey protein and shellac are used for protection of interior egg quality (Copur et al., 2009). Being the breathable material, eggshells permit moistness and carbon dioxide to infuse over the pores. This infusion reasons fluctuations in albumen, yolk resulted in weight loss. So, there is a need to seal pores on eggshell to lessen evaporation and leakage of carbon dioxide. There would be minimum changes in internal quality of egg as the pores are sealed. Usage of better shielding approaches like coating and edible films could reduce damages. Shell oil coating is one of the previously accepted methods for preservation of egg value. Coatings can increase the overall interior quality and mechanical characteristics of eggshell and could aid to lessen cost-effective damage from breaking (Saeed et al., 2016). Thus it is important to protect the egg shells against mass transfer. A process that seals porous of the eggshell has to be developed not only to reduce mass transfer through eggshell but also to improve shell strength to extend the shelf-life and reduce shell breakage.

It is very challenging to extend the shelf life and the maintain quality of foods. Therefore, development of emerging practices is necessary for preserving the quality of fresh foods. Several technologies, including cold storage, UV, MAP and ozonation have been used for reducing deterioration of the quality while prolonging shelf life of foods (Allende et al., 2006; Debabandya et al., 2013). There has been increasing interest in using coatings as a food preservation method as well as tool to enhance its quality, safety and stability. Such coatings are used as a thin layer to protect perishable foods by controlling the internal gas atmosphere (Allende et al., 2006; Olivas and Barbosa-Canovas, 2005). Using coating of eggshell may increase its strength and potentially decrease the number of cracked eggs. Even a small improvement will result in significant savings for the egg industry. Potentially, a thin protective coating layer should provide a barrier against mass transfer and may preserve viscosity, whipping and foam stability (Caner and Yüceer, 2015; Foegeding et al., 2006; Lomakina and Mikova, 2006).

Various raw edible materials are suitable for coatings of food products: proteins (e.g. whey, corn, soy), polysaccharides (e.g. cellulose derivatives or starches), lipids (e.g. waxes, shellac), and even some synthetic polymers (e.g. polyvinyl acetate) (Attila and Orts., 2009). *Selecting a suitable coating* for fresh eggshell quality is important to minimized mass transfer, oxidation processes or microbial growth. Barrier and mechanical properties of coatings or films depend on their molecular structure. Therefore, it is important to use appropriate coatings that will provide the best protection for internal quality of fresh eggs.

Protein coatings show potential as value-added applications that might receive little resistance from regulators for food use. Caner and Yüceer (2015), in a study using various coatings (whey protein isolate [WPI], whey protein concentrate [WPC], zein, and shellac) as coating materials of eggs, reported that coatings and storage time had significant effects on Haugh unit, yolk index, albumen pH, dry matter, relative whipping capacity, and albumen viscosity. Uncoated eggs had higher albumen pH (9.56) and weight loss, and lower albumen viscosity (5.73), Haugh unit (HU), and yolk index (YI) during storage. Among the coated eggs, the shellac and zein coated eggs had the highest value of albumen viscosity (27.26 to 26.90), HU (74.10 to 73.61), and YI (44.84 to 44.63) after storage. Shellac (1.44%) was more effective in preventing weight loss than WPC (4.59%), WPI

(4.60%), and zein (2.13%) coatings. All coatings increased shell strength (5.18 to 5.73 for top and 3.58 to 4.71 for bottom) significantly compared to the uncoated eggs (4.70 for top and 3.15 for bottom). The functional properties such as albumen dry matter (14.50 to 16.66 and 18.97 for uncoated) and albumen relative whipping capacity (841 to 891 and 475 for uncoated) of fresh eggs can be preserved during storage when they are coated. The shellac and zein coatings were more effective for maintaining the internal quality of fresh eggs during storage.

Protein based biopolymers such as whey proteins and corn zein have desirable barrier properties (Kirsten et al., 2009). Whey is one of the most promising proteins due to gas barrier properties and glossy appearance (Hosseini, 2011). Whey protein (WPC, protein concentration 65-80 % in dry matter, or WPI, protein concentrations over 90% in dry matter), a byproduct of the cheese industry, has excellent nutritional and functional properties and has the potential to be used in edible films. Among other proteins corn zein, obtained from the corn gluten that is a by product of corn industry, has great potential in food packaging applications (Padua and Wang, 2002). Therefore, use of corn zein in coatings of eggshell applications is very attractive because it has better barrier characteristics to moisture and oxygen compared to other proteins. Numerous other food-grade coating materials (mineral oils, waxes, whey protein, soy protein, gluten, chitosan and cellulose-based materials) have also proven to be effective in reducing mass transfer by sealing porous and have been researched extensively (Caner, 2005; Hernandez-Ledesma and Chia-Chien, 2013; Rhim et al., 2004; Waimaleongora-Ek et al., 2009; Wong et al., 1996; Xie et al., 2002). Waimaleongora-Ek et al. (2009), in a study using different viscosities of mineral oil (from 7 to 26 mPa s) as coating materials of eggs, reported that mineral oil with the highest viscosity (26 mPa s) was more effective in preventing weight loss and in preserving albumen quality of eggs compared with that observed for other lower viscosity mineral oil coatings during storage. Wong et al. (1996) reported that eggshells coated with mineral oil possessed a higher  $L^*$  value (lightness) than non-coated eggs (87.05 vs. 83.90), possibly due to glossier surface.

Mudannayaka et al. (2016), in a study using mineral oil, beeswax, *Aloe vera* gel and gelatine as a coating materials of fresh eggs, reported that beeswax and gelatine coated eggs showed significantly ( $P<0.05$ ) lower weight loss values and preserved albumin and yolk

quality of eggs than control eggs. Eggs coated with mineral oil and beeswax showed similar results for weight loss, HU, YI, albumen and yolk pH. Based on the HU, eggs can be classified into four grades as AA (above 72), A (72-60), B (59-31) and C (below 30). Quality of uncoated eggs, *Aloe vera* coated eggs and gelatine coated eggs dropped from AA to B and mineral oil and beeswax coated eggs changed from initial AA quality to A quality after six weeks of storage at 30°C. Results of microbiological analysis showed that all coated eggs were microbiologically safe throughout the storage period. The present study demonstrated that, in comparison to the mineral oil and the uncoated eggs, beeswax is a better novel coating material and gelatine can also be successfully used as coating material in preserving the internal quality and extending the shelf life of chicken eggs for six weeks (30°C). However, few research has been conducted using food proteins such as WPC, WPI and corn zein as coatings on shell eggs for extending interior qualities and functional properties. The effects of protein based edible coatings on the preserving internal quality and functional properties of fresh eggs have also not been extensively studied. Thus, the goals of this research were to compare different types of food protein coatings [whey protein isolate, whey protein concentrate, corn zein]. Food grade shellac is also used as "wax" coating on shell eggs to comparison (Caner and Yüceer, 2015; Musa et al., 2011).

Effects of various concentrations of propolis for egg coating (5%, 8% and 10% of propolis in ethanol) on the interior quality of fresh eggs were evaluated during 4 weeks of storage. During storage, albumen height decreased whereas albumen pH increased. The albumen pH of the uncoated eggs), and the eggs coated with alcohol and 5% propolis was significantly higher than the albumen pH of eggs coated with 8% and 10% propolis. On the other hand, at 4 weeks storage eggs of 8% and 10% had a higher albumen index than the rest of the groups. In conclusion, coating of eggs with 10% propolis extract improved interior egg quality during storage (Copur et al., 2009). Musa et al. (2011), in a study using 5% shellac concentration can be used successfully to improve the internal quality changes in eggs during a storage time. Khattak et al. (2016), in a study revealed that coatings and storage time had significant effects on pH, Haugh unit, weight loss, eggshell breaking strength, foaming properties, total solid of albumen and yolk.

## Conclusion

To conclude, the resistance to gas exchange of coated eggs is strongly influenced by the coating's ability to block pores on the surface of the eggs. Coatings, especially zein and shellac coating are promising and most effective coatings since they delay the deterioration of the internal quality. The coatings improved functional properties and also shell strength and could be a viable alternative technology for maintaining the internal quality of eggs during long-term storage. This study highlights the promising use of various coatings to both enhance the functional properties and to reduce the breakage of eggs

## References

- Allende, A., Toma's-Barbera'n, F.A., Gril, M., (2006). Minimal Processing for Healty Traditional Foods. *Trends in Food Science & Technology* 17(9), 513-519.
- Attila, E., Orts., P.a.W., (2009). Edible films and coatings: why, what, and how?, in: Embuscado, M.E., Huber, K.C. (Eds.), *Edible Films and Coatings for Food Applications*. Springer Dordrecht Heidelberg London New York.
- Berrang, M.E., Cox, N.A., J.F., F., Buhr, R.J., (1999). Bacterial Penetration of the Eggshell and Shell Membranes of the Chicken Hatching Egg- A Review. *J. Appl. Poult. Res.* 8, 499-504.
- Biladeau, A.M., Keener, K.M., (2009). The effects of edible coatings on chicken egg quality under refrigerated storage. *Poult. Sci.* 88(6), 1266-1274.
- Caner, C., (2005). Whey protein isolate coating and concentration effects on egg shelf life. *J. of the Sci. of Food and Agric.* 85(13), 2143-2148.
- Caner, C., Cansız, Ö., (2007). Effectiveness of chitosan-based coating in improving shelf-life of eggs. *J. of the Sci. of Food and Agric.* 87(2), 227-232.
- Caner, C., Cansız, Ö., (2008). Chitosan coating minimises eggshell breakage and improves egg quality. *J. of the Sci. of Food and Agric.* 88(1), 56-61.
- Caner, C., Yüceer, M., (2015). Efficacy of various protein-based coating on enhancing the shelf life of fresh eggs during storage. *Poult Sci* 94(7), 1665-1677.
- Copur, G., Camci, O., Sahinler, N., Gul, A., (2009). The effect of propolis egg shell coatings on interior egg quality. *Arch.Geflügelk* 72(1), 35-40.
- De Reu, K., Grijspeerdt, K., Messens, W., Heyndrickx, M., Uyttendaele, M., Debevere, J., Herman, L., (2006). Eggshell factors influencing eggshell penetration and whole egg contamination by different bacteria, including *Salmonella enteritidis*. *Int J Food Microbiol* 112(3), 253-260.
- Debabandya, M., Sabyasachi, M., Saroj, G., Abhijit, K., (2013). Application of hurdles for extending the shelf life of fresh fruits. *Trends in Post Harvest Technol.* 1, 37-54.

- Foegeding, E.A., Luck, P.J., Davis, J.P., (2006). Factors determining the physical properties of protein foams. *Food Hydrocolloids* 20(2-3), 284-292.
- Gupta, L., (2008). Maintaining Egg Shell Quality. *ThePoultrySite.com*
- Hernandez-Ledesma, B., Chia-Chien, H., (2013). Chapter 5. functional proteins and peptides of hen's egg origin, in: M. Abdou, A., Kim, M., Sato, K. (Eds.), *Bioactive Food Peptides in Health and Disease*, pp. 115-116.
- Hossein, J., (2011). Whey protein films and coatings: a review. *Pakistan Journal of Nutrition* 10(3), 296-301.
- Jones, D.R., Musgrove, M.T., Northcutt, J.K., (2004). Variations in External and Internal Microbial Populations in Shell Eggs during Extended Storage. *J. of Food Protec.* 67(12), 2657-2666.
- Khattak, A., Sharma, M., Sanghi, D., (2016). Extension of Shelf Life of Raw Eggs Using Whey Protein Based Eggshell Coating. *International Journal of Food and Nutritional Sciences* 5(3), 80-83.
- Kirsten, D., Peggy, M., Tomasula, a.P.Q., (2009). Structure and function of protein-based edible films and coatings, in: Embuscado, M.E., Huber, K.C. (Eds.), *Edible Films and Coatings for Food Applications*. Springer Dordrecht Heidelberg, London New York.
- Leleu, S., Herman, L., Heyndrickx, M., De Reu, K., Michiels, C.W., De Baerdemaeker, J., Messens, W., (2011). Effects on Salmonella shell contamination and trans-shell penetration of coating hens' eggs with chitosan. *Int. J. Food Microbiol.* 145(1), 43-48.
- Lomakina, K., Mikova, K., (2006). A study of the factors affecting the foaming properties of egg white – a review. *Czech J. of Food Sci.* 24(3), 110-118.
- Mudannayaka, A.I., Rajapaksha, D.S.W., Kodithuwakku, K.A.H.T., (2016). Effect of Beeswax, Gelatin and Aloe vera Gel Coatings on Physical Properties and Shelf Life of Chicken Eggs Stoted at 30 C. *J. World Poult Res.* 6(1), 06-13.
- Musa, T.N., Ulawi, W.S., Al-Hajo, N.A.A., (2011). The Effect of Shellac as Coating Material on the Internal Quality of Chicken Eggs. *Int. J. of Poult. Sci.* 10(1), 38-41.
- Olivas, G.I., Barbosa-Canovas, G.V., (2005). Edible coatings for fresh-cut fruits. *Crit Rev Food Sci Nutr* 45(7-8), 657-670.
- Padua, G.W., Wang, Q., (2002). Formation and properties of corn zein films and coatings, in: Gennadios, A. (Ed.), *Protein-Based Films and Coatings*. CRC Press, Florida, pp. 43-67.
- Rhim, J.W., Weller, C.L., Gennadios, A., (2004). Effects of soy protein coating on shell strength and quality of shell eggs. *Food Science and Biotechnology* 13(4), 455-459.
- Saeed, F., Javaid, A., Ahmed, N., Nadeem, M.T., Arshad, M.S., Imran, A., Sohaib, M., Khan, A.U., (2016). Influence of Edible Coating Techniques on Quality Characteristics of Eggs. *Journal of Food Processing and Preservation*.

- Salgado, P.R., Ortiz, C.M., Musso, Y.S., Di Giorgio, L., Mauri, A.N., (2015). Edible films and coatings containing bioactives. *Current Opinion in Food Science* 5, 86-92.
- Scott, T.A., Silversides, F.G., (2000). The effect of storage and strain of hen on egg quality. *Poult. Sci.* 79(12), 1725-1729.
- Stadelman, W.J., Cotterill, O.J., (1995). *Egg Science and Technology* The Haworth Press Inc - Food Products Press, New York.
- Waimaleongora-Ek, P., Garcia, K.M., No, H.K., Prinyawiwatkul, W., Ingram, D.R., (2009). Selected quality and shelf life of eggs coated with mineral oil with different viscosities. *J Food Sci* 74(9), S423-429.
- Wong, Y.C., Herald, T.J., Hachmeister, K.A., (1996). Evaluation of mechanical and barrier properties of protein coatings on shell eggs. *Poult Sci* 75(417-422).
- Xie, L., Hettiarachchy, N.S., Ju, Z.Y., Mueullenet, J., Wang, H., Slavik, M.F., Janes, M.E., (2002). Edible film coating to minimize eggshell breakage and reduce post-wash bacterial contamination measured by dye penetration in eggs. *J Food Sci* 67(1), 280-284.
- Yuceer, M., Caner, C., (2014). Antimicrobial lysozyme-chitosan coatings affect functional properties and shelf life of chicken eggs during storage. *J Sci Food Agric* 94(1), 153-162.
- Zeidler, G., (2002). Shell Eggs and Their Nutritional Value, in: Bell, D., Weaver, W. (Eds.), *Commercial Chicken Meat and Egg Production*, 5 ed. Norwell, Mass.: Kluwer Academic Publishers. pp. 1109-1128.

## **Emerging and New Non-Thermal Food Preservation Technologies in Egg Processing – Trends and Future Industrial Perspectives: An Overview**

**Muhammed Yüceer**

Department of Food Processing, Canakkale Onsekiz Mart University, Turkey,  
017020;

### **Abstract**

There is an increasing demand for an emerging non-thermal food processing techniques which are finding increasingly new applications in the food preservation. Novel techniques also have a potential in improving functional and physico-chemical properties of foods with high-value-added functional food and bioactive ingredients. Egg products which are known as products are obtained from eggs and egg derivatives are ready for use in human consumption available in form of frozen, liquid, concentrated, salted, and powdered.

This research provides an overview and industry-based projections about the egg and egg products and novel technology perspectives.

**Key words:** *egg and egg products, non-thermal processing, novel and emerging food technologies.*

### **Yumurta İşleme Endüstrisindeki Yenilikçi ve Isıl Olmayan Yeni Gıda Muhafaza Teknolojileri: Güncel Eğilimler ve Gelecekteki Endüstriyel Perspektifler - Genel Bakış**

### **Özet**

Gıda muhafazasında ısıl-olmayan yenilikçi gıda işleme uygulamalarına yönelik talep artmaktadır. Yenilikçi teknikleri ile fonksiyonel gıda ve biyoaktif bileşenleri içeren gıdaların fonksiyonel ve fiziko-kimyasal özelliklerini geliştirmek mümkün olmaktadır. Yumurta ürünleri yumurtadan elde edilen; yumurtanın sıvı, konsantre, toz, dondurulmuş ve tuzlanmış olan formlarını kapsayan insani tüketime uygun olan endüstriyel ürünlerdir.

Bu araştırma, yumurta ve yumurta ürünlerinde yeni ve yenilikçi teknolojik perspektifler hakkında genel bir bakış açısı ile endüstriyel temelli projeksiyonlar sağlamayı amaçlamaktadır.

*Anahtar kelimeler:* yumurta ve yumurta ürünleri, ısıl olmayan işlemler, yenilikçi gıda teknolojileri.

## **Introduction**

Eggs are excellent protein sources, easy to obtain, contains proteins and have been utilized as benefit to functional ingredient applications with functionalities of foaming, gelling, binding etc. Egg Products are ready to use, and adaptable to different recipes of food products such as meringue, cake, and mayonnaise. Egg undergo considerable quality changes resulting in losses during storage due to the fact that eggs are highly perishable. Thus, it is necessary for eggs to reach the final consumer market without considerable time lapse (Caner ve Cansız, 2007; Caner ve Cansız, 2008) or if time lapse is unavoidable it is important to improve the egg freshness and extend the shelf life using effective treatment techniques during storage and beyond.

Development of non-thermal food preservation methods is necessary for maintaining the qualities of perishable foods. Non-thermal methods allow processing of foods below the temperatures used during thermal pasteurization. Thermal and non-thermal processing technologies are both used in the preserving and extending shelf life of food products. However, the common food processing methods currently used to increase shelf life and inactivate microbial growth in foods are conventional heat treatment, whereas thermal treatment cause to nutritional losses, deterioration of functional properties, development of undesirable flavors, and odors (Shankar, et al., 2014). Novel non-thermal food processing techniques include such as high hydrostatic pressure (HHP), pulsed electric field (PEF), UV, ultrasound (US), ozone, radio frequency (RF) and pulsed light technology (PL). The novel technology has been shown to be an attractive alternative to conventional thermal treatments. Many researchers have been studying to develop and design process replacing heat treatments in food and egg industry. However, this emerging technology must also maintain or surpass the main purpose of egg pasteurization, which is to yield a wholesome product by eliminating pathogenic bacteria and maintain functional properties (Anonymous, 2015).

The goal of this review discusses various non-thermal techniques (ultraviolet light, ionizing radiation, pulsed light processing, pulsed electric field, high pressure processing, ultrasound, ozone processing, plasma technology, pulse x-rays, etc.) functional effects on the egg products in order to minimize functional losses and physico-chemical degradation whereas increasing shelf life and physico-functional properties.

High hydrostatic pressure (HPP) is suitable for inactivation of microorganisms and enzymes, and denaturation of functionality of protein in liquid egg products (Nemeth, et al., 2012). HPP can be used to replace thermal processing methods as it provide minimum losses in functional properties (Ahmed, et al., 2003). Ibarz, et al. (1999) studied high hydrostatic pressure application in egg products (egg yolk, egg white and whole egg) for 410-690 MPa with exposure time of 1-30 min. The results of study showed that, egg yolk was susceptible to pressure than egg white and whole egg samples.

Ultrasonic treatment is one of these emerging techniques that could be the alternative to existing thermal processing techniques. It is based on the transmission of ultrasonic sound waves (20 kHz to 100 kHz frequency) through a media. It enhances convective heat transfer as well as generates bubble explosions, which produce local hot spots that could cause microorganism inactivation and enzyme destruction by cavitation (Ajlouni, et al., 2006; Piyasena, et al., 2003). High power ultrasonic treatment is also known to damage or disrupt biological cell walls, which will result in the destruction of living cells (Aday, et al., 2013; Ajlouni, et al., 2006; Chemat, et al., 2011; Feng, et al., 2011).

The use of ultrasound in fresh produce as a non-thermal technique is a relatively recent endeavour and considered as a food preservation method to enhance food quality, safety and stability. Recently, numerous ultrasound studies were published on fruits, vegetables, fruit juices and dairy products (Ajlouni, et al., 2006; Birmpa, et al., 2013; Chemat, et al., 2011). Similarly, using ultrasonic waves may improve the overall characteristics of shell eggs that will result in significant savings for the egg industry (Caner ve Yuceer, 2015).

The ozone treatments have gained interest for extending the shelf life of perishable foods. Ozone (O<sub>3</sub>), a highly reactive and an effective antimicrobial agent, generates no residual chemicals (Braun, et al.,

2011; Kim, et al., 2003). The United States Department of Agriculture (USDA) and Food and Drug Administration (FDA) approved gaseous and aqueous ozone as an antimicrobial agent for direct use in food applications (Anonymous, 2014; Braun, et al., 2011; Kamotani, et al., 2010). Ozone is also approved in the US on meat and poultry products in accordance with industrial standards of good manufacturing practice (21 CFR 173.368; FDA 2003). As a result, there is a growing research interest in use of ozone applications for extending shelf life of food products (Khadre, et al., 2001; Kim, et al., 1999; Kim, et al., 2003; Pirani, 2010; Sopher, et al., 2002).

In the last decade the efficacy of ozonation on the surface of fresh eggs have been studied (Braun, et al., 2011; Fuhrmann, et al., 2010; Goo-Hee ve Kyung-Haeng, 2012; Kamotani, 2009; Maxkwee, 2013; Perry, 2010; Rodriguez-Romo, et al., 2007). Rodriguez-Romo, et al. (2007) reported that gaseous ozone can penetrate through eggshell pores. Fuhrmann, et al. (2010) showed that even at low ozone concentrations, cuticula proteins of the egg can be destroyed by oxidation of amino acids and three-dimensional structures. Goo-Hee ve Kyung-Haeng (2012) studied the effects of gaseous ozone (38.8 ppm) for 10 to 30 minutes treatment times on the egg's physical and chemical characteristics including HU, yolk colour, pH of egg albumen and yolk, foaming ability, foam stability and lipid oxidation development. The results of that study showed that ozone treated eggs were no different than controls when stored at 4 °C for 14 days. The effects of gaseous ozone on extending the shell of eggs and internal quality (Yuceer, et al., 2016).

## **Conclusion**

In conclusion, nowadays several non-thermal methods including high-pressure, ultrasound and ozonation have been *studied* as food preservation technologies. Thus, novel food processing methods are relatively new in industrial application and the development of emerging technologies with larger capacities are still have some both technical and economic issues needs to be solved. But a combination of both traditional pasteurization technologies and novel non-thermal methods with use of hurdle strategy method could be an emerging approach for near-future egg processing plants.

## References

- Aday, M. S., Temizkan, R., Büyükcan, M. B., and Caner, C. (2013). An innovative technique for extending shelf life of strawberry: Ultrasound. *LWT - Food Sci. and Tech.* 52:93-101
- Ahmed, J., Ramaswamy, H. S., Alli, I., and Ngadi, M. (2003). Effect of high pressure on rheological characteristics of liquid egg. *LWT - Food Science and Technology* 36:517-524
- Ajlouni, S., Sibrani, H., Premier, R., and Tomkins, B. (2006). Ultrasonication and Fresh Produce (Cos lettuce) Preservation. *J. of Food Sci.* 71:62-68
- Anonymous (2014). Secondary Direct Food Additives Permitted in Food for Human Consumption. <http://www.fda.gov/ohrms/dockets/98fr/062601a.htm>. Accessed 07.02.2014 2014.
- Anonymous (2015). Emerging Food Innovation: Trends and Opportunities. [http://www.agr.gc.ca/resources/prod/doc/pdf/emerging\\_food\\_innovations\\_innovations\\_alimentaires\\_emergentes-eng.pdf](http://www.agr.gc.ca/resources/prod/doc/pdf/emerging_food_innovations_innovations_alimentaires_emergentes-eng.pdf).
- Birmpa, A., Sfika, V., and Vantarakis, A. (2013). Ultraviolet light and ultrasound as non-thermal treatments for the inactivation of microorganisms in fresh ready-to-eat foods. *Int. J. of Food Microb.* 167:96-102
- Braun, P. G., Fernandez, N., and Fuhrmann, H. (2011). Investigations on the Effect of Ozone as a Disinfectant of Egg Surfaces. *Ozone: Sci. & Eng.* 33:374-378
- Caner, C., and Cansız, Ö. (2007). Effectiveness of chitosan-based coating in improving shelf-life of eggs. *J. of the Sci. of Food and Agric.* 87:227-232
- Caner, C., and Cansız, Ö. (2008). Chitosan coating minimises eggshell breakage and improves egg quality. *J. of the Sci. of Food and Agric.* 88:56-61
- Caner, C., and Yuceer, M. (2015). Maintaining functional properties of shell eggs by ultrasound treatment. *J Sci Food Agric* 95:2880-2891
- Chemat, F., Huma, Z., and Khan, M. K. (2011). Applications of ultrasound in food technology: Processing, preservation and extraction. *Ultrasonics Sonochem.* 18:813-835
- Feng, H., Barbarosa-Canovas, G. V., and Weiss, J. (2011). *Ultrasound Technologies for Food and Bioprocessing*. Springer Science +Business Media.

- Fuhrmann, H., Rupp, N., Buchner, A., and Braun, P. (2010). The Effect of Gaseous Ozone Treatment on Egg Components. *J. Sci. Food Agric.* 90:593-598
- Goo-Hee, C., and Kyung-Haeng, L. (2012). Effect of Ozone Treatment for Sanitation of Egg. *Korean J. for Food Sci. of Ani. Res.* 32:198-203
- Ibarz, A., Sangronis, E., Barbosa-Cánovas, G. V., and Swanson, B. G. (1999). Textura de geles de huevo obtenidos por alta presión / Texture of egg gels induced by high hydrostatic pressure. *Food Science and Technology International* 5:191-201
- Kamotani, S. (2009). *Consumer Accpetance of Ozone-Treated Whole Shell Eggs*. MSc Dissertation. The Ohio State University, Colombus, Ohio, USA.
- Kamotani, S., Hooker, N., Smith, S., and Lee, K. (2010). Consumer Acceptance of Ozone-Treated Whole Shell Eggs. *J. of Food Sci.* 75:S103-107
- Khadre, M. A., Yousef, A. E., and Kim, J. G. (2001). Microbiological Aspects of Ozone Applications in Food: A Review. *J. Food Sci.* 66:1242-1252
- Kim, J.-G., Yousef, A. E., and Dave, S. (1999). Application of Ozone for Enhancing the Microbiological Safety and Quality of Foods- A Review. *KJournal of Food Protection* 62:1071-1087
- Kim, J.-G., Yousef, A. E., and Khadre, M. A. (2003). Ozone and Its Current and Future Application In The Food Industry. *Adv. in Food Nut. Res.* 45:167-218
- Maxkwee, E. N. H. (2013). *Consumer Acceptance, Quality, and Functionality of Heat-Ozone-Pasteurized Whole Eggs Processed with Commercial Scale Equipment*. MSc Dissertation. The Ohio State University, Colombus, Ohio, USA.
- Nemeth, C., Dalmadi, I., Friedrich, L., Pásztor-Huszár, K., Suhajda, A., Ivanics J., and Balla, C. (2012). Pasteurization of Liquid Egg by High Hydrostatic Pressure (HHP) Treatment. *African Journal of Microbiology Research* 6:660-664
- Perry, J. J. (2010). *Ozone Based Treatments for Inactivation of Salmonella Enterica Serovar Enteritidis in Shell Eggs*. PhD Dissertation. The Ohio State University, Colombus, Ohio, USA.
- Pirani, S. (2010). *Application of Ozone in Food Industries*. Ph.D. Dissertation. Università degli Studi di Milano, Milano, Italy.
- Piyasena, P., Mohareb, E., and McKellar, R. C. (2003). Inactivation of microbes using ultrasound: a review. *Int. J. of Food Microbiol.* 87:207-216

- Rodriguez-Romo, L. A., Vurma, M., Lee, K., and Yousef, A. E. (2007). Research Note: Penetration of Ozone Gas Across the Shell of Hen Eggs. *Ozone: Sci. & Eng.* 29:147-150
- Shankar, R., Kaushik, U., and Bhat, S. A. (2014). The Emerging Technology in The Sector of Food Technology- The Non-Thermal Technology. *International Journal of Innovation and Applied Studies* 6:941-958
- Sopher, C. D., Graham, D. M., Rice, R. G., and Strasser, J. H. 2002. Studies on the Use of Ozone in Production Agriculture and Food Processing in Proceedings of the International Ozone Association, USA.
- Yuceer, M., Aday, M. S., and Caner, C. (2016). Ozone treatment of shell eggs to preserve functional quality and enhance shelf life during storage. *J Sci Food Agric* 96:2755-2763

## Examination Of The Effects Of Some Egg Quality Characteristics On Yolk And Albumen Weight By MARS Method In Japanese Quails

Şenol Çelik, Turgay Şengül, Bünyamin Söğüt, Yusuf Şengül, Hakan İnci

Bingol University, Faculty of Agriculture, Depart. of Anim. Sci., Bingol- TURKEY

### Abstract

In this study, effects of some egg quality characteristics on yolk and albumen weights were investigated by MARS (Multivariate Adaptive Regression Splines) method. For this purpose, some quality characteristics of 160 eggs collected from quails in the Facility of Department of Animal Science in Bingol University were measured. In the study, egg weight, shape index, albumen index, yolk index, egg shell thickness and weight, albumen height and Haugh unit were evaluated as independent variables while yolk and albumen weight were considered as dependent variables. In order to estimate the dependent variables, the MARS method was used, the interaction level was based on 2 and 30 exponential validity. Criteria such as GCV (General Cross-validation),  $R^2$  (determination coefficient), Adjusted- $R^2$ ,  $r$  (correlation coefficient) were calculated to determine the estimation accuracy of the method. The compliance goodness criteria for both yolk and albumen weight estimation models were calculated for GCV (0.284 and 0.266),  $R^2$  (0.775 and 0.785), Adjusted- $R^2$  (0.752 and 0.763) and  $r$  (0.881 and 0.886), respectively. As a result, it has been determined that MARS method can be used for predicting yolk and albumen weight by using egg quality characteristics.

**Key words:** *Quail, egg quality, egg characteristics, MARS, GCV*

### Introduction

Quail eggs are an important source of animal protein production increasingly widespread in Turkey. For this reason, it is important to determine some external and internal quality characteristics that determine quality in quail eggs, and to estimate the relationships between these characteristics and the genetic impacts and environmental factors that affect these characteristics (Uluocak et al., 1995).

Egg quality is examined in two parts, internal and external quality characteristics, which also significantly affect the incubation results (Durmuş, 2014). In determining the quality of eggs, many criteria related to external and internal quality are used. In this study, with regard to external quality, egg weight, shape index, shell thickness and shell weight; with respect to internal quality, criteria such as egg albumen and egg yolk were taken into consideration. It has been reported that many important correlations between internal and external quality characteristics have been reported in quail eggs studies (Ozçelik, 2002; Alazahan et al., 2015, Sato et al., 1989. Narinc et al., 2015; Mirjana et al., 2012).

The aim of this study was to investigate the effects of some quality characteristics on yolk and albumen weight of quail eggs by MARS method.

### Material and Method

Multivariate adaptive regression splines (MARS) is a popular nonparametric regression technique used to study the nonlinear relationship between a response variable and the set of predictor variables with the help of splines. MARS uses piecewise linear or cubic splines for local fit and applies an adaptive procedure to select the final model (Friedman, 1991).

The form of the MARS model defined to approximate the function in (1) is defined as

$$f(X) = \beta_0 + \sum_{i=1}^M \beta_i B_i(X)$$

where each  $B_i$  is a basic functions (BF) (Friedman 1991; Friedman and Silverman, 1989).

Following the forward-step, a backward elimination is implemented to refine the model fitting process. In this pruning step, the BFs contributing less to the model are eliminated step by step through modified GCV (Craven and Wahba, 1979) until the best submodel is found. GCV (generalized cross-validation) depends on the idea of minimizing the average-squared residuals of the fit of the model given by

$$GCV = \frac{1}{n} \frac{\sum_{i=1}^n (y_i - \hat{y}_i)^2}{(1 - P(M) * /n)^2}$$

where,  $y_i$ :  $i$  is the  $i^{\text{th}}$  observed response value,  $\hat{y}_i$ : is the fitted response value obtained for the  $i^{\text{th}}$  observed predictor vector,  $n$  is the number of observations, and  $M$  represents the maximum number of BFs in the model.

## Results

The estimation equations for the MARS model for the maximum interaction grade 2 to estimate the egg weight and egg weight are given below.

Yolk weight=3.4447+0.4687\*max(0; egg weight-11.19)-0.4981\*max(0; 11.19- egg weight)- 4.3765\*max(0; egg weight - 11.19)\*max(0; 0.6623-yolk index)-45.7388\*max(0; yolk index-0.7172)+ 6.1744\*max(0; 0.7172-yolk index)+7.8026\*max(0; shape index-0.8853)+8,1921\*max(0; 0.8853-shape index)+28.1952\*max(0; yolk index-0.7086)-23.0177\*max(0; egg weight-13.15)\*max(0; 0.8853-shape index)-1.9584\*max(0; 13.15-egg weight)\*max(0; 0.8853-shape index)+8.3101\*max(0; egg weight-13.15)\*max(0; 0.7172-yolk index)-5.4212\*max(0; egg weight-11.19)\*max(0; albumen index-0.3246)- 2.1444\*max(0; egg weight-11.19)\*max(0; 0.3246-albumen index)+17.4802\*max(0; yolk index-0.7201)\*max(0; albumen height-5.25)

Albumen weight=5.8781+0.7310\*max(0; egg weight-11.19)-0.6501\*max(0; 11.19-egg weight)+7.6953\*max(0; egg weight-11.19)\*max(0; 0.6623-yolk index)+110.4\*max(0; yolk index-0.7172)-4.8778\*max(0; 0.7172-yolk index)-9.1816\*max(0; shape index-0.8853)-36.635\*max(0; 0.8853-shape index)-76.4358\*max(0; yolk index-0.7086)+77.7226\*max(0; egg weight-13.15)\*max(0; 0.8853-shape index)+ 15.5412\*max(0; 13.15-egg weight)\*max(0; 0.8853-shape index)-32.5294\*max(0; egg weight-13.15)\*max(0; 0.7172-yolk index)-0.164\*max(0; egg weight-11.19)\*max(0; albumen index-0.3246)+ 4.7441\*max(0; egg weight-11.19)\*max(0; 0.3246-albumen index)-14.9746\*max(0; yolk index-0.7201)\*max(0; albumen height-5.25)

According to these models, the effects of egg weight and albumin index variables on yolk and albumen weight are interdependent. For example, in an egg yolk weight estimation model with egg weight>11.19 g and albumen index>0.3246,  $-5.4212 * \max (0; \text{egg weight}-11.19) * \max (0;$  Similarly, in the egg white weight estimation

model, the  $-0.164 * \max (0; \text{egg weight}-11.19) * \max (0; \text{albumen index}-0.3246)$  has the effect of reducing the net network variable. Based on these models, yolk weight and albumen weight estimates can be made for various values of egg quality characteristics. The MARS method explains the variables that are effective relative to values that are greater or less than a certain value by specifying the node point and predicts the dependent variable.

### Conclusion

In this study, egg weight, shape index, albumen index and yolk index were the most significant variables affecting egg yolk and albumen weight. These variables were increasing effect on the weight of yolk and albumen, while other variables were not. It can be said that the MARS method is a useful model without estimating the important variables affecting yolk and albumen weight.

### References

- ALAŞAHAN, S., ÇOPUR A, G., CANOĞULLARI, S., and BAYLAN, M. (2015) Bildircin yumurtalarının (*Coturnix coturnix japonica*) kabuk ve benek rengine göre bazı dış ve iç kalite özelliklerinin belirlenmesi. Eurasian journal of Veterinary Science, 31 (4), 235-241.
- CRAVEN, P., WAHBA, G. (1979) Smoothing noisy data with spline functions: Estimating the correct degree of smoothing by the method of generalized cross validation. Numerische Mathematik, 31, 377-403.
- DURMUŞ, İ. (2014) Yumurta kalite özelliklerinin kuluçka sonuçlarına etkisi. Akademik Ziraat Dergisi 3(2):95-99
- FRIEDMAN, J. H. (1991) Multivariate adaptive regression splines. The Annals of Statistics, 19: 1-61.
- FRIEDMAN, J. H., SILVERMAN, B. W. (1989) Flexible parsimonious smoothing and additive modelling. Technometrics, 31: 3-21
- MIRJANA, Đ., STOJČIĆ, N, M., LIDIJA, P., (2012) Determining some exterior and interior quality traits of Japanese quail eggs (*Coturnix japonica*). Agroznanje, vol. 13 (4), 667-672.
- NARINC, D, AYGUN, A, KARAMAN, and E, AKSOY, T. (2015) Egg shell quality in Japanese quail: characteristics, heritabilities and genetic and phenotypic relationships. Animal. 9 (7):1091-1096.

- ÖZÇELİK, M., (2002) Japon bıldırcını yumurtalarında bazı dış ve iç kalite özellikleri arasındaki fenotipik korelasyonlar Ank., Üniv. Vet. Fak. Derg. 49, 67-72.
- SATO, K, IDA, N, INO, T. (1989) Genetic parameters of egg characteristics in Japanese quail. Jikken Dobutsu. 38(1): 55-59.
- ULUOCAK, A. N., OKAN F., EFE, E., AND NACAR, H. (1995) Bıldırcın yumurtalarında bazı dış ve iç kalite özellikleri ile bunların yaşa göre değişmesi. Tr J Vet Anim Sci. 19, 181-185.

## Histopathological aspects of the *Pectoralis major* muscle of broiler chickens affected with deep pectoral myopathy<sup>a</sup>

Bruna Richelle de Oliveira Castilho<sup>b</sup>, Juliana Lolli Malagoli de Mello<sup>c</sup>,  
Maysa Longo Maduro<sup>b</sup>, Aline Giampietro-Ganeco<sup>c</sup>, Larissa Tátero  
Carvalho<sup>c</sup>, Hirasilva Borba<sup>c</sup>, Lismara Castro do Nascimento<sup>b</sup>, Lizandra  
Amoroso<sup>b</sup>

<sup>a</sup>This study was financially supported by the São Paulo Research Foundation (FAPESP, 2015/08471-8).

<sup>b</sup>Department of Animal Morphology and Physiology, São Paulo State University, Jaboticabal, SP, Brazil.

<sup>c</sup>Department of Technology, São Paulo State University, Jaboticabal, SP, Brazil.

### Abstract

The aim of this work was to evaluate the histopathological characteristics of the *Pectoralis major* muscle of broilers, reared and slaughtered in Brazil, affected with deep pectoral myopathy (DPM). During slaughter, the necrotic areas of the *Pectoralis major* muscle were classified as normal, moderate and severe. Macroscopically, the affected musculature presented varied coloration with marked atrophy, in some cases. After sampling and histological analysis, we observed that myofibers from *Pectoralis major* of healthy broilers presented similar sizes with minimal endomysial and perimysial spacing, while myofibers from affected broilers had different sizes with macrophage infiltration and fiber necrosis. It was concluded that morphological exams are necessary to confirm the presence of this disease, which seems to cause chronic lesions in the affected tissue.

**Key words:** *Green Muscle Disease, Histological Analysis, Muscle Fibers*

### Introduction

Deep pectoral myopathy (DPM) is a polygenic disease (Harper *et al.*, 1983), characterized by supracoracoid muscle necrosis of commercial broilers and chickens (Santiago-Anadón *et al.*, 2014). This disease was first described on turkey farms in Oregon, United States, in females aged 10 months or older, and was also reported in broilers and broiler breeding (Jones *et al.*, 1978). DPM leads to the condemnation of carcasses in the slaughter line, as it can also cause damage to the consumer (Paschoal and Santos, 2013). According to Freitas (2015),

myopathies account for 10.35% of meat condemnations in Brazil during the autumn.

The increase in muscle fiber diameter results in reduced availability for connective tissue spacing, reduced blood supply, and altered muscle metabolism in the breast muscle. These changes have increased muscle fiber degeneration and necrosis, but have limited muscle repair mechanisms mediated by the adult myoblast (satellite cell) population of cells, likely resulting in the onset of myopathies (Vellman, 2015).

According to Bilgili and Hess (2008), the condition arises when the muscle fibers become deficient in oxygen by excessive movement of the wings. The development of the disease can be divided into three categories: Category 1 is the acute inflammatory lesion, in which the deep pectoral muscle presents diffuse hemorrhage; Category 2 describes the stage at which the lesion in the internal fillet is well defined and sometimes surrounded by an obvious hemorrhagic halo; Category 3 characterizes a progressive degeneration with the greenish appearance of damaged muscle tissue. Although the incidence of DPM increases in heavier chickens, it can occur at any age or weight and depends on the management and breeding system used.

Considering that DPM is becoming more common in the broiler industry, especially in broilers grown with heavier body weights for the deboning market, this study aimed to investigate the histological aspects of *Pectoralis major* muscle in broilers obtained from Brazilian slaughter plants.

## **Materials and Methods**

### *Place, period and sample collection*

The *Pectoralis major* muscle of Cobb-lineage broilers affected with DPM, with differing degrees of severity, were sampled in three refrigeration plants in the southeastern region of Brazil. Initially, the *Pectoralis major* muscles were classified macroscopically as "normal," "moderate" or "severe" according to the appearance of necrotic lesions. A total of ten samples of normal muscle, ten with moderate myopathy and ten with myopathy were submitted for histological analysis.

### *Histological analysis*

In order to analyze the histological parameters of the muscle fiber, two-centimeter transverse samples of the *Pectoralis major* muscle from thirty broilers were removed from the sternal region of an injured area with healthy surrounding tissue to evaluate the involvement of the musculature around the area affected with DPM.

The material was then fixed for 24 hours in plastic containers containing Bouin's solution. The samples were then washed with 70% ethanol to remove the fixative, and dehydrated in a series of increasing alcohol concentrations (70, 80, 90 and 100%). Subsequently, diaphanization in xylol and histological paraffin infiltration were performed. Histological sections were cut 5 micrometers ( $\mu\text{m}$ ) thick and stained with Hematoxylin and Eosin (Tolosa *et al.*, 2003). The blades were assembled with Entellan, and the obtained material was visualized with an Olympus photomicroscope. The images were viewed at a magnification of 100x and 400x using the Olympus Computerized Image Analyzer System. The selected images were photographed for later histological analysis. The architecture, shape, size, position of the nuclei and the presence of artifacts or anomalies in the histological sections were observed.

## Results

Macroscopically, the affected musculature presented a varied coloration, appearing red-purple, light-yellow or green, and also had marked atrophy. With regard to the microscopic aspects, muscle fibers of the *Pectoralis major* of broiler chickens were acidophilic and appeared circular in the cross-section. The nuclei were numerous and basophilic, in general, and were located at the periphery of muscle fibers. The unstructured, dense connective tissue was characterized as perimysium with skeletal muscular fibers organized in fascicles (Figure 1).

Muscle fibers from healthy broiler chickens presented homogeneous diameters (Figure 1A), while muscle fibers from broiler chickens affected with DPM were hypertrophied or reduced (Figure 1B, G and m, respectively) and thicker connective tissue lining than the normal group. The muscular tissue sampled from broiler chickens affected with DPM presented macrophage infiltration and tissue destruction characterized by fiber necrosis (Figure 1B). According to MacRae *et al.* (2006), an increase in the size of muscle fibers that is not accompanied by adequate nutritional support can lead to intermediate metabolic stress due to the inadequate diffusion of oxygen in the tissue.

Unaffected *Pectoralis major* muscle tissue from a healthy chicken (Figure 1A) had minimal endomysial and perimysial spacing when compared with affected tissue (Figure 1B).

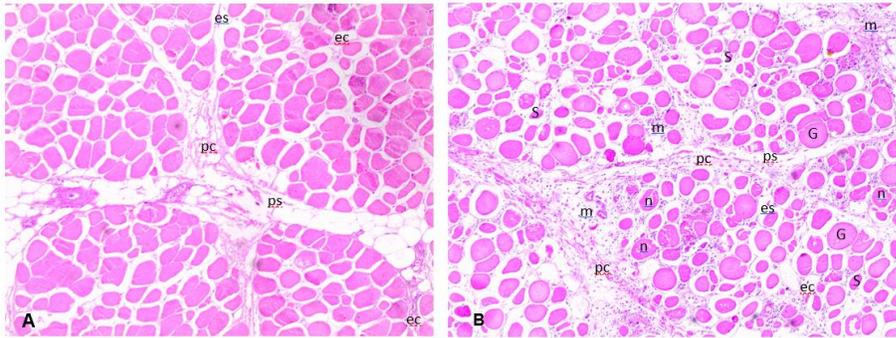


Figure 1. Photomicrographs of muscular tissue from a healthy broiler chicken (A) and a broiler with deep pectoral myopathy (B); ec = endomysial connective tissue; es = endomysial spacing; m = macrophage infiltration; n = fiber necrosis; pc = perimysial connective tissue; ps = perimysial spacing; G = Giant Hypertrophic Fibers; S = Small Fibers. H&E, 100x.

## Conclusion

Myofibers from the *Pectoralis major* of healthy broilers presented similar diameters with minimal endomysial and perimysial spacing, while myofibers from affected broilers had different diameters with macrophage infiltration and fiber necrosis. This work demonstrates that morphological exams are necessary to confirm the presence of this disease that has, in general, aspects of chronic lesions.

## References

- BILGILIE, S.F. and HESS, J.H. (2008) Miopatia peitoral profunda. Translated from the original Ross Tech 08/48, 2008. Aviagen Brasil: Tecnologia, Campinas, v. 1, n. 3.
- FREITAS, L.S. (2015) Causas de condenações post-mortem de frangos. *Thesis of the specialization course*. Federal University of Rio Grande do Sul, Brazil.
- HARPER, J.A, BERNIER, P.E. and THOMPSON-COWLEY, L.L. (1983) Early expression of hereditary deep pectoral myopathy in turkeys due to forced wing exercise. *Poultry Science* 62: 2303-2308.
- JONES, H.G.R., RANDALL, C.J. and MILLS, C.P.J. (1978) A survey of mortality in three adult broiler breeder flocks. *Avian Pathology* 7: 619-628.
- MACRAE, V.E., MAHON, M., GILPIN, S., SANDERCOCK, D.A. and MITCHELL M.A. (2006) Skeletal muscle fibre growth and growth associated myopathy in the domestic chicken (*Gallus domesticus*). *British Poultry Science* 47: 264-272.

- PASCHOAL, E.C. and SANTOS, J.M.G. (2013) Miopatia peitoral profunda como causa de condenação em abatedouro de aves. *Revista em Agronegócios e Meio Ambiente* 6: 223-233.
- SANTIAGO-ANADÓN, H.L., ORAMA, J.A. and TORRES, J.C. (2014) Incidence and degree of severity of deep pectoral myopathy in commercial genotypes of broilers. *The Journal of Agriculture of the University of Puerto Rico* 98: 195-199.
- TOLOSA, E.M.C., RODRIGUES C.J., BEHMER, O.A. and FREITAS-NETO, A.G. (2003) Manual de técnicas para histologia normal e patológica. 2ª ed. Manole, São Paulo, Brazil, p.331.
- VELLMAN, S.G. (2015) Relationship of Skeletal Muscle Development and Growth to Breast Muscle Myopathies: A Review. *Avian Diseases* 59: 525-531.

## **A Comparison of Turkey and European Union Countries In Terms of Chicken Meat and Egg Prices with Cluster Analysis**

**Aytaç Akçay<sup>1</sup>, Mehmet Küçükoflaz<sup>2</sup>, Savaş Sarıözkan<sup>2</sup>**

<sup>1</sup> Erciyes University, Faculty of Veterinary Medicine, Department of Biometrics, Kayseri-Turkey

<sup>2</sup> Erciyes University, Faculty of Veterinary Medicine, Department of Animal Health Economics and Management, Kayseri-Turkey

### **Abstract**

In this study, it is aimed to compare Turkey and European Union Countries (EU-28) with cluster analysis in terms of chicken meat and egg prices with production quantities per capita. Prices and production quantities for last 10 years (2005-2014) obtained from Food and Agriculture Organization (FAO) as a material of study. Chicken meat and egg prices have been given in USD (\$). In the study, Turkey and EU-28 countries have been clustered according to chicken meat and egg prices and production quantities with hierarchical cluster analysis and hierarchical clustering has been used as analysis tool and Ward's method has been used as method in this cluster analysis. Euclidean distance measure has been based as distance measure tool. In conclusion, although it is similar to some European countries in terms of prices of chicken meat and eggs, in Turkey the prices were higher than average of EU-28 and its needed to reduce the prices.

**Key words:** *Animal product prices, Cluster analysis, European Union, Turkey*

## **Türkiye ve Avrupa Birliği Ülkelerinin Tavuk Eti ve Yumurta Fiyatları Yönünden Kümeleme Analizi ile Karşılaştırılması**

### **Özet**

Bu çalışmada, tavuk eti ve yumurta fiyatları ile kişi başına düşen tavuk eti (kg) ve yumurta üretim miktarları (adet) bakımından Türkiye ve Avrupa Birliği ülkelerinin (AB-28) kümeleme analizi ile karşılaştırılması amaçlanmıştır. Çalışmanın materyalini, Gıda ve Tarım Örgütü'nden (FAO) elde edilen son 10 yılın (2005-2014) tavuk eti ve yumurta fiyatları ile ülkelerin kişi başına düşen tavuk eti ile

yumurta miktarları oluşturmuştur. Yapılan hesaplamalarda son 10 yılın tavuk eti ve yumurta fiyatları USD (\$) cinsinden aritmetik ortalaması alınmıştır. Çalışmada, tavuk eti ve yumurta fiyatları ile kişi başına düşen ortalama üretim miktarlarına göre, Türkiye ve AB-28 ülkeleri aşamalı kümeleme analizine tabi tutulmuş ve yöntem olarak hiyerarşik kümeleme yöntemi Ward metodu kullanılmıştır. Uzaklık ölçüsü aracı olarak Öklidyen uzaklık ölçüsü esas alınmıştır. Sonuç olarak, Türkiye’de son 10 yılda ortalama tavuk eti ve yumurta fiyatları AB-28 ülkelerinden yüksek olduğu ve düşürülmesinin gerektiği ortaya çıkmıştır.

**Anahtar kelimeler:** *Avrupa Birliği, Hayvansal ürün fiyatları, Kümeleme analizi, Türkiye*

### **Introduction**

Turkey is in the integration period of European Union (EU). So, the livestock sector needs to be harmonized with the European Union both with production and consumption. However, in Turkey, the share of animal originated protein is low compared with EU countries. Additionally, the prices of livestock products like chicken meat and egg comparatively expensive. In this study, it is aimed to compare Turkey and EU-28 with cluster analysis in terms of chicken meat and egg prices with production quantities per capita.

### **Materials and Methods**

In this study the prices and production quantities for last 10 years (2005-2014) obtained from Food and Agriculture Organization (FAO) were used as material. In the study, Turkey and EU-28 countries have been clustered according to chicken meat and egg prices and production quantities with hierarchical cluster analysis and hierarchical clustering has been used as analysis tool and Ward’s method has been used as method in this cluster analysis. Euclidean distance measure has been based as distance measure tool. As a result of Ward's technique, the dendrogram method is used to determine the clusters of countries and the number of clusters. The dendrogram is a graphical summary of the results of the clustering analysis, showing the distances between the vertical exponents and the horizontal axes of the clusters. In this study, countries were grouped at scaled distances according to the animal product prices and animal product quantities mentioned earlier. NCSS 9.0 package program was used for statistical analysis.

**Results**

In Turkey and EU countries, chicken meat and egg prices and per capita product quantities are given in Table 1. In Turkey between 2005 and 2014, the average price of chicken meat was \$2712.78/ton and egg price was \$2095.57/ton. The average amount of chicken meat per capita in Turkey is 18,891 kg and the amount of egg production is 189,165 units.

Table 1. Turkey and EU-28 countries ' chicken meat and egg prices and per capita production amounts

<i>Countries</i>	<i>Chichen meat</i>		<i>Egg</i>	
	<i>\$/ton</i>	<i>Produce amount (kg/person)</i>	<i>\$/ton</i>	<i>Produce amount (Amount/person)</i>
Turkey	2712,78	18,891	2095,57	189,165
Germany	1908,35	9,9062	1971,73	146,153
Austria	2740,47	12,0993	2610,25	192,613
Belgium	1586,97	37,3244	853,41	247,6
Bulgaria	1799,77	11,7392	1588,52	184,715
Czech C.	1462,12	17,2434	1531,65	223,708
Denmark	1359,44	31,4198	1807,88	237,361
Estonia	1885,55	11,4969	1430,84	132,367
Finland	1691,86	17,8371	1193,9	179,03
France	1920,95	16,219	1380,6	236,058
Cyprus	3163,3	24,359	2166,6	156,078
Croatia	1820,84	6,6129	2255,5	166,674
Netherlands	1378,77	46,648	1144,8	616,52
England	1637,9	21,339	898,5	171,729
Ireland	1546,05	19,354	1526,28	163,475
Spain	1803,86	24,884	1775,3	276,258
Swedish	1676,3	11,592	1737,9	189,554
Italy	2042,3	13,725	1664,2	221,078
Latvia	2193,7	10,897	1438,69	297,585
Lithuanian	1572,84	23,097	1395,1	256,78
Luxembourg	7000	1,0534	3021,9	46,438
Hungary	1582,76	23,239	1609,3	270,561
Malta	1529	10,478	1544,4	232,003
Poland	1584,16	29,093	1294,65	265,6
Portugal	986,4	22,49	1549,8	212,25
Romania	2096,16	16,183	2851,44	310,17
Slovakia	1601,49	13,38	1230,97	221,129
Slovenia	1866,76	24,851	722,25	156,167
Greece	2492,79	11,913	3104,8	173,516
AB-average	1997,53	18,588	1689,32	220,8275

Table 2. Progressive clustering analysis results for average chicken meat price and the amount of chicken meat production per capita

<i>Cluster No</i>	<i>Average Chicken Meal</i>	<i>Average Chicken Price (\$/ton)</i>
1.Cluster	Austria, Bulgaria, Croatia, Estonia, Germany, Greece, Italy, Latvia, Sweden, Malta, Slovakia, Luxembourg ( <b>1,0534-13,725</b> )	Belgium, Czech Republic,, Denmark, FIRRANDIA, Hungary, Ireland, Lithuania, Malta, Netherlands England, Portugal, Slovakia, Sweden Poland ( <b>986,4- 1691,86</b> )
2.Cluster	<b>Turkey</b> , Cyprus, Czech Republic, Finland, France, Hungary, Ireland, Lithuania, Portugal, Romania, England, Spain, Slovenia ( <b>16,183- 24,884</b> )	Bulgaria, Croatia, Estonia, France, Germany, Italy, Latvia, Romania, Spain, Slovenia ( <b>1799,77- 2193,7</b> )
3.Cluster	Poland, Denmark, Netherlands, Belgium ( <b>29,093- 46,648</b> )	Turkey, Austria Greece, Cyprus ( <b>2492,79 - 3163,3</b> )
4.Cluster		Luxembourg ( <b>7000</b> )

Table 3. Progressive clustering analysis results for average egg price and the amount of egg production per capita

<i>Cluster No</i>	<i>Average egg quantity (number/ year)</i>	<i>Average egg prices (\$/ton)</i>
1. Cluster	<b>TURKEY</b> , Austria Bulgaria, Croatia Cyprus, United Kingdom Finland, Germany Greece, Ireland Luxembourg, Slovenia Sweden, Estonia ( <b>46,438-189,554</b> )	Belgium, Slovenia, England ( <b>722,25- 898,5</b> )
2. Cluster	Belgium, Czech Republic, Denmark, France, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Spain, Romania, Slovakia, Portugal ( <b>212,25-310,17</b> )	Bulgaria, Slovakia, Czech Republic, Estonia Finland, France, Hungary Ireland, Italy, Latvia, Lithuania Malta, Netherlands, Poland, Portugal ( <b>1193,9- 1664,2</b> )
3 Cluster	Netherlands ( <b>616,52</b> )	Turkey, Croatia, Cyprus, Denmark, Sweden, Spain, Germany ( <b>1737,9- 2255,5</b> )
4. Cluster		Austria, Romania, Luxembourg, Greece ( <b>2610,25- 3104,8</b> )

According to the clustering analysis, the production quantities of chicken meat per person were formed by the combination of clusters close to each other. According to the analysis results Turkey took place in the second group in terms of the chicken meat production. According to the analysis results Turkey took place in the first group in terms of the chicken egg quantity.

### **Conclusion**

With the clustering analysis, it was observed that the prices of chicken meat decreased inversely with the level of development of the countries and the amounts that could be taken increased. Production of chicken meat in Turkey has started to increase in recent years. It has been reported that the carcass weight of a chicken cut to consume meat in Turkey is above the EU average. In this way, Turkey has seen similar characteristics with European countries in the production of chicken meat. It has been concluded that the price of chicken meat is higher than most European countries. In recent years, there have been significant developments in the egg industry. However, Turkey was included in the lowest set in terms of production quantity, and accordingly, it was found that it was included in the highest set in terms of egg prices.

### **References**

- ARAL Y, SARIÖZKAN S: AB ile müzakere sürecinde Türkiye hayvancılığı  
SARIÖZKAN S, AKÇAY A: Hayvansal Protein Tüketimleri Bakımından Türkiye ve Avrupa Ülkelerinin Kümeleme Analizi ile Karşılaştırılması  
FAO: Food and Agriculture Organization of the United Nations, Erişim: [www.fao.org](http://www.fao.org)

## Effect of Thyme Species Extracts on Performance and Nutrients Digestibility of Broiler Chickens

Mir Daryoush Shakouri, Mohammad Malekzadeh

Department of Animal Science, Faculty of Agriculture and Natural Resources,  
University of Mohaghegh Ardabili, Ardabil, Iran

### Abstract

To investigate the effect of thyme extracts on performance and nutrients digestibility, a study was conducted using 160 day-old male chicks with five treatments including a control or 0.1% of four thyme extracts (*Thymus daenensis*, *T. kotschyanus*, *T. lancifolius*, and *T. transcaspicus*) with four replicates. The chickens on *T. daenensis* extract showed the best WG ( $P<0.05$ ), while FI and FCR were not affected by the treatments. *T. daenensis* extract improved the digestibility of organic matter, dry matter, crude carbohydrate, crude ash and ether extract ( $P<0.01$ ). The results showed the best performance and nutrients digestibility of chickens by *T. daenensis* extract.

**Key words:** Broilers, Digestibility, Performance, Thyme species

### Introduction

Phytochemicals have been recently considered by researchers and producers as feed additives in poultry diets. It has been shown that adding medicinal plant extracts and essential oils into the diets can improve growth performance (Al-Kassie, 2009).

Thyme (*Thymus* spp., L) is one of the aromatic plants that belong to the *Lamiaceae* family. It contains different essential oils such as thymol, carvacrol, linalool,  $\alpha$ -terpineol, 1,8 cineole,  $\alpha$ -pinen, p-simenn, camphene, limonene, and several other compounds (Lee et al., 2005). It is demonstrated that the quantity of bioactive components of medicinal plants and their activity varies by plant species (Amiri, 2012), climatic and environmental conditions (Lalle`s et al., 2009).

The amount of carvacrol and thymol, as two major essential oils of thyme, is variable between thyme species (2 to 42 and 1 to 50 percent of total essential oils, respectively) (Lalle`s et al., 2009) and even between populations of one species (Ghasemi Pirbalouti et al., 2011). There are evidences that essential oils stimulate the secretion of digestive enzymes in broilers (Al-kasie, 2009).

Although there are plenty of reports on thyme and its derivatives, to our knowledge, there is no study to compare the physiological effects of different species of thyme on broilers. Hence, the objective of this study was to investigate the influence of dietary supplementation with a hydroalcoholic extract of different thyme species on growth performance and nutrient digestibility of broiler chickens.

### **Materials and Methods**

The hydroalcoholic extract of plants aerial parts was obtained by maceration technique using 50% ethanol as solvent at 10:1 solvent to plant ratio (Azwanida, 2015).

A total of 160 one-day old Ross 308 male broiler chicks were used in an *in vivo* study. The chicks were distributed into 20 wire floor cages with equal group weight and were randomly assigned to one of five experimental diets. Therefore, a completely randomized design with five treatments including a control diet with no extract and four diets with 0.1% of four thyme species extract was employed with four replicates of 8 birds per each replicate. The diets were fed to the chickens in three feeding phases of 1-10, 11-24 and 25-28 days of age. The trial was lasted 28 days and conducted in an environmentally controlled room. Feed and water were provided *ad-libitum*. Feed consumption and WG were measured and FCR was calculated.

To determine the total tract nutrient digestibility coefficients, 0.3 percent chromic oxide, as an inert marker, was added to the experimental diets, and fed to chickens from 25 to 28 days. The excreta samples of each replicate were collected twice daily and mixed together, then kept in the freezer ( $-20^{\circ}\text{C}$ ) for subsequent analyses. The chemical compositions of feed and excreta samples, including dry matter, organic matter, ether extract and crude protein were measured according to the AOAC (2000) methods. The chromium oxide content of excreta and feed samples was measured according to the method described by Fenton and Fenton (1979), then the apparent nutrients digestibility and nitrogen retention was determined. All collected data were subjected to statistical analysis using the General Linear Model procedure of SAS software 9.1. Duncan's Multiple Range test was used to detect the differences ( $P<0.05$ ) between different means.

### **Results and Discussion**

WG of chickens was only improved by *T. daenensis* extract ( $P<0.05$ ). FI and FCR were not significantly affected by the treatments. Interestingly, the highest digestibility of dry matter, organic matter,

ether extract, crude carbohydrate and crude ash ( $P < 0.01$ ) was observed as the effect of *T. daenensis* extract (Table 1). Digestibility of ether extract was similar between *T. daenensis* and *T. lancifolius* extracts. Nitrogen retention was not changed significantly by different thyme extract compared with control.

To compare the obtained results, there were no available reports on different thyme species supplementation in broilers diet. There are contradictory effects of thyme on broiler performance in literatures. Beside the reports indicating affect less of thyme product, as mentioned above, in agreement with beneficial effect of one thyme extract in this study, there are some observations representing the positive effect of thyme on broilers growth response. Al-Kassie (2009) used 100 and 200 ppm thyme essential oils and observed improved WG.

In contrast to Al-Kassie, (2009) who used thyme phytochemicals and observed their growth promoting effect, in this study, thyme extracts failed to show much improvement in growth response of broilers, except one case. The probable reason behind this observation might be related to housing system. Because in the mentioned studies, the birds were raised in deep litter pens, while in the present trial the wire floor cages were used for raising. It is well known that in deep litter systems, birds directly contacts with litter microorganisms which can affect their intestinal microbial population (Pan and Yu, 2014). However, in cages the birds cannot access to the litter as an infection source.

Table 1. The effect of different thyme species extract on performance and apparent digestibility of nutrients (%) at 28 days of age

P*	Treatments					Statistics	
	C	TS1	TS2	TS3	TS4	SEM	P
WG (g)	1263.4 <sup>b</sup>	1333.0 <sup>a</sup>	1265.9 <sup>b</sup>	1278.0 <sup>b</sup>	1284.1 <sup>b</sup>	15.37	0.037
FI (g)	1815.0	1832.2	1805.2	1768.5	1825.2	16.89	0.120
FCR	1.43	1.37	1.43	1.38	1.42	0.019	0.139
DM	69.40 <sup>bc</sup>	73.57 <sup>a</sup>	68.39 <sup>cd</sup>	70.38 <sup>b</sup>	67.61 <sup>d</sup>	0.429	0.0001
OM	72.35 <sup>bc</sup>	76.09 <sup>a</sup>	71.51 <sup>cd</sup>	73.47 <sup>b</sup>	70.93 <sup>d</sup>	0.403	0.0001
EE	68.34 <sup>c</sup>	73.37 <sup>a</sup>	69.70 <sup>bc</sup>	71.87 <sup>ab</sup>	67.49 <sup>c</sup>	2.466	0.0002
NR	67.08 <sup>abc</sup>	70.10 <sup>a</sup>	63.53 <sup>c</sup>	68.19 <sup>ab</sup>	64.61 <sup>bc</sup>	1.431	0.026
CC	74.07 <sup>bc</sup>	78.91 <sup>a</sup>	73.69 <sup>bc</sup>	75.12 <sup>b</sup>	73.28 <sup>c</sup>	0.532	0.0001
ASh	32.39 <sup>b</sup>	39.86 <sup>a</sup>	27.04 <sup>cd</sup>	29.46 <sup>bc</sup>	23.23 <sup>d</sup>	1.295	0.0001

P\*: Parameters, C: Control, TS1: *T. daenensis*, TS2: *T. kotschyanus*, TS3: *T. lancifolius*, TS4: *T. transcaspicus*, <sup>a,b</sup>Means with different superscripts in the same row differ significantly ( $P \leq 0.05$ ). \*WG, Weight Gain; FI, Feed Intake; FCR, Feed Conversion Ratio; DM, Dry Matter; OM, Organic Matter; EE, Ether Extract; NR, Nitrogen Retention; CC, Crude Carbohydrate, SEM: Standard error of means

The increased nutrients digestibility as the effect of thyme extracts have also been reported by Garcia et al. (2007). It may be because of the presence of more essential oils in *T.daenensis* extract, as it is shown that the essential oils can stimulate the secretion of digestive enzymes in broilers (Al-kasie, 2009). The improvement of broiler performance on this extract can be explained by increased nutrients digestibility.

### Conclusion

It can be concluded that the response of broilers to dietary inclusion of thyme extracts depends on the plant genotype. The improvement in broiler performance as the effect of thyme extract is well related to improved nutrients digestibility.

### References

- AL-KASSIE GA. (2009). Influence of two plant extracts derived from thyme and cinnamon on broiler performance. *Pakistan Veterinary Journal*, 29:169-173.
- AMIRI H. (2012). Essential oils composition and antioxidant properties of three thymus species. *Evidence-Based Complementary and Alternative Medicine*, 2012:1-8.
- AOAC. (2000). Official Methods of Analysis, 17th edn. Association of Official Analytical Chemists, Arlington, VA.
- AZWANIDA NN. (2015). A Review on the extraction methods used in medicinal plants, principle, strength and limitation. *Medicinal & Aromatic Plant*, 4:2167-0412. 2015
- FENTON TW and FENTON M. (1979). An improved procedure for the determination of chromic oxid in feed and feces. *Canadian Journal of Animal Science*, 59:631-634.
- GARCIA V, CATALA-GREGORI P, HERNANDEZ F, MEGIAS MD and MADRID J. (2007). Effect of formic acid and plant extracts on growth, nutrient digestibility, intestine mucosa morphology, and meat yield of broilers. *of Applied Poultry Research*, 16:555-562.
- GHASEMI PIRBALOUTI A, RAHIMMALEK M, MALEKPOOR F and KARIMI A. (2011). Variation in antibacterial activity, thymol and carvacrol contents of wild populations of *Thymus daenensis* subsp. *daenensis* Celak. *Plant Omics*, 4: 209-214.
- LALLE'S JP, BOSI P, JANCZYK P, KOOPMANS SJ and TORRALLARDONA D. (2009). Impact of bioactive substances on the gastrointestinal tract and performance of weaned piglets: a review. *Animal*, 3(12): 1625–1643.

- LEE SJ, UMANO K, SHIBAMOTO T and LEE KG. (2005). Identification of volatile components in basil (*Ocimum basilicum* L.) and thyme leaves (*Thymus vulgaris* L.) and their antioxidant properties. *Food Chemistry*, 91:131-137.
- PAN D and YU Z. (2014). Intestinal microbiome of poultry and its interaction with host and diet. *Gut Microbes*, 5:108-119.

## MAIN SPONSOR



## PLATINIUM SPONSORS



## SILVER SPONSORS



## OTHER SPONSORS



## ORGANIZATION PARTNERS

