

Volume 74

# POULTRY SCIENCE JOURNAL

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research

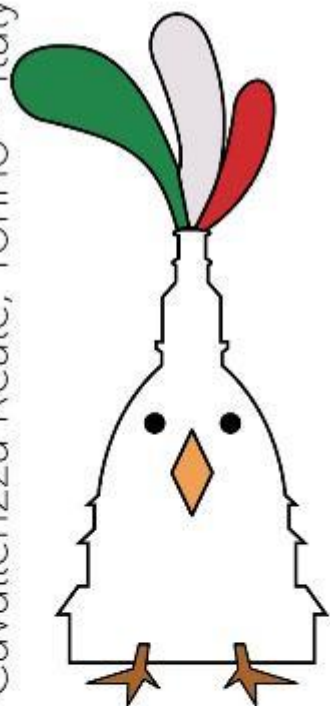


Book of

# WORLD'S SCIENCE JOURNAL

6<sup>TH</sup> MEDITERRANEAN  
POULTRY SUMMIT

Cavallerizza Reale, Torino - Italy



June 18-20, 2018  
Turin - Italy

ABSTRACTS

**6<sup>th</sup> Mediterranean Poultry Summit  
Of the Mediterranean Poultry Network of the WPSA  
Turin - Italy  
June 18 – 20, 2018**

**Book of abstracts**  
Supplement of the  
**World's Poultry Science Journal**

**Editors**  
**N. Dagher, H. Khouri, G. Sayegh and A. Schiavone**

**Hosted by the:**  
**Italian Branch of the World's Poultry Science Association**



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Website: [www.wpsa.com](http://www.wpsa.com) and [www.mpn-wpsa.org](http://www.mpn-wpsa.org)

## MPN President's Message



As President of the Mediterranean Poultry Network (MPN), I would like to extend to all participants of the 6th MPS my heartiest welcome. This summit is being held at the University of Torino, one of the oldest and most prestigious universities in Europe.

The MPN was established in 2008 and presently operates under the umbrella of Working Group (WG 11) which is for Education and Information. This unit is part of the WPSA European Federation. The MPN was formed for the purpose of promoting WPSA activities in all the Mediterranean countries and to help expand its membership in the region. Its main function is to organize the MPS once every two years in one of the countries of the region and to spread knowledge in the poultry sciences through education, research and services.

I want to take this opportunity to thank the Italian Branch of WPSA for hosting this summit, especially the president and all his colleagues for all their hard work for making this 6th summit a success. I also want to thank all members of the scientific committee, headed by Dr. Martino Cassandro, and all members of the organizing committee, headed by Ghassan Sayegh for a job very well done. I also wish to recognize the hard work of our moderators Hoda Haddad and Achille Schiavone and all the students and other helpers.

I am sure that you will find this Book of Abstracts a very informative and useful one containing abstracts of all papers and posters to be presented.

Thank you all for joining our summit and look forward to your being with us at future meetings.

Nuhad J. Dagher, President

A handwritten signature in blue ink that reads "Nuhad J. Dagher".

Mediterranean Poultry Network of WPSA.

## Welcome to the 6<sup>th</sup> Mediterranean Poultry Summit



The Mediterranean Poultry Summit (MPS) is one of the main events for researchers and professionals involved in the poultry sector in the year 2018.

Delegates from all over the Mediterranean area meet every two years to participate in the summit program and get in touch with colleagues.

This MPS is the 6<sup>th</sup> one following successful summits in Greece (2008), Turkey (2009), Egypt (2012), Beirut (2014) and on a cruise around the sea of Italy-Spain-France (2016).

The location is the Royal Torino, the city of the royal Savoy family, the main city of the Piemonte region. We are sure that your experience will be the best to experiment the Piedmontese's hospitality, culture and food, making your travel a valuable one.

Scientific program is great and very interesting with a high level of speakers, research and keynote speakers, from 30 countries and with more than 200 participants by poultry industry and research's experts and young passionate students available to discuss the most relevant topics on poultry science.

As President of the Italian Branch and of the scientific committee I would like to thank all colleagues that organized this relevant event and put all their energy to realize this event.

Special thanks to Ghassan, Laura and Achille and all of those that are attending

With my very sincere regards,

Prof. Martino Cassandro

President of the Scientific Committee of the 6th MPS of WPSA

**President of the Event**  
N. DAGHIR (Lebanon)

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The Organizing Committee of the 6<sup>th</sup> Mediterranean Poultry Summit (Torino 2018) wishes to thank the sponsors of the Conference for their generous support.

## Program Outlook

### Monday, June 18

08h30 09h30 Registration

**09h30 10h00 Opening session**

10h00 10h30 **Session I** **Economic Studies on the Poultry Industry in the Mediterranean Region**

10h00 11h00 Plenary Session *Slot: K1*

11:00 11:30 Coffee break

11h30 12h30 Oral Session *Slot: O1*

*10h45 11h00 Lunch Break*

**13h30 16h30 Session II** **Nutrition and feed additives**

13h30 14h00 Plenary Session *Slot: K2*

14h00 16h30 Oral Session *Slot: O2*

16h30 16h45 *Coffee break*

**16h45 18h15 Session III** **Poultry gut health**

14h00 16h30 Oral Session *Slot: O3*

**18h30 20h30 Opening Ceremony (Welcome Cocktail)**

### Tuesday, June 19

**09h00 10h30 Session IV** **Policies and regulations governing the poultry industry in the Mediterranean region**

09h00 09h45 Plenary Session *Slot: K4*

09h45 10h30 Oral Session *Slot: O4*

10h30 10h45 *Coffee break*

**10h45 13h00 Session V** **Genetics and breeding**

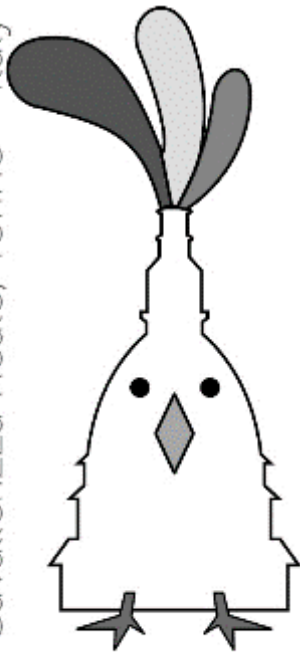
10h45 11h15 Plenary Session *Slot: K5*

11h15 13h00 Oral Session *Slot: O5*



**Tuesday, June 19****14h00 15h45 Session VI Poultry housing and environment**14h00 15h45 Oral Session *Slot: O6*15h45 16h00 *Coffee break***16h00 18h30 Session VII Poultry health**16h00 17h00 Plenary Session *Slot: K7*16h45 18h30 Oral Session *Slot: O7***20h30 24h00 Gala Dinner****Wednesday, June 20****08h30 10h30 Session VIII Feeds alternatives**08h30 10h30 Oral Session *Slot: O8*10h30 10h45 *Coffee break***10h45 13h00 Session IX Miscellaneous**10h45 13h00 Oral Session *Slot: O9***13h00 13h30 Closing Session***Lunch Boxes*

**6<sup>TH</sup> MEDITERRANEAN  
POULTRY SUMMIT**  
Cavallerizza Reale, Torino – Italy



**June 18-20, 2018**

**Keynote Speakers**  
(In alphabetical order)

## **Elie Barbour**



Professor  
Faculty of Agricultural and Food Sciences  
American University of Beirut  
Beirut, Lebanon

### **Education**

A. BS and MS: From American University of Beirut  
B. PhD: From School of Veterinary Medicine, University of Minnesota

### **Experience**

- A. Former Technical Director for Innovation of Biologics, Brinton Co., Willmar, Minnesota, USA
- B. Former Professor at American University of Beirut
- C. Currently, Adjunct Prof. at King Abdulaziz University, KSA
- D. Currently Head of R & D at Opticon, Switzerland

### **Publications**

- A. 186 manuscripts in refereed scientific journals
- B. 4 US Patents and one International Patent
- C. Two books at Barnes and Noble

### **Inventions**

- A. Vaccines for MG, velogenic NDV, Salmonella Enteritidis  
Antiviral, anti-inflammatory, and Anti-coccidial pharmaceuticals

## **Silvia Cerolini**



Professor.

University of Milan, Department of Veterinary Medicine  
Via Trentacoste 2, 20134 Milan, Italy.

### **Education**

- 1978-1982 Graduation in Animal Production, University of Milan, Italy. Thesis title: *Cage design and foot pad dermatitis in laying hens.*
- 1983-1986 PhD in Animal Science, University of Milan, Italy. Thesis title: *Intensive husbandry system and reproduction in laying hens: productive and physiological functions.*
- 1987-1998 Researcher at the 'Institute for the safeguard and valorisation of animal germplasm' (Unit of Animal Reproduction), National Research Council (CNR), Milan, Italy.
- 1995-1998 Secondment in post-doc position at the Biochemical Sciences Department, Scottish Agricultural College, Ayr, UK.
- 1998-Present Associate professor in Poultry Science, SSD AGR20 Zooculture, at the University of Milan, Italy.

### **Research interests and current research activity**

- Management and reproductive function during ageing in laying hens.
- In vitro assessment of sperm quality, semen storage and sperm changes related to ageing in domestic animals (bulls, chickens, pheasants).
- Lipid and antioxidant components of semen in domestic birds (chickens and turkeys) and mammals (boars and rabbits). Relation between lipids, quality parameters and fertility in sperm.
- Dietary manipulation of sperm fatty acids to improve male fertility and semen storage in poultry.

Current research activity is related to the conservation of local avian breeds: genetic and phenotypic characterization, management guidelines for free range rearing systems, semen cryopreservation technology.

### **Publications**

Author and co-author of 56 full papers in scientific journals, 49 of which in peer-reviewed journals with IF, and 13 chapters in books.

**Nuhad Dagher**

Dean Emeritus  
Faculty of Agricultural and Food Sciences  
American University of Beirut  
Beirut, Lebanon  
President of the 6th Mediterranean Poultry Summit

Dr N.J. Dagher received his BSc from the American University of Beirut (AUB) in 1957 and was immediately appointed by AUB to provide agricultural extension services to the central and northern Beqa'a region in Lebanon, to where he introduced commercial poultry production. He earned both his MSc and PhD degrees from Iowa State University in 1959 and 1962, respectively. In 1962, he helped establish the Lebanese branch of the World Poultry Science Association and became president of that branch until 1984. During the same year, he started his teaching and research career at the AUB. In 1967, he was promoted to associate professor and in 1975 to full professor. He has served as adviser for over 50 MSc graduate students, many of whom have later received PhD degrees from US universities and are now occupying key positions all over the world.

Dr Dagher is a member of several professional and honorary organizations and has served as a consultant to poultry companies in Lebanon, Jordan, Syria, Iraq, Iran, Egypt, Kuwait, Tunisia, Saudi Arabia and Yemen. He has participated in lecture tours on poultry production in countries all over the World and has served on special assignments for several organizations such as the Food and Agriculture Organization of the United Nations, American Soybean Association, and the Kuwait Institute of Scientific Research. He also served on many international, regional and national committees such as the International Standing committee of WPSA on Nutrient Requirements and the committee of the International Union of Nutritional Sciences (commission VI, committee 8) on Nutrition of Poultry.

Dr Dagher has had over 100 articles published in scientific journals and the proceedings of international meetings as well as several chapters in books and compendia. The second edition of his book "Poultry Production in Hot Climates" was published by CABI in 2008. His research has covered a wide range of subjects, such as factors affecting vitamin requirements of poultry, utilization of agricultural by-products in poultry feeds, nutrient requirements of poultry at high-temperature conditions, seeds of desert plants as potential sources of feed and food, and plant protein supplements of importance to hot regions. His research has received funding from the US National Institutes of Health, the International Development Research Centre of Canada and the Lebanese National Council for Scientific Research. He has served as Chairman of the Animal Science Department, Associate Dean and Dean

of his Faculty at AUB. From 1986 to 1992, he served as Director of Technical Services at the Shaver Poultry Breeding Company in Cambridge, Ontario, Canada. He served as Dean of the Faculty of Agricultural Sciences at the United Arab Emirates University, Al-Ain, UAE, from 1992 to 1996, and as Dean of the Faculty of Agricultural and Food Sciences at AUB, from 1996 to 2006. In 2012, he was inducted into the International Poultry Hall of Fame.

### **Musa Freiji**



CEO  
Wadi Group / Tanmia Co.  
Cairo, Egypt / Beirut, Lebanon

Eng. Musa Freiji may easily be described as the father of commercial poultry production in Lebanon and the Arab World. Upon his graduation from AUB in 1957 up to the present time he got involved in establishing production companies and in promoting the latest technologies in poultry husbandry in Lebanon, Syria, Jordan, Saudi Arabia, Egypt and Sudan.

He also extended the free service principle to growers of egg or poultry meat production in 20 Arab and African countries in order to improve their efficiency, productivity, bio-security, food safety and profitability.

*Ph.* Born in Zahleh- Lebanon November 1937

*Ph.* Education: Primary School – Zahle 1949, Evangelical High School – Zahle 1953, AUB – Faculty of Agriculture, B.Sc. - 1957

#### **Work Career**

*Ph.* Green Leaf; Lebanon; 1957–1958

*Ph.* Established The White Farm; Bekaa, Lebanon; 1958-1980

*Ph.* Established and managed Wardi & Co.; Lebanon; 1959-1972

*Ph.* Established and co-managed the Bekaa Fresh Eggs Producing and Marketing Cooperative (FREGCO); Bekaa, Lebanon; 1964–1990

*Ph.* Established and managed Tanmia - The Agricultural Development Co.; Lebanon; 1972-2013

*Ph.* Established and managed The Arab Poultry Co.  
Lebanon; 1973-1980

*Ph.* Established and managed The Modern Feed Co.; Lebanon; 1973-1996

*Ph.* Established and managed Syria Poultry Co.; Syria; 1973-1982

*Ph.* Co-established and technically managed Homs Poultry; Syria; 1976-1998

*Ph.* Established and managed Saudi Poultry Co.; Saudi Arabia; 1976-1990

*Ph.* Co-established and technically managed Jordan Poultry Breeding Co; Jordan; 1976 to date

- P<sup>a</sup>* Established and managed The Saudi Agricultural Development Co.; Saudi Arabia; 1977-1990
- P<sup>a</sup>* Co-established and technically managed the Arab Poultry Parents Co.; Saudi Arabia; 1991-2001
- P<sup>a</sup>* Co-established and held the position of Chairman of the Board of Directors and President of the following companies in Egypt; (1984 To date): Wadi Poultry, Rula for land Reclamation, Wadi Hatcheries, Wadi Feed, Wadi Holdings, Wadi Poultry Grandparents, Wadi Food Processing, Wadi Farms, Wadi Poultry Parents, Wadi Glass, Haditha for import, export and production

### **Hafez M Hafez**



Professor Veterinarian  
Institute of Poultry Diseases  
Free University Berlin  
Berlin, Germany

Prof. Dr. Dr. Hafez was head of the Institute of Poultry Diseases of the Free University in Berlin from October 1st 1997 until 31st March 2016. He is currently Gust “Senior” Professor at the same Institute. Dr Hafez gained his Master of Veterinary Science (MVSc) at the department of Poultry Diseases from Cairo University in 1975, and in 1981 completed his Dr. medicinae veterinariae (Dr. med. vet) at the department of Poultry Diseases, Giessen University, Germany and in 1994 he finished the Dr. habilitatus (Dr. med. vet. habil.) thesis at the department of Poultry Diseases, Munich University, Germany.

Hafez is Veterinary Poultry Specialist since 1982; Veterinary Microbiology Specialist since 1989, Veterinary Animal Hygiene Specialist since 1996 and since 2005 Diplomate of European College of Veterinary Public health (Dipl. ECVPH) and since 2009 Diplomate of European College of Poultry Veterinary Science (Dipl. ECPVS).

He is currently the Honorary Life President of the World Veterinary Poultry Association (WVPA), He is Past-President of the WVPA, Past-President of European College of Poultry Veterinary Science (ECPVS), Chairman of Poultry Scientific Committee of the German Veterinary Chamber, Chairman of the German Branch of the World Veterinary Poultry Association and Chairman Working group 10 (Turkey) European Branch of World Poultry Science Association (WPSA).

In addition, he is an honorary Professor at the University of Hohenheim since 1996 as well as honorary Professor at the Alexandria University, Egypt since 2009. Dr. Hafez is a member of several other scientific committees related to veterinary medicine. Since 2015 he is advisor of the Arab Federation for Food Industries (AFFI).

Dr. Hafez research interest focused on poultry diseases diagnosis and control in general and on respiratory and food borne diseases, management, and hygiene.

Dr. Hafez has published 241 articles in peer reviewed journals, 50 books and chapters in books, and made over 570 presentations in scientific meetings. He has also supervised 80 Masters, doctor thesis, Ph.D and Habilitation students..

### **Nadim Khouri**



Independent Researcher

World Bank

International Food Policy Research Institute (IFPRI)

Khouri is an independent researcher on food security. He presently advises The World Bank and the International Food Policy Research Institute (IFPRI) on evidence-based policies and investments in agriculture and global food security, the adaptation of African agriculture to climate change, and food security in the Middle-East and North Africa Region. Khouri's professional experience started in consulting for natural resources development (Dar-Al-Handasah, Beirut, 1979-1984). Later, he had a 20-year career at the World Bank (Washington, 1988-2008), operational and leadership position, leading the design and implementation of evidence-supported strategies and investments in rural development in South Asia and Latin America and the Caribbean. From 2008 to 2011, as Regional Director, he led the International Fund for Agricultural Development (IFAD) Europe, Near East and North Africa Division based in Rome, developing and managing a portfolio of \$100 million per year in researching, piloting and large-scale investing in agriculture and food security. Between 2011 and 2015, Khouri joined the United Nations Secretariat, as the Deputy Executive Secretary of the Economic and Social Commission for Western Asia (ESCWA) based in Beirut. His responsibilities at UN-ESCWA included management of a 400+ workforce and planning and supervising its work for the promotion of regional economic integration—with food security as one key priority. He has a PhD in agriculture from the University of Massachusetts in the US, an MSc in agriculture development from the University of London, UK, and a BSc and MSc in agriculture



engineering and soils and irrigation from the American University of Beirut, Lebanon.

### **Laura Rossi**



Large experiences in nutrition activities in developing and developed countries. Evaluation of nutritional status in individuals and populations: field studies using anthropometric and biochemical techniques; use of nutrition indicators for projects' evaluation; design of nutritional surveillance systems; clinical trials. Extensive institutional activities for public health nutrition consensus document preparation. Member of Management Editorial Board for revision of Italian

Recommended Intake of Energy and Nutrient (LARN) and Co-coordinator of Editorial Board for National Food Based Dietary Guidelines revision. Italian Technical Focal point (FAO) for INC+21 preparation. Management of complex national and international research projects. Member of Italian governmental committees and scientific societies. Consultant for UN bodies, EU, NGOs for nutritional programmes in low and medium income countries (LMICs). Bibliographical activity, peer reviews papers, consensus documents and technical reports.

Maturity and initiative to establish effective working relationships with people of different cultural backgrounds. Strong leadership skills and supportive management. Diplomatic ability.

**Key words:** Public health nutrition, nutrient recommendations, evaluation of nutritional status

## **Samuele Trestini**



*Professor*

*University of Padova - Italy*

*Vice Director*

*Department of Land, Environment, Agriculture and Forestry  
Viale dell'Università 16, 35020 Legnaro, Padova (Italy)*

### **Main activities:**

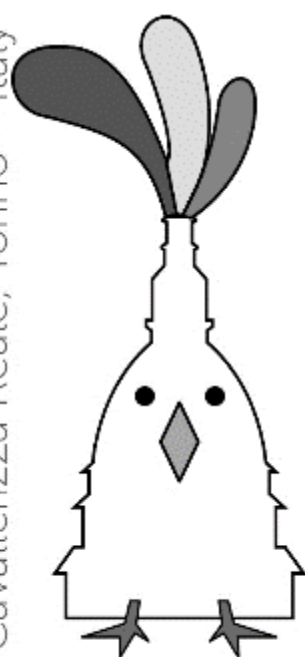
Master degree in Agricultural Science (2002) and Ph.D. in Agri-food Economics and Policy (2006) at the University of Padova (Italy). Visiting PhD scholar (2005) at University College of Dublin, Dept. of Agribusiness Extension and Rural Development, Dublin (Ireland). From 2015, Associate Professor and chair in Agri-food Economics and Policy at the University of Padova. Vice-director of the Dept. of Land, Environment, Agriculture and Forestry (Unipd). Authors of peer reviewed papers and conference papers, anonymous referee for international peer reviewed journals: EIP, National and local project coordinator. Member of the European Association of Agricultural Economics (EAAE), Società Italiana di Economia Agraria (SIDEA), Società Italiana di Economia Agroalimentare (SIEA).

### **Main scientific interest:**

EU Common Agricultural Policy reforms (both I and II Pillar). Agricultural risk management policy analysis. Marketing and consumer behavior analysis. Analysis of food market and trade dynamics (among others, specific focus on livestock, fishery, vegetables, fruits, wine sectors and functional food). EU policy on food quality. Analysis of supply chain management and dynamics related to the most relevant agri-food sectors. Environmental economics and policy.

**6<sup>TH</sup> MEDITERRANEAN  
POULTRY SUMMIT**

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**June 18-20, 2018**

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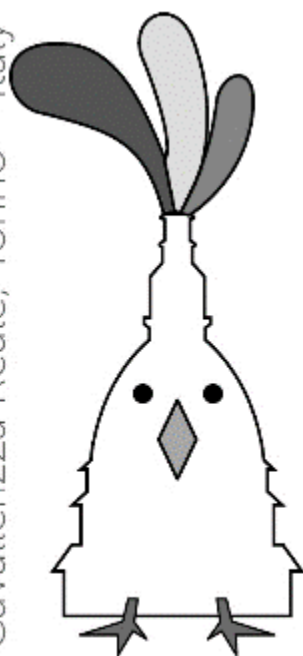
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**6<sup>TH</sup> MEDITERRANEAN  
POULTRY SUMMIT**  
Cavallerizza Reale, Torino – Italy



**June 18-20, 2018**

**Plenary Sessions**  
(Keynote Speakers)

[KI-01]: *Economic Studies on the Poultry Industry in the Mediterranean Region* (ID: 120042)

[United States]

## **The role of poultry in the region's food security: room for growth?**

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There is an increasing blurring of the line between private and public investments in support of overall food security-globally and in the Mediterranean Region. The Poultry Sector offers an ideal example of private investment participation in perhaps the noblest of economic development goals: fighting hunger and malnutrition. In a region that is basically the least self-sufficient in overall food production, poultry production offers a comforting exception. Still, there this presentation will present evidence to support the hypothesis that more growth can play both an economic role for overall development (especially in economically “lagging” rural areas) as well as a national, regional and global goal to achieve food security-latest by 2030. The concept of food security is holistic and therefore may inspire innovative linkages and partnerships to promote the poultry sector. Poultry, indeed, plays an important role in the four components defining food security: Availability (how much food is produced/processed/imported); Access (are there income, poverty, distribution, infrastructural or other obstacles limiting people’s access to the available food?); Use (how nutritious is the food?) and, finally, Stability (How stable are markets? How resilient are people and food supply chains to crises-environmental, economic, political/conflict, etc). The presentation will conclude with the identification of key and emerging investments concepts and instruments that can be tailored to the regional poultry production sector and take advantage of the combined public and private “return on investments” from the promotion of the poultry sector.

Keywords: food security; poultry; availability; access; nutrition; stability; private-public partnerships; blended investments.

[K1-02]: *Economic Studies on the Poultry Industry in the Mediterranean Region* (ID: 120186)

[Lebanon]

## **Animal and poultry production water footprint in The MENA region**

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The production of animal products has been increasing steadily in most countries of the Middle East and North African (MENA) region since the beginning of the 21st Century. This increase which has been estimated at about 70% is putting more demand on water resources in a region that is already suffering from water scarcity. It is generally known that globally, poultry production has a lower impact on water resources than the other animal enterprises. This impact has not been specifically studied for the MENA region. The objective of this study was to determine new estimates for the water footprint (WFP) for the different animal products (eggs, chickens, turkeys, beef, milk, goat and sheep meat) in the region. Up to date country specific blue, green and grey WFP (m<sup>3</sup>) were calculated for grazing, industrial and mixed feeding systems for each country for the period 2006-2016. Regarding poultry products, the industry is dependent on imported corn and soybean whose production constitutes over 90% percent of the WFP. The region should concentrate more on the production of feeds from rain fed crops rather than irrigated crops in an attempt to save on blue waters. The WFP for poultry meat in the MENA was estimated to be 2710 m<sup>3</sup> / ton while that for eggs it was found to be 2210 m<sup>3</sup>/ton for industrial system of management. Countries of the MENA region should push for the production of poultry meat and eggs in preference to that of red meat, thus contributing to improvements in food security. This would also be in line with recommendations of various nutritional and health agencies from all over the World.

**Keywords:** animal products; poultry products; water consumption; animal feed.

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[K2-01]: Nutrition and feed additives (ID: 120205)

[Italy]

## **Role of poultry products in the human diet**

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Chicken meat and eggs are the best source of quality protein, vitamin and mineral. In addition to that, poultry meat and eggs are widely available, relatively inexpensive so widely accessible particularly to low income people. Poultry production has a less detrimental impact on the environment compared to other livestock and uses less water. Excessive red meat consumption is a risk factor of several non-communicable chronic disease such as cardiovascular disease, type 2 diabetes and cancers. Epidemiological studies performed across the world, in highly diverse populations with different food preferences and nutritional habits, provide solid information on the association between poultry consumption, within a balanced diet, and good health. Consumption of poultry meat, as part of a vegetable-rich diet, is associated with a risk reduction of developing overweight and obesity, cardiovascular diseases, and type 2 diabetes mellitus. Moreover, poultry meat consumption also contributes to the overall quality of the diet in specific ages and conditions (e.g. elderly) and is suitable for those who have an increased need for calorie and protein compared to the general population. The dietary advice to reduce red meat consumption could easily be met by maximizing chicken and eggs consumption in a plant-based Human diet.

**Keywords:** human diet, chicken meat, eggs, obesity, cardiovascular diseases, and type 2 diabetes mellitus.

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[K4-01]: *Policies and regulations governing the poultry industry in the Mediterranean region* (ID: 120182)

[Lebanon]

## **Freedom of trade not "free trade agreements"**

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Trade balance between the underdeveloped countries and the rest of the world has been highly in favor of the latter. Importation of poultry meat or table eggs by the European countries, the USA, Canada and many other industrialized countries has been very limited if not prohibited in many ways. Most, if not all, underdeveloped or even developing countries have signed bilateral free trade agreements with countries or economic groups whose governments subsidize local production or export or both. Such subsidy results in unfair competition and prevents the development of the poultry industry in the importing countries. For the underdeveloped or developing countries to become self-sufficient in poultry meat and egg production, they need to withdraw from any binding trade agreements, protect the local industry via imposing effective import duties and thus encourage local producers to produce and help reach self-sufficiency.

**Keywords:** trade balance; government subsidies; free trade agreements.

[K4-02]: *Policies and regulations governing the poultry industry in the Mediterranean region* (ID: 120206)

[Italy]

## **Mediterranean poultry sector outlook in the global market**

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Poultry sector gained in 2017 the leading position in the world meat sector surpassing for the first-time pig meat production. This position is expected to be stable in the next years due to the forecasted growth in the medium-term (FAO-OECD). Four main area of production (US, Brazil, China and EU) dominate the poultry sector production at world level. These countries are able to produce more than 60% of the world's supply. They also are the main poultry meat consumers (54%) and the main supplier to the world market. In fact, they account altogether for nearly 80% of world export. Despite this concentration of world exporters, importers are fairly diversified with the first 10 markets accounting for the 64% of total import. Within this scenario, the Mediterranean area is characterized by the relevant role of EU - being the third producer, consumers and exporter – and of Turkey (8th producers, 10th consumers and 6th exporters). All countries within the Euro-Mediterranean partnership are experiencing a positive evolution in the last years with an increase in the production of around 35% from 2010 to 2016. Due to the unstable socio-economic condition in the Middle Eastern countries, the production growth is mainly concentrated in the North African regions (FAOSTAT). Poultry meat is expected to be the primary driver in the meat consumption increase, supported by the increase of the population and income and by the changes in dietary patterns in developing countries. Furthermore, this typology of meat is consumed among all the countries is due to the absence of religious limitation. At the same time, poultry meat seems to be the typology of meat able to respond better to emerging trend of the demand oriented towards more ready-to-eat processed meat. Beside this, the importance attached to the origin of meat and its production method is gaining relevance. Although there are huge opportunities for the development of this sector at global and local level, a relevant attention has to be paid to various factors: economic, political and health related. From the economic point of view, the profitability of poultry production is mainly linked to grain prices, domestic demand, household income, especially for developing countries. From the trade point of view, a key element able to significantly affect international trade is the avian flu that may cyclically imply the imposition of a trade ban among trade partners. This disease occurrence may have severe implications on the market equilibrium, prices and income of farmers. It affects the positive perception that consumers place in this product in developed countries.

**Keywords:** mediterranean poultry, global market, economics.

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[K5-01]: *Genetics and breeding* (ID: 120200)

[Italy]

## **Sperm cryopreservation in poultry: a review**

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Semen cryopreservation in domestic animal species is a reproductive biotechnology used to increase the diffusion and measurement of genetic progress, sustain the conservation of genetic biodiversity and improve the management of AI. In birds, the key role of semen cryopreservation is magnified being the only reproductive technology currently feasible for the conservation of genetic resources, given the impossibility to freeze embryos and oocytes. Despite many years of research studies, poor fertilization rates are still obtained with avian as opposed to mammalian cryopreserved sperm, and the unique morphological characteristics of avian sperm are probably responsible for their high susceptibility to freezing damage. In addition, sperm membrane damages induced by cryopreservation result in impaired sperm transport and survival in the female reproductive tract within the sperm storage tubules with the consequence of a decreased fertile period. Modified artificial insemination protocols, including higher insemination doses and frequency of insemination, are usually also adopted with the aim to compensate the decreased fertilizing potential of cryopreserved sperm, but only a partial effect may be present. The choice of the cryoprotectant and its concentration is certainly one of the most important factors affecting semen freezing protocols. Several studies have been recently focused on the action of cryoprotectants on sperm quality and fertility and embryo viability, and the results are reviewed.

**Keywords:** sperm cryopreservation, poultry AI.



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[K7-01]: Poultry health (ID: 120001)

[United States]

## **Review of pros and cons of different programs for the control of coccidiosis in poultry**

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Coccidiosis is a protozoan economic disease of poultry, in which around 80% of losses are due to mortality, reduced weight gain, inefficient feed conversion, associated with loss of egg production in layers. The pathogenicity of *Eimeria* spp. etiology in various poultry breeds is documented. Control programs of this economic disease included poultry house management, introduction of live vaccines (non-attenuated and attenuated), development of subunit, recombinant, and DNA-based vaccines, and supplementation of feed by prophylactic coccidiostatic drugs. This literature review will evaluate the Pros and Cons of each of these programs, targeting the control of coccidiosis in poultry, by reducing the oocyst output and its sporulation, building sufficient immunity in the birds, and sustaining an acceptable production standard. This presentation will help the poultry industry in evaluation of their present control programs, the implementation of the most appropriate control programs by the decision makers on their operations, and to recommend future road map to researchers, in an attempt to better control this persistent coccidiosis disease in the global poultry industry.

**Keywords:** coccidiosis, control programs, pros, cons, future road map.

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[K7-02]: Poultry health (ID: 120117)

[Germany]

## **Poultry health: current challenges and future approaches to disease control**

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Emerging diseases of poultry are mostly associated with severe economic losses. Several infectious agents such as viruses, bacteria and parasites are involved in many of these conditions. These infectious agents can be introduced and spread in wide geographic area by different routes. Several factors can precipitate and/or predispose to disease emergence. These include changes in the structure and development of the poultry industry as well as strong global competition leading to an increase of the global movement of poultry and poultry products. Another factor is microbial adaptation allowing escaping vaccinal pressure and antibiotic treatment. Classic examples are avian influenza and the emergence of infectious bronchitis caused by novel variant strains as well as introduction of antibiotic resistant bacteria such as Vancomycin-resistant Enterococci (VRE) and Methicillin-resistant Staphylococcus aureus (MRSA). In addition, increased the incidence of food-borne diseases caused by Salmonella and Campylobacter remains an important issue for the poultry industry. Furthermore, after the ban of antimicrobial growth promoters, a rapid increase in incidence of clostridial infections was observed in the EU. This paper explores some of these problems, their economic impact, diagnosis and control approaches.

**Keywords:** poultry, avian influenza, Salmonella, Necrotic enteritis, diagnosis, control.

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A stylized, minimalist illustration of a chicken. The body is a simple white outline with a scalloped bottom edge. It has two small black dots for eyes and a grey diamond-shaped beak. The tail feathers are represented by three large, overlapping shapes in shades of grey and black. The feet are simple black shapes with three toes each.

**June 18-20, 2018**

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[OI-01]: *Economic Studies on the Poultry Industry in the Mediterranean Region* (ID: 120204)

[Algeria]

## **Avian populations in Algeria (Ghardaya): phenotypic characterization of local breeds**

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In Algeria, local chickens (*Gallus gallus domesticus*) are part of the traditional breeding; they occupy the first place without competition among avian species. They are characterized by extremely varying phenotypes, such as coloration of plumage, types of peak, crest, feathered legs, and other features which are hardly recorded. Many of these features are monogenic traits controlled by a single gene and / or, in some cases, by two or three genes. In order to characterize the local chicken population of the region of Ghardaya, more than thirty outputs were spread out over four months in the majority of the villages which belonged to Ladirra, Lachboure, Oasis, Ougba, Street daya, Malika, Ben yesgen, El atteuf, Berriane, and Guerrara. A database was used with respect to various characters: coloration of the beak, the peak and the plumage; the presence of the crest, feathered lugs, the presence of ergot in females and their absence in males and bare neck. Recording of different phenotypes allowed to deduce both allele and genotypic frequencies of these populations which are considered as a natural breed. The presence of several allelic forms showed that these populations conceal a high genetic variability.

**Keywords:** characterization, phenotype, chicken, local breed Ghardaya.

[01-02]: *Economic Studies on the Poultry Industry in the Mediterranean Region* (ID: 120134)

[Italy]

## **Productive and reproductive performances of duck, turkeys and guinea fowls in Veneto region of Italy**

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The aim of this study was to evaluate the productive and reproductive performances of three poultry species of several Veneto poultry breeds (Faraona Camosciata, Anatra Mignon, Anatra Germanata Veneta, Tacchino Ermellinato di Rovigo and Tacchino Comune Bronzato) under conservation scheme. The productive traits were: live weights in male and females from 122 until 253 days of age (lw) and average daily gain (adg), while the reproductive traits were fertility and live born chicks. Results showed some interesting aspects as Anatra Mignon breed, was always different from other breeds for the productive and reproductive performances; lw was  $1037 \pm 109.49$  g and adg was  $6.68 \pm 1.16$  g/d, being the lightest amongst the breeds. Indeed, Anatra Germanata Veneta show higher lw of  $2302.31 \pm 191.04$  g with adg of  $14.04 \pm 3.61$  g/d. Different result was found for lw and adg of Faraona Camosciata breed that showed lw of  $1536.76 \pm 140.72$  g and adg of  $11.52 \pm 2.15$  g/d. Tacchino Ermellinato di Rovigo and Tacchino Comune Bronzato breeds showed higher lw with respect to the other breeds; the lw were  $4538.44 \pm 1512.52$  g and  $3722.08 \pm 1388.90$  g, while adg were  $27.62 \pm 6.23$  g/d and  $23.25 \pm 6.23$  g/d, respectively. A greater total growth was noted in males compared to females in each considered breed, associated with a low sexual dimorphism. Tacchino Ermellinato di Rovigo, Tacchino Comune Bronzato and Anatra Mignon showed highest fertility rates with values ranging from 86% to 93%, while Anatra Germanata Veneta and Faraona Camosciata showed lowest fertility rates (~75%). Highest percentage of live born chicks was showed in Tacchino Comune Bronzato (~77%), while lowest value was showed in Tacchino Ermellinato di Rovigo (~50%), Anatra Germanata Veneta (~52%), Anatra Mignon (~52%), and Faraona Camosciata (~53%). In conclusion, the adg and lw are two important parameters to be considered in the development of breeds and nutritional programs; moreover, a controlled diet can be designed to optimize the reproductive performance and the lw of the carcasses and to improve meat quality and quantity on the market.

Keywords: chicken; local breed; conservation; meat quality; eggs production.

[OI-03]: *Economic Studies on the Poultry Industry in the Mediterranean Region* (ID: 120194)

[Iran (Islamic Republic of)]

### **Effects of different levels of natural glauconite and zeolite on performance, tibia bone characteristics and blood parameters of broiler chicken**

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An experiment with 300 one-day old Ross male broiler chicks was conducted to determine the effects of glauconite and zeolite on the broiler's performance, tibia bone and blood characteristics. Five experimental treatments [control, glauconite (2 or 4 percent), and zeolite (2 or 4 percent)] were used in a completely randomized design with 4 replicates per treatment. During the experiment weight gain, feed consumption and feed conversion ratio (FCR) were measured periodically. At 42 days of age, one chick per replicate was slaughtered to determine blood serum calcium and phosphorus and tibia bone parameters. Analysis of variance and separation of means by Duncan's multiple range tests were conducted by SAS software. The results indicated that by adding 4% zeolite to diet, weight gain was increased ( $P<0.05$ ) in starter and total rearing period. In comparison with other treatments, cumulative feed consumption was significantly increased ( $P<0.05$ ) in the 4% zeolite treatment but not for the 4% glauconite group. There were no significant differences ( $P>0.05$ ) in FCR among treatments. Also, adding 4% zeolite led to a significant ( $P<0.05$ ) increase in tibia bone volume when compared to the 2% zeolite group but experimental diets had not significant ( $P>0.05$ ) effect on tibia bone relative weight, length and density. Dietary supplementation with glauconite or zeolite failed to significantly ( $P>0.05$ ) influence serum Ca and P content at the end of experiment.

**Keywords:** broiler; glauconite; zeolite; performance; tibia.

[OI-04]: *Economic Studies on the Poultry Industry in the Mediterranean Region* (ID: 120197)

[Iran (Islamic Republic of)]

## **Influence of purslane extract and probiotic on energy and protein utilization, droppings characteristics and welfare related parameters of broiler chickens at high stocking density**

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This study evaluated the effects of purslane extract and probiotic on energy and protein utilization, droppings characteristics and welfare related parameters of broiler chicks under high stocking density. A total 280 one-day-old broiler chicks were used in a completely randomized design with five treatments and four replicates per each. Dietary treatments included: 1) positive control (PC; 10 chicks/m<sup>2</sup>), 2) negative control (NC; 15 chicks/m<sup>2</sup>), 3) NC + 500 mg/kg purslane extract (PE), 4) NC + 200 mg/kg probiotic supplementation (PS) and 5) NC+500 mg/kg PE + 200 mg/kg PS. The results of this experiment showed that energy efficiency ratio (EER) and protein efficiency ratio (PER) were increased ( $P < 0.05$ ) as a result of increasing density in starter and overall experimental period. Birds reared in high density and supplemented with the feed additives had greater ( $P < 0.05$ ) EER and PER as compared to PC group. Litter and excreta moisture was significantly increased ( $P < 0.05$ ) with higher placement density. These results indicate that increasing the bird density positively influenced broiler EER and PER, but negatively influenced litter moisture, gait score, foot pad dermatitis and hock burns. Dietary supplementation with purslane extract and probiotics in high stoking density improved energy and protein utilization but failed to have a clear effect on droppings moisture and the welfare related parameters.

**Keywords:** broiler; probiotics; purslane; stoking density; welfare.

[OI-05]: *Economic Studies on the Poultry Industry in the Mediterranean Region* (ID: 120199)

[Iran (Islamic Republic of)]

## **Effects of particle size and dietary levels of perlite on performance and tibia bone characteristics of broiler chickens**

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This study was to investigate the effects of different levels perlite on performance and tibia bone characteristics of broiler chickens. 336 one day old broiler chicks reared for 42 days in a completely randomized design with 7 treatments, 4 replicates and 12 chicks per each. The experimental treatments were control (without perlite supplementation), perlite levels (2 and 4%), and particle size (fine, medium, coarse). The results showed that inclusion of 4% fine perlite increased feed intake in comparison to other groups significantly in 3-6 and 1-6 weeks of age ( $P<0.05$ ). As body weight gain, supplementation of 4% coarse perlite led to lowest in comparison to other treatments at finisher and total rearing phase ( $P<0.05$ ). But, control group and 2 % medium and coarse perlite supplemented broilers had lowest feed conversion ratio ( $P<0.05$ ). Tibia bone ash content increased with no perlite addition and in groups supplemented with 4% fine and 2% coarse perlite compared to 4% coarse group significantly ( $P<0.05$ ).

**Keywords:** broiler; particle size; performance; perlite; tibia.



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[O2-01]: Nutrition and feed additives (ID: 120096)

[United States]

## **Corn milling efficiency and particle size effects on pullet growth performance and reproductive development**

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Previous research with broilers would suggest dietary particle size (PS) is important for body weight (BW) and feed conversion (FC), though little information is available regarding the impact on pullet growth or performance. Therefore, four ground corn PS treatments (600, 900, 1200 and 1500  $\mu\text{m}$ ) were fabricated for this study (and another) then analyzed for nutrients and PS distribution using the ASABE procedure S319.4 to calculate the geometric mean diameter (GMD) and geometric standard deviation (GSD). Hammer mill electrical expenditures to grind the corn treatments and power, amperage, rate in tonnes/hr (TPH), milling efficiency, cost and speed were measured. Day old Hy-Line W-36 chicks ( $n=325$ ) were placed 25 birds per cage and fed isonitrogenous, isocaloric mash treatment diets with the 600, 900 or 1500  $\mu\text{m}$  corn. Body weight and BW gain (BWG) were measured at placement and 5, 10, 16 and 17 weeks of age. Feed intake and FC were calculated at each age. The actual corn GMD $\pm$ GSD were: 703.21 $\pm$ 0.43; 913.06 $\pm$ 0.40; 1166.46 $\pm$ 0.47 and 1714.68 $\pm$ 0.41 for the 600, 900, 1200 and 1500  $\mu\text{m}$  treatments, respectively. Economic analysis showed a significant trend with lower amperage, power and energy costs, greater efficiency and TPH associated with greater PS. Among the pullets there was a significant trend for the birds fed 600  $\mu\text{m}$  corn to be heavier than those fed 900 or 1500  $\mu\text{m}$  at 5, 10, 16 weeks and trending toward the same at 17 weeks of age ( $P=0.0521$ ). Pullet BWG reflected BW results from placement to 5 weeks with pullets fed the 600  $\mu\text{m}$  treatment gaining significantly more than those fed 900 and 1500  $\mu\text{m}$ . Also pullet breast fleshing score was significantly higher for the birds fed the 600  $\mu\text{m}$  diet compared to those fed 900 or 1500  $\mu\text{m}$ . This study indicated that despite milling cost and efficiency, finely milled corn (600  $\mu\text{m}$ ) was more beneficial for optimum pullet growth and reproductive development for successful hen performance, while larger PS reduced pullet BW, delayed fleshing and overall growth performance.

Keywords: corn; milling; particle size; pullet; growth; fleshing.

[O2-02]: Nutrition and feed additives (ID: 120159)

[Italy]

## **Evaluation of productive performance and plasma metabolomics profile of broiler chickens fed diets with different arginine/lysine ratio.**

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Arginine is an essential amino acid for poultry and plays crucial roles in different biological pathways. Recent findings highlighted that the recommended levels of dietary arginine might be suboptimal for the current fast-growing broilers. Therefore, this study was performed to evaluate the effects of increased dietary arginine/lysine ratio on productive aspects and plasma metabolomics profile of broiler chickens. 1,168 1-d-old male chicks (ROSS 308) were weighed and equally divided in two experimental groups (9 replicates each) fed a commercial basal diet (CON group; Arg/Lys ratio 105-105-106-107 of each feeding phase, respectively) or the same basal diet supplemented with synthetic arginine (ARG group; Arg/Lys 115-115-116-117). Productive performance were recorded at the end of each feeding phase (12, 22, 33, 43 d). At processing (43 d), blood was collected from 1 bird/replication (9 birds/group), centrifuged and plasma stored at -80°C for metabolomics analysis. Plasma was analyzed through a Nuclear Magnetic Resonance (1H-NMR)-based approach and metabolites were identified using the Human Metabolome and ChemoX software data bank. At slaughter, carcass and cut-up yields were assessed on each bird. Dietary supplementation of arginine significantly reduced feed conversion rate (FCR) at 12 d (1.352 vs. 1.401, respectively for ARG and CON;  $P < 0.05$ ), 22 d (1.398 vs. 1.420, respectively for ARG and CON;  $P < 0.01$ ) and 33 d (1.494 vs. 1.524, respectively for ARG and CON;  $P < 0.05$ ), while tended to improve FCR in the overall period of trial (1.646 vs. 1.675, respectively for ARG and CON;  $P = 0.09$ ). Body weight was significantly affected by the dietary treatment at 33 d (1,884 vs. 1,829 g., ARG and CON respectively;  $P < 0.05$ ). Breast yield was increased by 1.1% in ARG group. From the metabolomics analysis emerged that ARG group had a higher plasma concentration of arginine, hypoxanthine, histidine, leucine, as well as higher 3-hydroxybutyrate/acetoacetate and lactate/pyruvate ratios. Furthermore, ARG group exhibited lower plasma levels of adenosine, proline, acetoacetate, glutamate, alanine and pyruvate. In conclusion, the increased arginine/lysine ratio tested in this trial enhanced feed efficiency and slaughter yields in fast growing broiler chickens and modified the plasma levels of key metabolites related to energy and protein metabolism, which may have played a role in the productive improvements observed in ARG group.

**Keywords:** broiler chicken; arginine; nutrition; plasma; metabolomics.

[O2-03]: Nutrition and feed additives (ID: 120120)

[Iran (Islamic Republic of)]

## **Interactive effects of dietary lysine and threonine in male broilers**

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A total of 240 1d old Ross 308 male broilers, in a completely randomized design as a 2×3 factorial arrangement with 4 replicate each, were allocated into 24 floor pen. The diets consisted of two levels of Lys (starter: 1.39 (recommended level) and 1.49, grower: 1.16(recommended level) and 1.25 and finisher: 1.05(recommended level), 1.13 percent) and three levels of Thr (starter: 0.85, 0.90 (recommended level) and 0.95, grower: 0.72, 0.76 (recommended level), 0.80 and finisher, 0.70, 0.72 (recommended level) and 0.75 %). Broiler chicks consumed feed and water at will from 1 to 42 d of age. Nutrient specification of the diets was according to the Ross Broiler Management Manual. Growth performance parameters, carcass traits were measured weekly and 42d of age, respectively. Hemagglutination test was performed to evaluate the humoral immunity at 28d of age. The collected data were analyzed using the general linear models procedure of the SAS (2002). The results showed that growth performance parameters, dressing percent, breast and thigh and abdominal fat were not affected by different levels of Lys. Increasing the level of Lys to as much as 7.5 % instead of the recommended level (1.49 percent) improved hemagglutination titers to Newcastle disease virus. The main significant ( $P<0.05$ ) effect of Thr was on feed intake, weight gain and feed conversion ratio as these traits were improved in chicks fed diets containing high levels of Thr. The effects of dietary Thr or Ly levels on humoral immunity against NDV were significant ( $P<0.05$ ) as low levels of Thr (0.72 %) impaired it while increasing Lys level improved it. Interactive effect of Thr and Lys on feed conversion ratio in finisher growth phase was significant ( $p<0.01$ ), so that the best feed efficiency was found in diet containing 1.05 % Lys and 0.75 % Thr. It is concluded that increasing dietary Lys level to more than recommended improved humoral immunity. Increasing dietary Thr level improved growth performance parameters while decreasing it to lower than recommended levels impaired humoral immunity response.

**Keywords:** performance; lysine; threonine; male broiler; dietary interaction.

[O2-04]: Nutrition and feed additives (ID: 120075)

[Iran (Islamic Republic of)]

## **Effect of strontium on osteoporosis, bone density and eggshell quality in Hy Line strain laying hens**

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This study was carried out to evaluate the effects of various levels of strontium on osteoporosis, bone density and eggshell quality in 180 Hy-Line W-36 of laying hens from 38-48 weeks of ages. Experiment was arranged in a completely randomized design (CRD) including 6 treatments, 5 replicates cages and 6 birds in each. Experimental treatments consisted of control diet contains corn and soybean meal (without strontium) and 2, 3, 4, 5 and 6 including 1, 2, 3, 4 and 5 gr strontium carbonate per kg of diet, respectively. The bone density was measured by X-ray for osteoporosis at 46 weeks of ages. Egg quality and quantity were measured biweekly. Results have indicated that there was a significant increase in ash contents, bone volume and density of leg bone in all treatments compared to the control diet ( $P < 0.0001$ ). Shape index, shell weight, shell ratio and shell thickness were not affected by different levels of strontium enduring the experimental period ( $P > 0.05$ ). Higher levels of bone strontium and calcium were shown in treatment 5 ( $p < 0.05$ ). Bending strength, density and leg bone weight were observed in the experimental groups. On the other hand, there were no significant differences in maximum strain, resistance to break and elasticity of bones. In general, the results of this study have shown that the level of 3 gr carbonate strontium/ kg diet could be considered to increase bone density and reduce osteoporosis. It is a good strategy for increasing resistance to bone fracture of laying hens. In addition, no adverse effects were observed on egg quality, quantity and bone parameters of laying hens.

Keywords: bone density; laying hens; osteoporosis; strontium.

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[O2-05]: Nutrition and feed additives (ID: 120126)

[India]

## **Identification of malate synthase as one of the targets of methionine sulfoxide reductase A of *Salmonella typhimurium* and their role in colonization in the chicken**

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The free radicals released from phagocytic cells in the immune system are detrimental to the survival of *Salmonella Typhimurium*. In order to survive against these oxidants, *S. Typhimurium* has developed various survival strategies. The methionine residues are most vulnerable to oxidant mediated attack. Methionine sulfoxide reductase A (MsrA) comes to rescue by repairing these Met-SO to Met and thus restoring the native function of protein. In this present piece of work we have identified malate synthase (MS) as one of the targets of MsrA by demonstrating their interaction using blot overlay and in vitro cross linking. By Mass Spectrometry analysis we clearly show MsrA mediated repair of oxidized Met residues in MS. Interestingly like  $\Delta$ msrA, we have also observed increased susceptibility of  $\Delta$ ms strain to HOCl in vitro and in macrophages. In comparison to WT both  $\Delta$ msrA and  $\Delta$ ms showed reduced colonization. However, MsrA have an upper hand over MS in its role in the virulence of *S. Typhimurium*.

Keywords: *S. typhimurium*; Msr; Met-SO; Malate synthase; chicken.

[O2-06]: Nutrition and feed additives (ID: 120146)

[France]

## **Effects of a vectorized dietary betaine and antioxidants supplementation on growth performance, oxidative stress and carcass quality of broilers kept under high environmental temperatures**

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Broilers growth performance and breast meat yield are impaired by high environmental temperature. Such impairment is attributable to a reduction in feed intake and an increase in oxidative stress, which induces hemolysis and lower carcass quality. Feeding betaine may reduce such negative effects thanks to its osmoprotective properties as well as its role as methyl donor. In addition, vitamin C and other antioxidants may protect against oxidative stress and hemolysis. As betaine and vitamins are aggressive or versatile active ingredients, a specific vectorizing process with a selected vegetal fat has been applied (BeTaHit). The aim of this study was to evaluate the effect of BeTaHit on growth performance, carcass quality and hemolysis of broilers raised in high housing temperature. A total of 192 male Ross 308 broilers were allocated to a randomized complete block design with 3 treatment groups: NC (negative control, no BeTaHit), B1 (NC + 750 g/T BeTaHit) and B2 (NC + 1300 g/T BeTaHit), each replicated 16 times with 4 birds per cage. From 21d to 35d, housing temperature varied every day to simulate high summer temperatures up to 30°C. Growth performance was measured during the whole experiment. At 36d, birds were sacrificed. Plasmatic oxidative stress markers as well as hemolysis score were compared between NC and B2. Dripping loss and breast meat yield were compared across all treatments. Data were analyzed using a univariate analysis of variance and Tukey's range test as a post hoc test. Dietary supplementation had a significant effect on body weight gain, feed intake and feed efficiency between 0 and 36d ( $P < 0.05$ ). Post hoc analysis revealed that B1 led to the best results for the aforementioned parameters ( $P < 0.05$ ). Breast meat yield has been significantly increased by BeTaHit supplementation, even more for B1 ( $P < 0.01$ ). Oxidative stress markers were not significantly affected by dietary intervention. B2 had, in addition, a lower hemolysis score than NC (4.12g/L vs 4.44g/L,  $P < 0.05$ ). Our results indicate that BeTaHit has a positive effect on the growth performance and erythrocytes integrity of broilers, suggesting a better resistance when the thermal environment exceeds the thermoneutral zone of animals.

Keywords: vectorized betaine; high temperatures; broiler chicken; antioxidants; hemolysis.

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[02-07]: Nutrition and feed additives (ID: 120137)

[Algeria]

## **Effects of dietary *Pediococcus acidilactici* supplementation on performance of poultry under Algerian condition**

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Probiotics are defined as microbial food supplements which beneficially affect the host animal by improving its intestinal microbial balance. The beneficial effect of probiotic preparations in poultry nutrition has been well documented. The objective of our study was to investigate the effect of *Pediococcus acidilactici* in drinking water on growth performance and carcass weight of chickens under Algerian condition during 56 days of summer season. The broiler chickens were assigned to two treatments (Control and Experimental) with five replicates per treatment. All animals were fed basal diet and probiotic (*Pediococcus acidilactici*) -supplemented drinking water, containing approximately 1011 cfu/ml, was offered to the experimental group only. At the end of the experiment, the birds were sacrificed and eviscerated to measure the eviscerated carcass weight. Results showed that use of *Pediococcus acidilactici*, as supplement in drinking water, significantly ( $P < 0.05$ ) improved the BW, feed intake and feed conversion ratio of chickens. After evisceration, significant difference ( $p < 0.05$ ) was found between eviscerated carcass weight groups whereby *Pediococcus acidilactici* -supplemented birds had higher carcass weight as compared to Control.

Keywords: probiotic; *Pediococcus acidilactici*; chickens; Algerian condition.

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[O2-08]: Nutrition and feed additives (ID: 120011)

[Pakistan]

**Effect of dietary organic selenium supplementation on the productivity, selenium distribution in egg and blood hematology of laying quail**

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The objective of this study was to determine the effect of selenium (Se) enriched yeast on productivity, egg quality, blood hematology and egg Se concentrations in laying Japanese quail. Total of 120 laying Japanese quail at 21 weeks of age were divided in to four groups. Each group consisted of three replicates and each replicate having 10 birds. The laying Japanese quails were given the basic diet without supplementation or with 1.5 mg Se/kg diet, 2 mg Se/kg diet and 3mg Se/kg diet in experimental groups. During the experimental period egg rate and dietary intake were recorded, six eggs were sampled on days 15 and 28 from each treatment group for Se content Determination, while blood was sampled at day 28 for hematological analysis. The results showed that there was no significant difference ( $p > 0.05$ ) in feed intake, egg production, egg quality and blood hematology among treatments. Selenium supplementation from Se enriched yeast markedly increased ( $p < 0.05$ ) egg Se concentration as compared to the control group. The results indicated that Se-enriched yeast could be used in large doses for the production of selenium enriched quail egg without any deleterious effect on the production performance and blood hematology.

Keywords: Se-enriched yeast; egg selenium content; laying japanese quail; eggs.



[O2-09]: Nutrition and feed additives (ID: 120110)

[China]

## **Influence of graded levels of L-Theanine dietary supplementation on growth performance, carcass traits, meat quality, organs histomorphometry, blood chemistry and immune response of broiler chickens**

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L-theanine is a water-soluble non-proteinous amino acid mainly found in green tea leaves. Despite the availability of abundant literature on green tea, studies on the use of l-theanine as a feed additive in animals, and especially broilers are limited. The objective of this study was, therefore, to evaluate the effect of different dietary levels of l-theanine on meat quality, growth performance, immune response, and blood metabolites in broilers. A total of 400-day-old broiler chicks were randomly divided into four treatment groups using a completely randomized design; C-control, basal diet; 100LT-basal diet + 100 mg l-theanine/kg diet; 200LT-basal diet + 200 mg l-theanine/kg diet; and 300LT-basal diet + 300 mg l-theanine /kg diet. Results revealed that the intermediate level of l-theanine (200 mg/kg diet) showed better results in terms of body weight gain (BWG), feed consumed (FC), and feed conversion ratio (FCR) as compared with the other supplemented groups and the control. The live weight eviscerated weight and gizzard weight were higher in all l-theanine levels as compared to those of the control group. Increased weight ( $p \leq 0.05$ ) of spleen and bursa were found in group 200LT (200 mg l-theanine/kg diet). Concerning meat color parameters, values for yellowness ( $b^*$ ), and redness ( $a^*$ ) were greater in l-theanine-supplemented groups than the control. Supplementing broiler diet with l-theanine reduced ( $p = 0.02$ ) total serum cholesterol contents while increased HDL. Further analysis revealed lower relative serum cytokines (IL-2 and INF- $\gamma$ ) and reduced mRNA expression of TNF- $\alpha$  and IL-6 in thymus, and IFN- $\gamma$  and IL-2 in spleen in the treated group. Moreover, supplementation with 200mg/kg of l-theanine improved antioxidant status in blood by increasing SOD, GSH-Px, and relative CAT levels. It is concluded that the optimum supplementation level of l-theanine is 200 mg/kg of diet because it resulted in improved performance parameters in broilers. However, higher levels of l-theanine (300 mg/kg diet) may have deleterious effects on performance and health of broiler chickens.

**Keywords:** blood chemistry; broilers growth; carcass; l-theanine; meat quality.

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[O2-10]: Nutrition and feed additives (ID: 120081)

[Spain]

## **Crude soybean lecithin and vegetable acid oil as energy sources for broiler chickens**

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Lecithin and acid oil, as co-products from vegetable oil refining process, are economic alternatives to conventional fat sources and may represent an efficient energy source for broiler nutrition. Lecithin is a lipid mixture mostly composed by phospholipids that presents emulsifying properties, and on the other hand, acid oil contains free fatty acids as main components. The aim of this experiment was to study the effect of a combination of vegetable acid oil with crude soybean lecithin on performance parameters, as well as energy and fatty acid utilization. A total of 96 Ross 308 newly hatched female broiler chickens were randomly distributed in 24 metabolic cages and assigned to four experimental treatments (6 replicates/treatment). A basal diet was supplemented with 3% of acid oil (A3); 2% of acid oil and 1% of lecithin (A2L1); 1% of acid oil and 2% of lecithin (A1L2); and 3% of lecithin (L3). Titanium dioxide (TiO<sub>2</sub>) was added as indigestible marker at 0.5% and two nutritional balances were performed between 9-11 d of age (starter period) and 36-37 d of age (growing-finishing period). No differences were seen in performance between either acid oil or lecithin diets. Starter digestibility showed statistically higher utilizations ( $P < 0.05$ ) in A1L2 animals compared to A3 of saturated fatty acids (SFA; 63.8 and 52.1 %, respectively) and polyunsaturated fatty acids (PUFA; 76.0 and 68.1 %, respectively). However, no differences were observed between treatments in total fatty acids (TFA) and monounsaturated fatty acids (MUFA) utilizations, and feed AME value. In contrast, growing-finishing digestibility showed that A2L1 feed AME value was statistically higher than the rest of treatments ( $P < 0.01$ ), and 1% of lecithin obtained the highest numerically values for TFA, SFA, MUFA and PUFA. It is concluded that the two diets combining lecithin and acid oil obtained the best results, in starter period, 2% of lecithin with 1% of acid oil present the highest SFA and PUFA utilization whereas in growing-finishing period 2% of acid oil with 1 % of lecithin provides the maximum fat utilization and feed AME value.

**Keywords:** lecithin; acid oil; fatty acid; nutritional balance.

[O3-01]: Poultry gut health (ID: 120063)

[India]

## Effect of feeding *Lactobacillus reuteri* PIA16 isolated from the gastrointestinal tract of indigenous chicken of Assam, India on the productive performance of broiler chickens

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Lactobacilli are commonly considered as probiotic bacteria for their ability to utilize nutrient efficiently and competitively exclude pathogenic microbes from the gastro-intestinal tract. The indigenous chickens are reared in free range condition under scavenging system, without much modern intervention. It has also been reported that these birds possess disease resistance as compared to intensively raised commercial chickens. Therefore, it can be presumed that this special attribute may have a link to their gut microflora having *Lactobacillus* spp. Therefore, in the proposed study *Lactobacillus reuteri* PIA16, collected from caecum (Code: ACE5) and from jejunum (Code: AJ3) of indigenous chicken of Assam, India was used to study the productive performance of broiler chickens and also to note if it has site specific effects. The said bacterial strain was isolated from indigenous chicken, purified, characterized and registered under GenBank, National Centre for Biotechnology Information. It was used either singly or in combination with prebiotic, mannan oligosaccharide (MOS). For feeding, 20% of the daily broiler ration was fermented with 20% of *L. reuteri* PIA16 culture, and administered at a dose of 108cfu/ml. A total of 240-day-old chick broilers were used for the present study following completely randomized design. The birds were randomly assigned into five groups (T1-T5) of 48 birds containing six numbers in each of eight replicates of mixed sex per group provided with different dietary treatments i.e., T1-basal diet (Control), T2- basal diet+ 1.85x108cfu of *L. reuteri* PIA16 (ACE5)/gm fermented feed, T3- basal diet+ 1.89x108cfu of *L. reuteri* PIA16 (AJ3)/gm fermented feed, T4- T2+ MOS @ 0.25% and T5- T3+ MOS @ 0.25% of feed. The birds were housed in battery cages with watering, feeding and manure collection facilities, reared under standard management conditions for a duration of 5 weeks. Probiotic and prebiotic feeding was done throughout the experimental period from first day of age and growth parameters were studied. The results showed that supplementation of *L. reuteri* PIA16 at 108cfu dose significantly ( $P < 0.05$ ) improved body weight gain, feed consumption and FCR in the birds. The effect was further improved when supplemented along with prebiotic. Thus, it could be concluded that the locally isolated *Lactobacillus reuteri* PIA16 can be used as potential probiotic agent for commercial broiler chicken production, either singly or in combination of prebiotics, MOS. Also, the effect of two identified *L. reuteri* PIA16 strains isolated from different parts of the GIT (caecum and jejunum) was found to be non-site specific.

Keywords: broiler chickens; *Lactobacillus reuteri*; MOS; prebiotic; probiotic.

[O3-03]: Poultry gut health (ID: 120185)

[Italy]

### ***In ovo* injection of a prebiotic and effects on productivity and intestinal transcriptomic profile of broiler chickens submitted to chronic heat-stress condition.**

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The aim of the trial was to determine the impact of a galactooligosaccharide (GOS) prebiotic product injected *in ovo* on productive performance and intestinal transcriptome of hatched broiler chickens kept under heat stress condition. A single dose of 3.5 mg GOS/egg (GOS) or physiological saline (0.9% NaCl) (CON) was injected into the air chamber at 12 d of incubation. A total of 300 male chicks/group were split into 2 groups and reared on floor pens (6 replicates/group/environmental condition) either in thermo-neutral (TN, 25°C) or chronic heat stress (HS, 30°C for 24h/d from 32 to 42 d) conditions. Body weight (BW) and feed intake (FI) were recorded at the end of each feeding phase (10, 25 and 42 d, slaughter), feed conversion rate (FCR) and mortality were calculated. At slaughter, carcass, cut-up yields and foot pad dermatitis incidence (FPD, 3 points-scale) were evaluated for each bird. Moreover, jejunum and cecum mucosa were collected from 2 birds/replicate. RNA was extracted to perform a microarray analysis for transcriptome using GeneChip Chicken Gene 1.0ST Array, data were analyzed by Transcriptomic Analysis Console software (Affymetrix) and genes were considered differentially expressed between treatments when showing a  $\geq 2$ -Fold Change (log<sub>2</sub> ratio) and a False Discovery Rate FDR < 0.05. Body weight improvements (428 vs. 412 g., respectively for GOS and CON; P < 0.05) at 10 d and higher FI at 25 d were observed in GOS group (1.637 vs. 1.590 g, P < 0.05). Overall, at the end of trial, GOS birds showed a higher BW (2.892 vs. 2.791 g, P < 0.05) and FI (4.620 vs. 4.505 g, P < 0.05). As expected, heat stress reduced BW (2.554 vs. 3.129 g., P < 0.01), FI (4.312 vs. 4.814 g., P < 0.01) and negatively affected FCR (1.725 vs. 1.593, P < 0.01), respectively for HS vs. TN. No effect on slaughter yields and FPD were observed between groups. No interaction between heat stress and *in ovo* treatments was detected in jejunum and cecum. No enriched genes were detected for the *in ovo* treatment in both tissues. Conversely, heat stress induced up and down regulation of the expression of 12 and 13 genes in jejunum and 2 and 9 genes in cecum. (MIUR, OVBIOTIC project, RBSI14WZCL)

Keywords: poultry; *in ovo* injection; prebiotic; heat stress; intestinal transcriptome.

[O3-04]: Poultry gut health (ID: 120072)

[India]

## **Evaluation of probiotic properties of *Lactobacillus* spp. isolated from the gastrointestinal tract of indigenous chicken of Assam, India**

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The present study was planned to study the *Lactobacillus* organisms of gut having probiotic properties collected from indigenous chickens of Assam state, India so as to use as a probable probiotic agent. Five nos. each of healthy indigenous chickens belonging to three age groups i.e., chick (0-8 weeks), grower (9-20 weeks) and adult (above 21 weeks) reared under scavenging condition were collected randomly. After slaughtering, the contents of digestive tract-segments (crop, proventriculus, jejunum, ileum and caecum) were collected aseptically in Phosphate Buffer Solution and pooled segment- and age-wise. Intestinal contents were processed and screened for *Lactobacillus* on morphological, cultural and biochemical grounds (catalase test and sugar utilization pattern). The *Lactobacillus* strains were subjected to in-vitro tests viz aggregation test, acidic pH tolerance test, bile salts tolerance test, enzymatic activity, cell surface hydrophobicity, co-aggregation test and antagonistic activity to check its potency. After screening, the strains showing good probiotic qualities were characterized by molecular methods using genus specific primers conducted at Institute of Microbial Technology, Chandigarh, India. One-way ANOVA and Duncan's multiple range tests were done to elucidate differences using SAS System. From the above work, a total of 80 lactic acid forming bacteria (LAB) were isolated, out of which 31 representative strains were selected randomly, and screened morphologically and biochemically for the characteristics of *Lactobacillus*. The sugar utilization patterns (32 sugars, ONPG, citrate utilization and esculin hydrolysis) of the 29 strains revealed that five strains, coded as APR1, APR2, AJ3, AJ6 and ACE5 utilized 32 out of the total 35 sugars and substrates which were selected for evaluation of probiotic properties. The strains ACE5 and AJ3 both showed 99.72 % genetic identity with *Lactobacillus reuteri* through the 16S rRNA gene sequence and BLAST search analysis. The 16S rRNA gene sequence of the identified isolate *L. reuteri* was submitted to GenBank, National Centre for Biotechnology Information and the strain is registered as *L. reuteri* PIA16 (accession No. KX260961). The present study showed that *Lactobacillus reuteri* PIA16 isolated from GI tract of indigenous chicken of Assam state, India can be utilized as a potential probiotic agent in commercial broiler chicken production.

**Keywords:** *Lactobacillus*; probiotic; Assam indigenous chicken.

[O3-05]: Poultry gut health (ID: 120132)

[Iran (Islamic Republic of)]

## **The effect of different dietary supplementation levels of nucleotide on performance, immune system, small intestine morphology and ileal microbial population of broiler chickens**

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Effect of different dietary levels of nucleotide supplementation on performance, carcass characteristics, immune system status, small intestine morphology and ileal microbial population of broiler chickens was evaluated using 308 one-day-old mixed-sex Ross 308 broilers in a completely randomized design with 4 treatments and 7 replicates of 11 chicks in each, up to 42 days of age. Experimental treatments included a corn-soybean meal basal diet (control), and the basal diet containing 0.05, 0.1 and 0.2 percent nucleotide supplementation. The results showed that feed intake, body weight gain and feed conversion ratio of the broilers were not significantly affected by experimental treatments. Results of humeral immune system response at 35 days of age showed that the blood serum IgM concentration in 0.2 percent nucleotide group was higher than 0.05 percent group ( $P < 0.05$ ). Moreover, at this age serum IgG concentration in 0.05 percent nucleotide group was higher than 0.2 percent group ( $P < 0.05$ ). At 42 days of age, serum IgG concentration in 0.1 percent nucleotide treatment was lower than control group ( $P < 0.05$ ). The cellular immune system response of chicks fed diet supplemented with 0.1 percent nucleotide at 48 hours after Phytohemagglutinin-P injection was higher than control treatment ( $P < 0.05$ ). On the basis of current experiment results, supplementation of broiler diets with nucleotide improved the cellular immune system response but has no significant effect on other parameters in broiler chickens.

**Keywords:** carcass yield; immunoglobulin; intestinal villi; lymphatic organs; weight gain.

[O3-06]: Poultry gut health (ID: 120121)

[Italy]

## **Modulation of gut microbiota, morphology and mucin composition by dietary *Hermetia illucens* meal inclusion in broiler chickens**

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Dietary modifications have been reported to influence intestinal microbiota, morphology and mucin dynamics in poultry. The present study evaluated the effects of dietary *Hermetia illucens* (HI) meal inclusion on gut microbiota, morphology and mucin composition in broiler chickens. A total of 192 male broiler chickens were divided into 4 dietary treatments (control feed and 5% [HI5], 10% [HI10] and 15% [HI15] HI meal inclusion) and slaughtered at 35 days of age (12 birds/diet). The gut microbiota was assessed on cecal content samples by 16S rRNA amplicon-based sequencing. Intestinal morphology was evaluated through morphometric measurements of villus height (Vh), crypt depth (Cd) and villus height/crypt depth ratio (Vh/Cd) on duodenum, jejunum and ileum. Small intestine and caecum were also stained with Periodic Acid Schiff, Alcian Blue pH 2.5 and High Iron Diamine to discriminate among neutral, acidic sialylated and acidic sulfated mucins, respectively. *L-Ruminococcus*, *Faecalibacterium*, *Blautia* and *Clostridium* genera were found to be characteristic of HI5 cecal microbiota (FDR < 0.05), while broiler chickens fed with HI10 and HI15 diets were characterized (FDR < 0.05) by *Lactobacillus* and *Ruminococcus* (HI10) and *Bacteroides*, *Roseburia* and *Helicobacter* genera (HI15). HI15 birds showed lower Vh (P < 0.05), higher Cd (P < 0.05) and reduced Vh/Cd (P < 0.01) than the others, with duodenum showing the highest morphometric indices in all the dietary treatments (P < 0.001). Lower mucin staining intensity (P < 0.001) was also observed in the intestinal villi of broilers fed with HI10 and HI15 diets than the others. Independently of HI meal utilization, crypt mucins were predominantly neutral and acidic sialylated and higher in ileum and base fragment (P < 0.001), while villus mucins were predominantly acidic sialylated (P = 0.10) and higher in ileum (P < 0.001). In conclusion, dietary HI meal utilization at 5% inclusion rate may positively modulate the cecal microbiota of broiler chickens without affecting the gut mucosal morphology and mucin composition. On the contrary, increasing levels of dietary HI meal inclusion (especially the 15%) may negatively affect the gut microbiota, mucosal morphology and mucin composition, thus suggesting that lower levels could be preferable.

**Keywords:** *Hermetia illucens*; broiler chickens; gut health; insect meal.

[O3-07]: Poultry gut health (ID: 120174)

[Italy]

### **Excreta characteristics and digestive efficiency in couple vs. singly housed breeding Sardinian partridges (*Alectoris barbara bonnaterre*, 1790)**

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Sardinian partridges are monogamic birds of the wild fauna of Sardinia island (Italy), naturally diffused also in other countries of the Mediterranean basin. Breeding of Sardinian partridge is carried out in authorized centers over the regional territory, for biodiversity conservation and game restocking. Previous own trials highlighted differences between male and female in a same couple bred in cage as to prevalence of foot disorders, being more frequent and severe in females. Lamé animals are known to reduce feed intake for impaired movement. The present investigation aimed to quantify daily feed consumption, excreta output and digestive efficiency in Sardinian partridges both in breeding females and males from stable couples and singly housed as well as when housed in couple. After an adaptation period of one week, 10 breeding couples were fed a conventional pelleted diet for partridges for two weeks (T1 phase). In the last three days of the feeding trial, daily feed intake (feed offer-leftovers weight everyday) was calculated and a total collection of excreta for each couple was carried out. Subsequently, couples were split into female and male that were singly housed and fed the same identical diet of the previous phase and monitored as to feed intake, excreta output and digestive efficiency of main nutrients (T2 phase). Both T1 and T2 phases were replicated. Significantly ( $p=0.019$ ) and progressively singly housed females increased daily feed consumption if compared to males (daily feed consumption g/g BW: 0.053 vs. 0.045, respectively). Excreta output changed as to DM contents and differences in digestive efficiency of some main nutrients were also pointed out to differ in females and males whether singly caged or in couples. In the light of the results obtained in this trial, it could be recommendable that housing conditions may be adapted to production periods, probably to reduce the effect of male domination over the female, with particular regard to feed consumption and digestive efficiency of the laying partridge.

Keywords: breeding couple; daily feed intake; nutrient; partridge.



[04-01]: *Policies and regulations governing the poultry industry in the Mediterranean region* (ID: 120180)

[Italy]

## **An introduction to comparative animal law: chicken cultures and the law**

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The article introduces the study of animal rights in comparative law by discussing the case of chickens. The legal systems of most Western nations have been primary culprits in facilitating the exploitation of animals, especially poultry. Common Law (eg UK) and Civil Law (eg Continental Europe) legal traditions are dualistic in that there are two primary normative categories in private law: persons and things, where animals (particularly poultry) are categorized within the second category, things. Such categorization has a fundamental consequence: animal welfare is instrumental to human exploitation. In the light of the above, a first research question consists of exploring the grounds of the traditional categorization of animals as things in the Western legal tradition. It is possible to explain the legal categorization by considering cultural and religious traditions. According to some authors, part of Christian thought has influenced the legal concept of animals as merely ‘things’ in our tradition, when compared with Non-Western legal traditions of Buddhism, or Hinduism. A second research question follows: Legal scholars now discuss the limits of such construction with respect to the present. The role and perception of animals (especially pets) in society has radically changed overtime with a tendency to ‘humanize’ animals, and pets. Should the law change accordingly, and how? Is the change of perception relevant to the chickens of a family run farm? Legal scholars have proposed a number of solutions aimed at granting rights to animals, this specifically when thinking of domestic animals (and pet-chickens one may question). Proposals typically either suggest changing the legal status of animals—from property to “living property” or “persons” - or altering the allowable uses of animals regardless of whether they are classified as property. At this regard, the paper maps the various proposals to give ‘personhood’ to animals, to expand ‘property views’, or to develop third and new concepts (e.g. living property). If animals are persons, we have to shift from ‘animal welfare’ to ‘animal rights’.

Keywords: animal rights; chicken; comparative law; religion; culture.

[04-02]: *Policies and regulations governing the poultry industry in the Mediterranean region* (ID: 120103)  
[Greece]

### **Keel bone damage: investigating causes and seeking solutions**

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The high frequency and severity of keel bone damage (KBD) represents one of the greatest welfare problems facing the laying hen industry. The aim of this paper is to present the objectives, methodology and activities of the European COST Action CA15224. The Action is a network of European researchers working on the causes of keel bone damage and seeking solutions to reduce their severity and frequency. Research focuses on three main objectives, addressed by the three working groups (WGs): 1) WG1 research objective is the development and validation of techniques that can diagnose, assess, and distinguish anatomical characteristics of keel bone damage with a high level of accuracy and consistency across a variety of environments which match specific needs of the research environment; 2) WG2 aims to determine and quantify the effects of varying types and severities of KBD on specific measures of welfare (e.g., sensation of pain, altered mobility) and productivity (e.g., egg production and quality), and 3) WG3 research aims to identify sources of KBD and their relationship with the morphology of birds across variable contexts (e.g., age, rearing environment, nutrition, housing, genetic background) and relevant interventions based on this understanding. Recent activities supported by the project have been a Training School organized by University of Bern, 23-24 August 2017 and six Short Term Scientific Missions of young researchers hosted by partner Institutions. Currently 19 European countries collaborate within the KBD network while new countries and new individual scientists are very welcome to join this open network.

**Keywords:** laying hens; keel bone; health; welfare,

[04-03]: *Policies and regulations governing the poultry industry in the Mediterranean region* (ID: 120057)  
[Turkey]

### **Deep pectoral myopathy lesions affected histology and gene expression profile of *pectoralis major* muscle of broilers**

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Deep pectoral myopathy (DPM) is a pectoralis minor (p. minor) muscle degeneration of broilers that cannot be observed externally. It is characterized by changes in color and texture of the p. minor muscle. It has already been reported that DPM lesions of p. minor muscle was associated with changes in the quality and composition of pectoralis major (p. major) muscle of broilers showing similar features to the other muscle disorders, such as white striping and wooden breast. Increasing evidence suggests that reduction in vascular development, increased intracellular calcium level and stability of muscle contractile proteins (e.g. myosin) play a crucial role in muscle degenerations. Therefore, this experiment was conducted to evaluate muscle fibre and capillary number and expression of vascular endothelial growth factor A (VEGFA), myosin light chain kinase 2 (MYLK2) and ATPase Ca<sup>2+</sup> transporting gene 1 (ATP2A1) in p. major muscle of broilers with DPM compared with unaffected broilers. A total of 80 Ross-308 broilers were used. On d 43, half of the broilers were kept as control while the other half was encouraged to wing flapping to induce DPM. Four days later, p. minor muscle was inspected and scored as normal or with DPM. The p. major muscle samples were collected from broilers with DPM and control groups for histological measurements and gene expression profile. The results showed that DPM occurrence in p. minor muscle did not influence p. major muscle fibre number but it increased capillary number/mm<sup>2</sup>. The expression of VEGFA and ATP2A1 was upregulated, MYLK1 was downregulated in p. major muscle of broilers with DPM. It was concluded that muscle repair system was activated in the p. major muscle of broilers after DPM induction.

Keywords: deep pectoral myopathy; broiler; breast muscle; gene expression.

[05-01]: *Genetics and breeding* (ID: 120147)

[France]

## **Mechanisms of bird eggshell formation: molecular control of early mineralization by organic matrix**

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The chicken egg is a giant reproductive cell protected by an eggshell. The eggshell is a porous bioceramic that regulates the exchange of metabolic gases and water and serves as a calcium reservoir for the developing embryo. It forms daily in the distal segment of oviduct, in an acellular uterine fluid that contains inorganic and organic precursors of the shell. Its distinctive features, as compared to bone or teeth, are the nature of the mineral and the absence of cell-directed assembly during its fabrication on eggshell membranes. Eggshell is made of 95% calcium carbonate (calcite) and 3.5% organic matrix (proteins and proteoglycans). The organic matrix plays a key role in the nucleation and stabilization of calcium carbonate on specific sites on the eggshell membranes, determining polymorphic phase selection, regulating crystal morphology and growth rate. These interactions between both mineral and organic matrix constituents result in a highly ordered structure of the eggshell, with unique mechanical properties. The sequential events of mineralization correspond to the following phases: 1) the widespread deposition of amorphous calcium carbonate (ACC), 2) ACC transformation into crystalline calcite aggregates, 3) formation of larger calcite crystal units followed by 4) the development of a columnar structure with preferential calcite crystal orientation and 5) the termination of calcification prior the oviposition. Transcriptomic and proteomic studies have identified a wealth of protein matrix candidates that may regulate shell mineralization. Their involvement has been demonstrated by numerous *in vitro* and *in vivo* evidences and putative candidates will be presented. The mechanisms regulating the precipitation of calcium carbonate and the structural organization of the eggshell and its constituting crystals will be described in particular at the early stage of mineralization on eggshell membranes.

**Keywords:** eggshell formation; organic matrix; amorphous calcium carbonate.

[O5-02]: *Genetics and breeding* (ID: 120135)

[Mexico]

## **Preliminary study of the genetic diversity of four regional Mexican turkey populations**

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The principal fossil discoveries of turkey ancestors have been found in the south of United States and north of Mexico. Turkeys moved to Europe at the beginning of the sixteenth century. Although the turkey varieties are considered as a single breed, evidence is emerging about significant strain differences among populations. The aim of the present study was to understand the genetic diversity in 4 populations of domestic turkey from Mexico (Paso del toro, Veracruz, Acayucan, Paso de Ovejas) using a panel of 39 microsatellite markers. A total of 54 blood samples of domestic turkeys (*Meleagris gallopavo gallopavo*) were randomly collected from animals of both sexes (24 male and 30 female). The following parameters were analyzed: genetic variation, genetic differentiation among populations and genetic distance. A total of 304 alleles were detected across the 39 loci investigated. The mean number of observed alleles across all the populations average value of  $7.82 \pm 3.95$  and of  $6.04 \pm 2.64$  alleles per locus as maximum and minimum, respectively. The mean expected and observed heterozygosity within populations across loci were 0.642 and 0.544 respectively. The Polymorphic Information Content was 0.599. The estimated inbreeding coefficients showed low values in the populations (0.153), implying a not significant level of inbreeding due to population substructure. The genetic differentiation ( $F_{ST}$ ) between pairs of populations ranged from 0.015 (Acayucan vs Paso de ovejas) to 0.082 (Veracruz vs Acayucan); overall population average  $F_{ST}$  value was 0.065. The Neighbor-Net dendrogram showed three clusters; the turkey of Paso de Ovejas and Acayucan, are in the same cluster together. A second cluster included only the population from Paso del toro, and the third cluster are constituted for Veracruz individuals. Therefore, it is possible to assume that nowadays the studied populations present a very close genetics independence as pointed out by the distance between populations. The information obtained in this research will be useful for the purposes of conservation and management of the traditional turkey production systems.

**Keywords:** genetic characterization; microsatellites; biodiversity; *Meleagris gallopavo*.

## Phenotypic characterisation of Italian local chicken populations

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In recent years the interest in saving biodiversity and local population is growing and becoming a matter of great importance. The aim of this study was to determine the growth performance and to provide the phenotypic characterization of four Italian purebred chicken populations: Siciliana (S), Ancona (A) and Livorno in two plumage varieties, white (WL) and black (BL). A total of 77 black Livorno (40 males and 37 females), 30 white Livorno (10 males and 20 females), 47 Ancona (22 males and 25 females) and 44 Siciliana (22 males and 22 females) were evaluated. The birds were raised from day 1 to day 28 in controlled environment and fed a starter commercial diet (23% CP and 11.80 MJ/kg ME) ad libitum. They were later transferred into outdoor pens (1,5 m<sup>2</sup>/bird) and, from 56 day of age, the starter diet was gradually replaced with a low protein diet (13% CP and 12.10 MJ/kg ME commercial mixed grain diet). Starting from day one, the birds were weighted at 14 days interval up to 16 weeks of age, then at 35 days interval up to 31 weeks of age. During the last data recording session, physical measurements of the young adults (body weight and length, chest circumference, shank length, circumference and diameter, wing span and spur length) were taken according to the 2012 FAO guidelines for chickens phenotypic characterization. The growth curves for males and females of each population were estimated by the Gompertz function and the goodness-of-fit of the model was assessed using R<sup>2</sup>adj. The physical measurements were analyzed by ANOVA. The R<sup>2</sup>adj calculated for the S, A, WL and BL young hens was 0.967, 0.965, 0.977 and 0.896 respectively, and for the S, A WL and BL cockerels was 0.967, 0.967, 0.978 and 0.921, respectively. The physical characterization confirmed that these breeds are slow-growing chickens, with a characteristic sexual dimorphism. Significant differences among the four populations ( $P < 0,001$ ), confirming S to be the lowest in body weight (male: 1766 g; female: 1367 g) as well as in most of the other recorded parameters. WL, BL and A resulted similar for body weight (range for males: 2137-2416 g; range for female: 1648-1685 g). WL was the widest for chest circumference while BL resulted the bigger in body length and wing span.

Keywords: growth; physical measurements; nonlinear model; local population; chicken.

[05-04]: *Genetics and breeding* (ID: 120173)

[Italy]

## **PAX7 gene polymorphism analysis in Bianca di Saluzzo and Bionda Piemontese poultry breeds**

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The polymorphism of PAX7 gene, an important transcription factor regulating myogenesis of skeletal muscle, was investigated in two slow growing chicken breeds, namely Bionda Piemontese (BP, n=108) and Bianca di Saluzzo (BS n=93) in order to detect a positive association with growth traits. The birds were raised in the same environmental conditions. Body Weight (BW) was individually measured every two weeks from hatch to 32 weeks of age. BW was significantly different between the two sexes from 6 weeks of age for both breeds, and the difference increased with age. At 32 weeks of age, the average BW was 2474 g in males and 1819 g in females for BP, and 2575 g in males and 1855 g in females for BS. The data analysis showed a significant allele association with BW in females of both breeds from the 14th week onward. The association between PAX7 and BW, with a dominant effect of G allele, was significant in BP ( $P < 0.05$ ) from 14 to 32 weeks, except in 22th week of age. Nevertheless, a different BW among genotypes was evident already from 14 to 24 weeks, with a slowdown between 18 to 22 weeks. An incomplete dominance of allele G revealed a significant additive effect ( $P < 0.05$ ) at week 14, 16, 24, 28 and 30. In BS, PAX7 association was evident ( $P < 0,05$ ) only at 14, 16 and 30 weeks of age and positive dominant effect was associated with F allele. In both breeds the most frequent allele is associated with positive effect on BW: in BP G allele frequency was 0.6 with 83% of favourable genotypes (0.47 for F/G and 0.36 for G/G) while in BS allele F frequency was 0.53 with 80% of favourable genotypes (0.30 for F/F, 0.5 for F/G), even if the two allele showed very similar frequencies. As the survival of autochthonous poultry breeds is related to the marketing of their products, the selection schemes of these small size populations should consider PAX7 gene polymorphism in order to increase female body weight using the marker assisted selection on males.

**Keywords:** PAX7; polymorphism; growth trait; poultry; slow growing chicken.

[O5-05]: Genetics and breeding (ID: 120181)

[Italy]

### **A mating scheme based on molecular parentage improves growth performance in slow-growing chickens over three generations**

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The objective of this study was to assess the effect on growth traits of a mating scheme aimed to minimize progeny inbreeding using genomic information. 150 birds (75 males and 75 females) of Bianca di Saluzzo, a slow growing breed autochthonous of Piedmont region, were genotyped by a set of 14 microsatellite markers. For each subject the genetic distances were calculated. Six family lines were identified and 10 hens for each line were grouped in a single box. For each line the cock with the highest genetic variability was identified and coupled with the most distant female genetic line. 440 individuals of three generations (G0, G1 and G2) were weighted every 15 days from hatch to 180 days of age; Gompertz linear model was used to describe the growth index over the three generations. Daily growth rate significantly increased ( $P < 0.001$ ) over successive generations in males (G0 = 16 g/d; G1 = 20 g/d; G2 = 25 g/d) and in females (G0 = 12 g/d; G1 = 14 g/d; G2 = 28 g/d). The age Inflection point significantly decreased ( $P < 0.05$ ) in males (G0 = 101 d; G1 = 93 d; G2 = 68 d) and in females (G0 = 90 d; G1 = 87 d; G2 = 62 d). The live weight corresponding to the inflection point decreased ( $P = 0.06$ ) over the generations in males (G0 = 1230 g; G1 = 1156 g; G2 = 1148 g) and in females (G0 = 881 g; G1 = 835 g; G2 = 794 g). The estimated weight at 180 days of age increased over the generations: +28% in cocks (G0 = 2288 g; G1 = 2470 g; G2 = 2853 g) and +13% in hens (G0 = 1758 g; G1 = 1810 g; G2 = 1988 g). In conclusion, the results showed an improvement of growth performance as the offspring heterozygosity increased and inbreeding decreased. The use of molecular parentage in mating schemes could be a reliable tool for the management of small size chicken populations and the improvement of their production.

Keywords: chicken; mating scheme; growth performance; microsatellite markers.



[O5-06]: *Genetics and breeding* (ID: 120003)

[Iran (Islamic Republic of)]

## **An applied method for the use of hairline cracked and toe punched broiler breeder eggs**

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This study was conducted to investigate an applicable strategy to use the hairline cracked and toe punched eggs of broiler breeders by covering the fractured and toe punched part of egg shell by typical glued and patched with egg shell (the shell of other broken eggs) respectively and examine the effect of this method on hatchability. A total of 1440 eggs was obtained from a commercial flock of Ross 308 broiler breeders (31-42 wk old) and based on the shell damage, assigned to 5 equal number of groups: normal, hairline cracked (HC), toe punched (TP), glued hairline cracked (GHC) and patched toe punched (PTP) eggs. Each group consisted of 4 replicates of 72 eggs each. After applying the treatments and disinfecting the eggs, they were set in the same incubator with the same conditions. The data were analyzed using SAS PROC GLM and the Duncan's multiple range test was used to compare the means ( $P \leq 0.05$ ). Percentage of hatchability of the fertile eggs from normal eggs (83.42%) when compared with those of other groups was higher ( $P < 0.0001$ ) and TP eggs (13.85%) had the lowest hatchability. However, hatchability from PTP fertile eggs (47.50%) significantly increased in comparison with those of TP group ( $P < 0.0001$ ). Similarly, hatchability of the GHC eggs (67.74%) was significantly higher than those of HC eggs (63.14%). Early embryonic mortality (0-18) of TP was higher than those of the other groups, but the late embryonic mortality (19-21) was higher for HC and PTP groups. Moreover, percentage of cull chicks in treatments containing GHC eggs (7.75%) and normal eggs (1.00%) in comparison with those of other groups was the highest and the lowest, respectively. Results of the present experiment indicated that covering the hairline cracked eggs with typical glue on fractured part of the shell and likewise covering the toe punched area (callus) is a simple and inexpensive strategy which can improve hatchability of the damaged eggs and supply meaningful economic contributions to the poultry industry.

**Keywords:** broiler breeder; economical profit; fertile eggs; hatchability; patched eggs.

[O5-07]: Genetics and breeding (ID: 120044)

[Poland]

## **Meta-analysis of genetic parameters of feed conversion and related traits in chickens**

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Over the last decades, a number of genetic parameter estimates for chicken traits has been reported in literature. It is suspected that these estimates vary across populations, time as well as statistical methods and models. The objective of this study was to estimate the impact of some factors on heritability estimates of body weight [BW], feed conversion ratio [FCR], feed intake [FI], age at first egg [AFE], egg production [EP] and egg weight [EW]. Data were possessed from 75 peer reviewed scientific papers published in 1986–2015 years. The heritability estimates were classified (depends on traits) according to: breed (commercial and local ones), size of population (linear covariable), sex (male, females and combined analyses), trait recording period (linear co-variable), statistical method (Bayesian, REML and others) and models (unitrait sire, sire and dam animal and random/fixe models, multitrait models). Statistical inference was based on: analysis of variance with the Tukey's honest significance post-hoc test as well as multiple regression equations. Moreover, 95% and 99% confidence intervals for expected values of heritabilities were constructed. These computations were performed using the R software. These 99% confidence intervals were as follow: 0.342-0.402 (BW), 0.209-0.325 (FCR), 0.299-0.467 (FI), 0.284-0.383 (AFE), 0.190-0.247 (EP) and 0.379-0.461 (EW). Generally, these results obtained by both analysis of variance and multiply regression equations indicate significant effects of studied factors on magnitudes of heritability estimates. \*ECO-FCE has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration.

**Keywords:** feed conversion; egg production; heritability; chicken.

[O6-01]: Poultry housing and environment (ID: 120170)  
[Pakistan]

### **Strategies to alleviate heat stress in poultry**

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Chickens can maintain their body temperature up to certain limits. In tropical climates where temperature remained high during most part of the year, heat stress is a big issue to deal with. It causes reduction in: feed intake, body weight, egg production, hatchability, fertility and immunity. Thus, in the last few decades, efforts are focused on finding solutions to reduce heat stress in chicken. So, certain strategies have been suggested such as alteration of dietary energy and protein concentration, pellet feeding, supplementation of various vitamins and electrolytes, changes in feeding time and increasing rate of air movement were found helpful. During heat stress, feed intake is reduced but for panting and other activities chicken require energy. In this situation increased fat contents of ration by 4-5% was found beneficial because fats have low heat increment compared to carbohydrates and proteins. The emphases is on supplementation of essential amino acids instead of increasing the whole protein content of the diet. Pellet feeding and feeding of wet mash has also been found suitable because they reduce heat increment due to activity. During heat stress chicken do panting which lead to increased loss of carbon dioxide and decreased hydrogen ion concentration causing respiratory alkalosis. In this case, sodium chloride, ammonium chloride, potassium chloride and sodium bicarbonate administration was found helpful. These minerals not only maintain acid-base balance but also increase water consumption. Supplementation of vitamin C improves carcass weight, feed intake, semen quality and immunity while vitamin E improves immunity by enhancing phagocytosis, weights of spleen and bursa. Moreover, feeding during cooler part of the day is also recommended. In conclusion integrated approach of changes in feeding time, altering energy and protein content of diets, and supplementation of various vitamins and minerals can help reducing heat stress in chicken.

**Keywords:** tropical climates; minerals; vitamins; amino acids.

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[O6-02]: Poultry housing and environment (ID: 120191)

[Pakistan]

## **Characterization of metals in intensive poultry farming facilities**

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The present study was conducted to determine the metal concentration in feed, litter and air in controlled environment poultry farms with differing feed. Air samples along with litter and feed were collected from ten poultry farms, differing in feed, in Punjab, Pakistan grouped into three categories: Group A (Feed A ), Group B (Feed B) and Group C (Feed C). These samples were analyzed by Inductively Coupled Plasma Atomic Mass Spectroscopy (ICP-MS) for trace metals like Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn) and non-essential heavy metals like Cadmium (Cd), Chromium (Cr), Mercury (Hg), Nickel (Ni) and lead (Pb). In general, the concentration of both trace and heavy metals was found to be highest in feed followed by litter and in air samples. However, Cr, Hg and Pb were highest in litter samples of group A as compared to feed and air which highlights the contribution of other sources of contamination in these facilities as well. The concentrations of trace metals, which play an essential role in the body, were 2-3 times higher as recommended by the Cobb broiler management guideline for all three feed groups. The concentrations of non-essential heavy metals found in all feed groups were still lower when compared to the maximum dietary acceptable limit. Nevertheless, there seems to be a need to ensure control strategies and management practices in intensive poultry farming facilities in order to keep heavy metal levels at a minimum to reduce their bioaccumulation in food chains.

**Keywords:** poultry; metals; feed; litter.

[O6-03]: Poultry housing and environment (ID: 120066)  
[Greece]

## **What are the best practices to improve Poultry welfare during transportation?**

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The COUNCIL REGULATION (EC) No 1/2005 applies to anyone transporting live vertebrate animals in connection with an economic activity and set up rules intended to improve the welfare of animals (with specific provisions for poultry) during transport. The Regulation has had beneficial impact on the welfare of animals during transport. However, it appears that there is a knowledge gap between the legislation and its practical implementation. Scientific evidence can address this gap and support the development and adoption of guides to good practices (EC, 2011). The aim of this paper is to present the 'Poultry Transport Guide' developed within the 'Animal Transport Guides' project, funded by DG SANTE of the European Commission (<http://animaltransportguides.eu/>). The project's ambition is to facilitate understanding and practical implementation of Regulation on the transport of animals. It will help transporters to further protect poultry from being subject to stressors arising from catching or handling, food and water deprivation, exposure to thermal challenges, loud noises or other. The Guide is structured in five Chapters according to different phases of the journey: (1) Competence, (2) Preparation and Planning, (3) Handling and Loading Animals, (4) Travelling and (5) Unloading Animals. Ninety six (96) 'good practices' are included in the Guide defined as procedures and processes that support compliance with requirements of legislation designed to protect the animals' welfare. Moreover, seventy-seven (77) 'best practices' are included, defined as providing methods of improvement of procedures and operations to exceed any legally defined minimum welfare requirement. The Poultry Transport Guide is currently being translated in several European languages and it is widely disseminated among stakeholders through Road Shows, Seminars, etc. to support the animal transport industry in complying with welfare standards during poultry transport.

**Keywords:** poultry transport; welfare; guide; good practices.

[06-04]: Poultry housing and environment (ID: 120151)

[Iran (Islamic Republic of)]

## **Effect of group size on the production parameters of breeding ostriches (*Struthio camelus*) in a grazing environment**

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There is relatively little information available on the effects of free-range and intensive colony breeding systems for breeding ostriches (*Struthio camelus*). An experiment was conducted to determine the effects of stocking rates and group size on reproductive performance of ostriches under free-range condition in the Ostrich Land Farm, Iran. Adult ostriches were assigned to a small group (group 1; 8M 12F), and a large group (group 2; 16M 24F). Stocking rates ranged from 10 to 30 birds/ha. A commercial diet was formulated and provided ad libitum to birds during the breeding season. The results indicated that larger group size did not affect the average daily feed intake (ADFI) and change in body weight, but increased the egg production, the number of chicks hatched and egg weight, and reduced the number of infertile eggs produced per hen. High stocking density (30 birds/ha) decreased the egg weight of female breeding birds, but did not affect any of the other measures. It was concluded that ostrich breeding flocks can be maintained at stocking rates higher than those presently used on commercial ostrich farms. Increasing group size will have a possible beneficial effect on the reproductive behavior of ostrich females and males in large flocks. This has important implications in terms of the intensification of ostrich farming especially in areas that are characterized by vegetation that is exposed to the trampling effect of ostriches. Therefore, the free-range and intensive colony systems can be applied as an appropriate model in a grazing environment.

Keywords: ostrich; free-range system; colony; performance; stocking density.

[O6-05]: Poultry housing and environment (ID: 120155)

[Belgium]

## **Effect of lighting program on broiler performance, litter quality and foot pad dermatitis**

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Previous research shows that intermittent lighting (repeated cycles of 1 h light (L) and 3 h dark (D)), compared to continuous light (23L:1D), results in the same weight, a lower mortality and better feed conversion. Light programs with a long dark period result in a lower dry matter content of the litter. Since 2010 continuous lighting is forbidden by the European legislation (council directive 2007/43/EG). In some countries the approved stocking density is depending on the level of foot pad dermatitis. The purpose of the present experiment was to evaluate the effects of lighting programs, that meet the EU standards, on the performance of modern fast-growing broilers, litter quality and foot pad dermatitis. Both treatments had alternating light and dark periods. The control group (C) had: 23L:1D for day 1 to 6; 1D:3L:4D:3L:1D:12L for day 7 to 37 and 23L:1D for day 38 to 40. The second group (IL) had more dark periods: 9L:3D:9L:3D for day 1 to 6 ; 1D:3L:4D:4L:1D:3L:4D:4L for day 7 to 37 and 23L:1D for day 38 to 40. During 4 production cycles the broilers (Ross 308 as hatched) were housed in 4 compartments with independent climate and light control (300 m<sup>2</sup>, 6200 birds / compartment). The IL program resulted in a significant lower mortality (3.86 % vs 4.39 %,  $p < 0.05$ ), a lower feed intake and feed conversion (1.561 vs 1.579,  $p < 0.1$ ). At slaughter age (day 40), there was no difference in average bird weight. The contribution margin (calculated as the income from meat minus costs for feed and day-old chicks) was € 0.007 higher per bird per flock. Litter quality was evaluated by the dry matter content of the litter and visual scoring (friability and moisture). Both parameters indicated that IL had a slightly negative effect on litter condition. This corresponds to the higher proportion of foot pad dermatitis (FDP-score 64 vs 54). Light programs with more alternating light and dark periods have positive effects on production, but it is preferable to avoid longer than 4 hours continuous darkness.

**Keywords:** broiler; light program; performance; foot pad dermatitis; litter quality.

[06-06]: Poultry housing and environment (ID: 120064)  
[Greece]

## Spent hens: Can we improve their welfare?

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Recent research studies demonstrated that Spent (end-of-lay hens) are treated as a by-product of the egg industry. As a result the welfare status of those birds is dramatically reduced. The aim of this study was to observe the improvement in welfare indicators of spent hens kept in three different housing systems. Sixteen Isa Brown spent hens were randomly placed in enriched cages together with nine other birds (H1). After two weeks of adaptation, birds were placed in individual enriched cages (H2) for a one month period and last, they were transferred to a deep litter system (H3) for two months. Observations and measurements of welfare indicators have been made on a weekly basis according to the Welfare Quality® protocol. The data collected was analyzed using SPSS, version 23. Significant improvement was found in most of welfare indicators from cages system vs. litter system. More specifically, severe damage to feathers of the head and neck (score=2), was observed in H1 ( 56.30%) of the cases and in H2 (35.90%) while in H3 the score 2 was only given to 6.70% of the birds. Similar results were found in damage of the back feathers (50% in H1, 35.90% in H2 and 13% in H3) and the belly feathers (62.5% in H1, 46,90% in H2 and 28.10% in H3). Keel bone deformation was observed in 75% and in 28.10% of the birds in H1 and H3, respectively. Skin lesions scores improved significantly in litter system in comparison to the cages system. Qualitative measures have shown that most of the birds have been calm but active in litter system while aggressive behaviors have been more common in cages system. Although welfare seems to be significantly improved for the spent hens moving from cages to litter system, the small number of birds used in this study cannot support general conclusions. More research is currently in progress to further investigate the options for poultry industry to add value to spent hens by improving their welfare status.

**Keywords:** end-of-lay hens; welfare; housing system.



[O6-07]: Poultry housing and environment (ID: 120163)

[Pakistan]

## **Comparative effect of green and white light emitting diodes on production performance of commercial layers**

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Light is a powerful management tool available to commercial layer farmers. It not only allows them to anticipate or delay the beginning of the lay but also aids in improving egg production and feed efficiency. In modern poultry houses, artificial illumination may be the only source of light used for rearing of poultry birds. This study was carried out to investigate the comparative effect of two different colors of light emitting diodes (LED) on reproductive performance of chicken layers. For this purpose, egg type commercial layer chicken hens (n=240, Age; 21 weeks, strain; Hisex) were housed in environmentally controlled house. Two light treatments i.e. A (green light emitting diode) and B (white light emitting diode) were applied to eight replicates of 30 hens each. Daily light was provided on 16 hours light: 08 hours dark cycle with intensity of 40 lux light. The experiment lasted 10 weeks and data on feed intake, egg production and mortality were recorded on weekly basis. Serum concentrations of follicle stimulating hormone (FSH) and Luteinizing hormone (LH) were determined at the end of the experiment. The egg production was significantly ( $P<0.05$ ) higher in hens kept under green light treatment compared with the white light. However, feed intake, mortality and concentration of FSH and LH remained similar between the treatments. We concluded that layers kept under green LED light produces more eggs compared to those kept under white LED light.

Keywords: light source; egg production; FSH; LH; reproductive performance.

[07-01]: Poultry health (ID: 120161)

[Lebanon]

## The prevalence and loads of *E. coli* and *Campylobacter* on Lebanese broiler meat at the retail level

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Broiler meat has increasingly become a popular and affordable source of nutrition worldwide. Despite its importance, broiler meat has been associated with a plethora of foodborne bacterial pathogens. Therefore, surveillance and control of bacterial contamination are essential to maintain the safety of broiler meat. Lebanese broiler meat (LBM) production is considered 1) relatively more developed in comparison to other local animal-farming practices, and 2) has a well-established economic value. However, the microbiological quality of LBM is scantily characterized and monitored. It is evident that LBM will benefit greatly from studies that identify, quantify, and characterize potential bacterial contamination and pathogens. Here, our overall objective was to quantify the prevalence and loads of *E. coli* and *Campylobacter* on LBM at the retail level. For this purpose, in 2017, we collected 100 skinless chicken breasts from 50 retailers (2 samples per retailer) that are located in the Lebanese capital. The samples were transported to the laboratory on ice and processed within 12 hours of collection. Twenty-five grams of each sample were aseptically suspended in 225 ml of buffered peptone water (BPW) and homogenized for 90 seconds in a stomacher. The homogenate was serially diluted (10-folds) in BPW and 100  $\mu$ L of each dilution were spread on RAPID'E. coli 2 and modified charcoal-cefoperazone-deoxycholate (mCCDA) agar plates for the selective isolation and enumeration of *E. coli* and *Campylobacter*, respectively. The plates were incubated at 37 °C for 24 h under aerobic conditions (*E. coli*) and for 48 h in micro-aerobic (*Campylobacter*) atmosphere, which was generated using Oxoid CampyGen™ sachets. Our results showed that ~ 70% of the samples were positive for *Campylobacter*, which ranged from ~ 2-4 log CFUs (colony forming units)/ gram. *E. coli* occurred in ~ 80% of the samples and ranged between ~ 2-6 log CFUs (colony forming units)/ gram. To our knowledge, this is the first study on the prevalence and loads of *Campylobacter* and *E. coli* on LBM at retail. The data collected in this study are essential to assess and enhance the safety and competitiveness of LBM.

Keywords: Lebanese broilers; *E. coli*; *Campylobacter*; food safety.

[07-02]: Poultry health (ID: 120021)

[Pakistan]

## **Cadmium induced pathological and haematological alterations and their amelioration with hydrated sodium calcium aluminium silicate (HSCAS) in male Japanese quail (*Coturnix japonica*)**

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Cadmium (Cd) is an environmental pollutant present in the industrial wastes and known to be highly toxic to wild and domestic animal species. The objective of the present study was to evaluate the toxico-pathological effects induced by cadmium and to evaluate the effect of hydrated sodium calcium aluminium silicates (HSCAS) upon cadmium induced toxicological and pathological alterations in male Japanese quail (*Coturnix japonica*). A total of 180 male Japanese quails (*Coturnix japonica*) at 25 days of age were divided into 9 groups viz??? what is that means. A, B, C, D, E, F, G, H and I. Group A was kept as control, while B and C were administered with cadmium at the rate of 100 and 200 mg/kg feed respectively. How long 60 days or 35 days? Groups D and E were fed HSCAS at the rate of 5 and 10 g/kg feed. Group F, G, H and I were administered with HSCAS along with cadmium in different combinations. The total duration of the experiment was 60 days. Mortalities in cadmium treated groups (Band C) were almost the same as compared to control (A) and from those groups which were treated in combination with HSCAS. Birds of control groups and those groups supplemented with HSCAS were alert and have normal feed intake compared to the groups being treated with cadmium (D, E). Body weights of cadmium treated groups were lower than that of control group. Gross changes in cadmium fed group includes enlarged liver and smaller testes. Histopathological images of group B (100 mg Cd/kg) and C (200 mg Cd/kg) showed fatty change, individual cell necrosis and proliferation of bile ducts at hepatic triad. Testes showed testicular degeneration, which includes absence of spermatogenesis, pyknotic and dark nuclei between the spermatids and absence of spermatozoa and spermatids. No adverse effect of feeding HSCAS to the Japanese quail at the given doses were reported. Groups of quail fed Cd and HSCS concurrently in different combinations did not show any adverse effects and all the parameters studied were non-significantly different from the control group. The results of the study revealed that concurrent administration of HSCAS and Cd protected the quail from adverse effects of Cd toxicity.

**Keywords:** quail; hydrated sodium calcium aluminium silicate; cadmium; amelioration.

[07-03]: Poultry health (ID: 120150)

[Italy]

**Chlamydia spp. detected in poultry in Piedmont, Italy**

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Chlamydia spp. are agents of re-emerging infections in poultry worldwide and deserve attention from a public health perspective due to the well-known zoonotic nature of *C. psittaci*, the agent of psittacosis-ornithosis. In 2014, the family Chlamydiaceae has been expanded with two new species, *C. avium* and *C. gallinacea*, which have been found so far in pigeons, parrots and poultry in Europe, China, Argentina and North America. Zoonotic potential of these new chlamydial species is under investigation. We undertook a study to investigate the prevalence of *C. psittaci* and other Chlamydia spp. in the northwestern Italian region of Piedmont, an area highly devoted to the poultry industry. In the context of the 2015 National monitoring plan for Avian Influenza, pharyngeal and cloacal swabs from poultry farms rearing ducks, chickens, turkeys and geese were collected and analyzed with a PCR screening test for the Chlamydiaceae family. Upon an automated nucleic acid extraction with magnetic beads, a real-time PCR targeting the 23S ribosomal gene was performed. Subsequently, all positive samples were characterized by four different real-time PCR assays specific for the species under investigation: *C. psittaci*, *C. abortus*, *C. avium* and *C. gallinacea*. The raw prevalence of Chlamydia spp. infections was found to be 23% with 20 out of 86 farms testing positive. The highest prevalences of infection with Chlamydia spp. were found in geese (29.4%; 5/17) and chicken farms (32.3%; 11/34). A lower prevalence was detected in duck farms (15.4%; 4/26) and interestingly, all turkey farms tested negative at the screening. *C. gallinacea* was the most commonly detected chlamydial species, with the highest prevalences in chicken (26.5%; 9/34) and duck farms (11.6%; 3/26), followed by *C. psittaci* in geese (23.5%; 4/17). Neither *C. avium* nor *C. abortus* were detected in any farm. Based on the results of our study, this year we started a Research Project on Chlamydia spp. in poultry, supported by the Italian Ministry of Health, to further investigate chlamydial prevalences and associated professional health risks in our region.

Keywords: *Chlamydia spp.*; poultry; Real time PCR; prevalence.

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[07-04]: Poultry health (ID: 120157)

[Algeria]

## **First identification of infectious laryngotracheitis in Algeria by RT-PCR**

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Algeria was considered a laryngotracheitis free country until 2014, when a study was published on 20 layers flocks in production with nothing else but 5 to 20% egg drop and highlighting laryngotracheitis positive sera. The pathology seems to be latent for the next 3 years, no evident clinical symptoms no vaccinations, in September 2017 mortality of 10 to 30% began to appear in the eastern region of Algeria in breeding and laying flocks with severe lesions in the trachea. Laboratory analyzes were performed (RT-PCR) on many samples (tracheal swabs, FTA organs), confirming the involvement of infectious laryngotracheitis virus in recent outbreaks. One month after, the first cases started to appear in broilers with mortality between 15 to 40%. 3 months later, the first cases were reported in the eastern region. The virus seems to have reached most of the territory, the vaccination started officially on December 2017 with a vectorized vaccine Fp LT. The purpose of this study is to describe the path of the epidemiology of LTI in Algeria since 2014 and the first results of the vaccination on the breeders, the layers and the broilers with a vectorized vaccine.

**Keywords:** Infectious Laryngotracheitis; respiratory disease; Algeria.

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[07-05]: Poultry health (ID: 120145)

[Tunisia]

### **First isolation of IBV variant 2 in Tunisia**

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The Variant 2 strain is one of the most important and widespread strains of Infectious Bronchitis virus (IBV) in Middle East; It was reported for the first time in Israel in 1996, causing serious respiratory and renal signs accompanied by high mortality. The IBV variant 2 was then isolated in Egypt (2010), Turkey (2011), Iran (2011), the United Arab Emirates (2012), Saudi Arabia, Lithuania (2012), Azerbaijan (2012), Armenia (2012) and in Tunisia in 2018 during analyzes carried out in a layer farm. After a five-week delay in spawning in a layer farm with egg deformations up to 7 to 8% of the total production, IB was suspected, with other pathologies such as LPAI and ND. Samples on FTA cards for PCR were performed and sent to a laboratory in Budapest, the results have confirmed the presence of the Variant 2 strain of the IBV for the first time in Tunisia. It should be noted that ELISAs were performed at 20 weeks of age to monitor the quality of vaccination, the results gave the titles are high which made us think that the animals was properly protected. This follow-up allowed us to conclude that the vaccination program applied and the vaccines used cannot protect the animals against this new introduced strain in Tunisia, and therefore solutions have been proposed for veterinarians and breeders in order to improve the control of this disease.

**Keywords:** vaccination; Infectious Bronchitis; spawning drop; laboratory analysis; vaccination; layers; monitoring; protection.

[07-06]: Poultry health (ID: 120111)

[Pakistan]

**Antimicrobial resistance profiles of *Escherichia coli* and *Salmonella* isolated from intestine of commercial and back-yard poultry**

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Back-yard poultry farming differs in many ways from commercial poultry farming, as it entirely deals natural feed and management conditions without the use of in-feed antibiotics. The current study investigated the antimicrobial resistance profiles of *Escherichia coli* and *Salmonella* isolated from intestine of back-yard and commercial broiler chickens. *E. coli* and *Salmonella* isolates from commercial broilers (n= 84 and 75 respectively) and back-yard chicken (n= 80 and 69 respectively) were compared for their antimicrobial resistance profiles using disk diffusion method. The results showed that isolates of commercial broilers exhibited a higher resistance ( $p < 0.05$ ) for 11/14 antimicrobials including amoxicillin, ampicillin, doxycycline, gentamicin, ciprofloxacin, augmentin oxytetracyclin, chloramphenicol, flumequine, enrofloxacin and norfloxacin as compared to back-yard chicken isolates. Furthermore, it was revealed that multi-drug resistant (MDR) *E. coli* and *Salmonella* were higher ( $p < 0.05$ ) in commercial chickens as compared to back-yard chicken. These results indicated that both commercial and back-yard chickens harbored highly resistant enterobacteria (*E. coli* and *Salmonella*) that could be a potential risk for poultry as well as human beings. Moreover, the results showed that back-yard poultry farming is better than commercial farming, because of less development of antimicrobial resistance in microorganisms.

Keywords: back-yard poultry; broiler; antimicrobial resistance; *Escherichia coli*; *Salmonella*.

[07-07]: Poultry health (ID: 120119)

[Bangladesh]

### **Effect of vaccination and medication on broiler farming: Bangladesh context**

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The Geographic area of this study was 5 selected unions of kalihati upazila in Tangail district of Bangladesh. A total number of 50 broiler farmers were surveyed to conduct this study. The objective of the study was to know the current vaccination and medication status in the study area. The collected information was: age, education, main occupation, family members, training, annual income, number of broiler in each batch, name of broiler strain, mortality rate, vaccination practicing rate, current situation of antibiotic and growth promoter use, use of footbath, use of disinfectant for spraying in inside and outside of the farm, percentage of antibiotic and feed withdraw rate before marketing of broiler, source of vaccine and medicine at farmer level, consultants of the farmers for vaccine and medicine specially antibiotic use, vaccination and medication cost in a batch. Commonly used vaccine and medicine list with their company name were also collected from the study area market. A correlation table was prepared to determine the relationship among some variables; education Vs age, education Vs income, income Vs no of broiler in a batch, education Vs antibiotic withdraw, income Vs antibiotic withdraw. Significant negative correlations ( $p < 0.01$ ) was found only with age Vs education and other all variables were positively and significantly correlated. The problems related to present vaccination and medication service and their probable solution suggested by broiler farmers were also emphasized in this study.

**Keywords:** vaccination; medication; footbath; disinfectant.



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[07-08]: Poultry health (ID: 120002)

[United States]

## **Invention of a comprehensive method for control of coccidiosis in poultry**

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The objective of this research is to invent a new method targeting a comprehensive control of coccidiosis in poultry. A global research was accomplished in nine countries, aiming 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.

Keywords: invention; method; comprehensive; control; coccidiosis.

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[O8-01]: *Feeds alternatives* (ID: I20016)

[Nigeria]

## **Effect of feeding sweet potatoes-based diets on performance, carcass by-products and visceral organs of broiler finisher**

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The study was conducted to evaluate the effect of sweet potatoes (*Ipomoea batatas* L. [Lam]) based diets (SPBDs) on performance, carcass by-products and visceral organs of broiler finisher as the replacement for yellow maize. Eight weeks feeding trial was conducted on one hundred and eighty (180) day-old Rose broiler chicks and weighed randomly. The birds were distributed to four dietary treatments (45 birds per treatment and 15 per replicate) in a completely randomized design. The data generated were subjected to analysis of variance (ANOVA) using SAS (2007) software. There were no significant ( $P>0.05$ ) treatment effects in average initial weights but all the other performance parameters were significantly ( $P<0.05$ ) affected by the SPBDs inclusion. Carcass weight and dressing percentage were not significantly ( $P>0.05$ ). The visceral organs result indicated that no significant ( $P>0.05$ ) difference was recorded as a result of SPBDs inclusion. However, this study recommends that, SPBDs can be incorporated into the diets of broilers up to 75% as replacement level for yellow maize without any effect on the performance, carcass by-products and visceral organs and it will also lower the cost of feeding birds.

**Keywords:** sweet potatoes; performance; carcass by-products; visceral organs; broiler finisher and yellow maize.

[O8-02]: Feeds alternatives (ID: 120079)

[Pakistan]

## Comparative efficacy of *Citrullus colocynthis* fruit powder and popular antibiotic growth promoters in broilers

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*Citrullus colocynthis*, also known as bitter cucumber is a widely distributed plant in the desert areas of Pakistan. Its fruit has several bioactive chemical constituents such as glycosides, flavonoids, alkaloids, fatty acids and essential oils and it is known for its wide range of medicinal, antidiabetic, antioxidant, anti-inflammatory and antibacterial activities. The present study was planned to evaluate the efficacy of *Citrullus colocynthis* fruit powder (CCFP) as alternative to antibiotic growth promoters (AGP) in broiler diets. A total of 400 d-old Ross-308 broiler chicks was randomly placed in twenty floor pens of twenty chicks each. A corn-based basal diet having 22% CP with 2,850 kcal/kg ME during starter (1 to 7 d), 21% CP with 2,900 kcal/kg ME during grower (8 to 21 d) and 20% CP with 2,950 kcal/kg ME during finisher period (22 to 35 d) was formulated (Control group). The other dietary treatments consisted of same diet supplemented with 0.335g zinc bacitracin (15%) per kg of diet (ZB group), 0.125g enramycin (4.4%) per kg of diet (ENR group), 1g CCFP per kg of diet (CCFP1 group) and 1.5g CCFP per kg of diet (CCFP1.5 group). Each experimental diet was assigned randomly to 4 replicate pens. The results showed that AGP replacement with CCFP resulted in improved weight gain with similar feed conversion ratio. No difference was observed in carcass characteristics including carcass yield, breast meat yield, thigh yield, abdominal fat, and liver, heart, thymus and spleen weights of broilers fed different dietary treatments. Similarly, cecal and ileal bacterial populations (total bacterial count, total coliform count, *Clostridium perfringens*, E-coli and *Lactobacillus*) and serum concentrations of glucose, uric acid, triglycerides, cholesterol, alanine aminotransferase, aspartate aminotransferase, total proteins, albumins and globulins were not different among CCFP and AGP treatment groups. Immune response against ND and IBD virus was also not affected by the dietary treatments. In conclusion, 1.5g CCFP per kg of diet can be used in broiler diets as a replacement of commonly used AGP.

Keywords: antibiotic growth promoter; broiler; *Citrullus colocynthis*; growth performance; gut bacterial ecology; serum profile.

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[O8-03]: *Feeds alternatives* (ID: 120167)

[Pakistan]

### **Effect of supplementation of exogenous xylanase and mananase enzymes on the growth performance of broiler in tropics**

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The use of dietary enzymes in summer conditions may be useful to broilers as heat stress reduces their feed intake and consequently their body weight. Enzyme supplementation may help deriving more nutrients from the available feed eaten by bird by improving digestion and metabolism. This study was carried out to investigate the effect of supplementation of Xylanase and Mananase enzymes on the growth performance of broilers during summer. For this purpose, 180-day-old chicks were divided into 6 groups having each three replicates of 10 chicks per replicate. The treatments were as followed: T1 and T2 served as control i.e. commercial traditional feed and high-density feed, respectively; T3 and T4 supplemented with Xylanase (200 ppm) and Mananase (150 ppm) enzymes in traditional and in high density feed, respectively. Treatments T5 and T6 were supplemented with combination of Xylanase (200 ppm) plus Mananase (150 ppm) enzymes in traditional and in high density feed, respectively. The experiment lasted for 35 days. The broilers were reared under similar housing and management conditions like temperature, ventilation, light, floor space, and feeding. Data on body weight gain, feed intake and feed conversion ratio were recorded on a weekly basis. No significant differences were obtained for body weight, feed intake and FCR for all the treatments during the starter phase (i.e. day 1 to day 21 of age). However, for the finisher phase significant ( $P < 0.05$ ) higher body weight and better feed conversion ratio were observed for broilers fed on diets T5 and T6 as compared to all other treatments. We conclude that supplementation of broiler feed with a combination of 200 ppm of Xylanase and 150 ppm of Mananase enzymes improves their growth performance during the finisher phase in summer conditions.

Keywords: broiler nutrition; heat stress; enzyme supplementation; feed to gain ratio.

[O8-04]: *Feeds alternatives* (ID: I20080)

[Italy]

## **Microbiology and physico-chemical characteristics of hen's egg submitted to ozone treatments**

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Eggs are a fundamental food for human nutrition thanks to their high proteins and lipids biological value. However, egg consumption is also linked to health and hygiene problems. One of these is due to the Salmonella, which has long been recognized as a relevant zoonotic pathogen in animals and humans. Heat treatment and application of gamma irradiation have been demonstrated to greatly reduce Salmonella contamination, but both processes also compromise the quality of treated eggs. A process that can combine safety with the production of a high-quality product is needed. The objective of this study was to assess the effects of ozone, a strong oxidant gas with no negative effects on the environment, on microbiological and qualitative characteristics of hen egg. During the experiment, 80 homogenous hens eggs were used: 20 for the qualitative analysis, of which 10 control group (C) and 10 ozonate (flow rate: 600 mg/h) for 2h (O). The remaining 60 were used for the microbiological evaluation and divided in 3 groups replicated 3 times: negative control (C-), eggs not experimentally contaminated by Salmonella; positive control (C+), experimentally contaminated eggs with a cell suspension of 3 Salmonella serotypes (*S. Typhimurium*, *S. Enteritidis* and *S. Senftenberg*); treated group (O) experimentally contaminated and ozonate eggs. Ozone did not significantly affect the egg bacterial content, but it significantly reduced Salmonella (both C+ and O), probably due to the lack of growth substrate (organic material), that did not allow bacterial proliferation. Even the physical characteristics of the eggs (Haugh index, yolk colour) were not influenced by ozonization. However, ozone affected the chemical composition mainly through a pro-oxidant action. The ozonate eggs showed a significantly reduction of the carotenoids and the  $\alpha$ -tocotrienol and  $\alpha$ -tocopherol content of the yolk; furthermore, treatment induced a higher concentration of the main cholesterol oxidation products (COPs). In conclusion, the ozonization cannot be considered an effective strategy to the sanification of eggs, further methodology (e.g. UV radiation) and/or different ozone treatments (concentration and time) need to be tested.

**Keywords:** Salmonella; ozone; egg; oxidation; cholesterol.

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[O8-05]: *Feeds alternatives* (ID: 120166)

[Pakistan]

## **Sweet orange pulp supplementation improves growth performance of chicken broilers**

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Sweet orange (*Citrus sin*) is one of the oldest plants and is a conventional agricultural product in many tropical and sub-tropical areas. The peeled skin is the main byproduct of the “peeled sweet orange processing industry” and is full of vitamin C and E however most of it goes to waste being not used as conventional source of animal feed. This study was carried out to investigate the effect of dried sweet orange pulp (DSOP) supplementation on chicken broiler growth. For this purpose, broiler chicks (n=120) were divided into four equal groups and administered with four treatments i.e. A (control), B (commercial feed supplemented with 1 % DSOP), C (commercial feed supplemented with 2 % DSOP) and D (commercial feed supplemented with 3 % DSOP). The experiment lasted for 1 to 35 day of broiler age during which period uniform management conditions were provided to all birds. Data on weekly feed intake, body weight gain and feed conversion ratio and mortality were recorded. There were non-significant differences between the treatments for feed intake and mortality, however, body weight was significantly higher for broilers fed on treatment B and C compared with the control. Feed conversion ratio was significantly better for treatment C compared with all other treatments. We concluded that supplementation of broiler diet with DSOP at the rate of 2 % increases growth performance and feed conversion ratio.

**Keywords:** non-conventional feed sources; broiler nutrition; growth rate; feed to gain ratio; feed supplement.

[O8-06]: Feeds alternatives (ID: 120074)

[Thailand]

### **Screening three cricket species (*Gryllus bimaculatus*, *Acheta domestica* and *Modicogryllus confirmata*) for broiler diets by in vitro digestibility techniques**

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Three cricket species (*Gryllus bimaculatus*: GB, *Acheta domestica*: AC and *Modicogryllus confirmata*: MC) were studied for in vitro digestibility efficiency comparing them to common protein source for broilers (Soybean meal: SB and Fishmeal: FM). The aim is to use them as a protein replacement in broiler nutrition. During slaughter process, stomach mucosa, pancreas and duodenal mucosa were collected from ten random healthy broilers for crude enzyme extraction. Two-step in vitro digestibility techniques were performed with an appropriate condition which 1-mm dried ground 100% of SB, FM, GB, AC and MC were used as substrates for in vitro digestibility. The highest in vitro digestibility for dry matter was found in FM (98.2%) following respectively by MC (92.91%), SM (91.24%), GB (88.52%) and AD (87.7%), ( $P < 0.001$ ). There was no statistic difference for in vitro digestibility of organic matter between FM (58.98%) and AD (58.68%;  $P > 0.05$ ), whereas MC (51.39%), SM (48.52%) and GB (46.65%) were lower than FM and AD ( $P < 0.001$ ). In conclusion, AD and MC are valuable protein sources for broilers based on in comparison to GB which has a lower digestibility efficiency.

Keywords: broiler; cricket; *in vitro* digestibility; insect; nutrition.

[O8-07]: Feeds alternatives (ID: I20116)

[Italy]

### **Effect of black soldier fly defatted meal on the growth performance and carcass yield of Muscovy duck: preliminary results**

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The aim of this study was to evaluate the effects of different inclusion levels of a partially defatted black soldier fly (*Hermetia illucens* L.; HI) larva meal on growth performance and carcass yield of Muscovy ducks (*Cairina moschata domestica*). Three-day-old females broiler Muscovy ducklings (R71 L, Grimaud Freres-France; average live weight:  $71.32 \pm 2.70$ g) were randomly allotted in 32 pens (8 replicates/treatment, 8 birds/replicate), and reared until 48 days of age. The HI larva meal was included substituting corn gluten at increasing level (0, 3, 6 and 9%; HI0, HI3, HI6 and HI9, respectively) in isonitrogenous and isoenergetic diets formulated for 3 feeding phases: starter (1-14 d), grower (14-35 d) and finisher (35-48 d). Live weight (LW), average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR) were assessed for each different period and for the whole trial. At day 48, carcass yield was determined in 16 animals per treatment for hot carcass weight (HCW) and cold carcass weight (CCW). Data were analysed by means of one-way ANOVA evaluating the effect of dietary HI inclusion level by polynomial contrasts. Significance was declared at  $P < 0.05$ . LW did not differ among groups (average final LW:  $2515.68 \pm 92.42$ g). From 14 to 35 days of age, the ADG showed a quadratic response ( $P < 0.05$ ), but no differences were observed among groups during the starter and finisher periods. The ADFI was never affected, whereas FCR showed a linear response to increasing HI meal levels during starter period ( $P < 0.05$ ), with a minimum for the HI9 group. However, no differences were observed for grower and finisher periods and for the whole trial. HCW and CCW showed a quadratic response to increasing HI larva meal ( $P < 0.05$ ), but no differences were observed for carcass yield. This preliminary investigation indicates that HI larva meal could be a valuable protein source for Muscovy duck, with no negative effect on growth performance and carcass yields.

**Keywords:** *Hermetia illucens*; Muscovy duck; performances; insect meal.



*[O8-08]: Feeds alternatives (ID: 120107)***[Bangladesh]**

## **Study on the duck rearing system in the river basin areas of Pabna district of Bangladesh**

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The study was conducted to find out the actual scenery and make a concrete suggestion. There were sixty (60) households studied. Total farmers were divided into two groups i.e. scavenging/control (no supplementation and number of ducks ranges from 50 to 100) and semi-scavenging (75% scavenging + 25% supplementation and the number of ducks ranges from 101 to 300) and each contained 30 farmers. The semi-scavenging group supplemented at the rate of 100 g mixed feed (Paddy + Wheat + Maize + Rice polish) /duck/day in adult age. They reared mainly Khaki Campbell and Zinding ducks genotypes and rare some mixed crosses (Duashal). All recorded data were analyzed using “SPSS” for the interpretation of the results. The study showed that rearing system significantly ( $P < 0.05$ ) differed among the farmers. Floor space significantly ( $p < 0.05$ ) differed between the groups (1.8 sq.ft/duck for scavenging and 1.4 sq.ft/duck for semi-scavenging). The scavenging season was divided into lean Season (July to August), abundance (May to June) and rest of the year moderate season (September to April each year). The abundance Season may be the best because there were plenty of paddy field wastes and snail in the canal, river etc. as a result crop and gizzards contents of ducks were also rich in Ca and Proteins. The daily live weight gain differed significantly ( $p < 0.01$ ) and maximum weight (g) gain ( $8.54 \pm 0.34$ ) was observed in semi-scavenging than scavenging system ( $7.23 \pm 0.23$ ). There was no significant difference of age at sexual maturity (ASM) between the groups but in genotypes Zinding slightly earlier ( $15 \pm 0.5$  weeks) than Khaki Campbell ( $16 \pm 0.5$  weeks). Body weight at ASM differed significantly ( $p < 0.05$ ) and maximum body weight (kg) observed in Khaki Campbell ( $2.4 \pm 0.2$ ) than Zinding ( $2.25 \pm 0.12$ ). Duck day egg production ( $48.46 \pm 0.13$ ) % in semi-scavenging system was significantly ( $p < 0.001$ ) higher than scavenging ( $32.54 \pm 0.13$ ) % system. Mortality percentage varied from 3 to 4 in whole the flocks. It may be concluded as Zinding genotypes in semi-scavenging system of rearing of that areas is the best practice for the alleviation of poverty from the society of that areas.

**Keywords:** scavenging; semi-scavenging; Duashal; supplement and ASM.

[O8-09]: Feeds alternatives (ID: 120154)

[Iran (Islamic Republic of)]

## **Effect of copper oxide nanoparticles (CuO-NPs) on growth performance and carcass traits of Japanese quail during the starter period**

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This research was conducted to compare the effects of copper oxide nanoparticles (CuO-NPs) on performance and carcass traits of quails from 1 to 21 days of age. A total of 200 one-day Japanese quails were randomly distributed into four experimental treatments with four replicates (pens) per treatment and 10 birds per pen. Experimental treatments were: T1 (Control, basal diet without CuO-NPs supplementation, contains 11.3 mg CuO/Kg), T2, T3 and T4 supplemented with 40, 80 or 120 mg CuO-NPs/kg, respectively. The bird's initial mean weight was  $42 \pm 1.4$  g. Birds had an ad lib access to feed and water throughout the study. Feed intake (FI), LBW and FCR were weekly measured. On day 21, 20 birds (five birds/per treatment) were selected and after slaughtering, carcass yield, fat pad, breast and thigh muscles percent recorded. For measuring carcass quality parameters (Moisture, DM, CP, EE, and Ash) samples of breast and thigh muscles were collected and stored at  $-20^{\circ}$  C until analysis time. The results indicated that LBW and FCR in the birds fed basal diet with 120 mg CuO-NPs/kg had significantly ( $P < 0.05$ ) improved values compared to control and other treatments. The amount of DM, CP and ASH in the breast and thigh muscles had significantly ( $P < 0.05$ ) increased in the birds fed basal diet with 120 mg CuO-NPs/kg compared to control. In conclusion, the results indicated that dietary supplementation with CuO-NPs (as the Cu source) could improve performance traits and carcass meat quality of starter Japanese quails.

Keywords: broiler; carcass; copper oxide; performance; nanoparticles.

[09-01]: Miscellaneous (ID: 120177)

[Italy]

## Evaluation of growth curve in domestic guinea fowl (*Numida meleagris*) embryo through Gompertz and Logistic model

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The interest in domestic guinea fowl farming is relevant to some Mediterranean EU countries, particularly France and Italy. Limited literature on embryo development in domestic guinea fowl is available. To our knowledge, an illustrated and written description of guinea fowl embryo development with its morphological changes is still missing. Therefore, to perform a descriptive chart of the guinea fowl embryo development, an industrial Italian breeding farm provided us with hatching eggs from a 56 weeks old genetically controlled flock (Galor ltd, Amboise, France). Eggs were weighted and set using incubation parameters applied in industrial hatchery (setter: 99.66°F and 57% RH; hatcher: 97.34°F and 82% RH), and then transferred on day 21 of incubation into the hatcher. Starting from hour 12 up to day 8 of incubation, 4 eggs were evaluated every 12 hours; thereafter 4 eggs were analyzed every 24 hours. Soon after removal from the incubator, eggs were cooled in a 4% Formaldehyde solution bath at 0°C for half an hour to prevent bleeding, then candled for the location of the embryo and carefully opened to expose it. During analyses embryos were photographed in-ovo and extra-ovo; main embryonic morphological changes were macroscopically evaluated. Blastoderm diameter (from day 0.5 to day 4.5) and embryo weight (from day 5 to the hatch) were recoded. The chronological development of the guinea fowl embryo is illustrated by growth curves and a photographic timetable. The growth curve and its parameters was estimated by Logistic and Gompertz functions. The accuracy of the curve fit was high in both models based on yolk-sacless embryo weights ( $R^2_{adj}=0.9956$  and  $0.9953$ , respectively). The position of the inflection point in terms of age resulted at day 21 and 23 of development for the Logistic and Gompertz model, respectively, where embryo achieved its maximum daily weight gain (2.66 g/d and 2.346 g/d) The auto acceleration phase of the guinea fowl embryonic growth ends after the third week of incubation.

Keywords: guinea fowl; embryonic development.

[O9-02]: *Miscellaneous* (ID: 120100)

[Iran (Islamic Republic of)]

## **Growth curves genetic analysis of native south Caspian sea poultry using bayesian statistics**

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This study is to determine the best non-linear regression model describing the growth curve of native poultry. 9657 chicks of generations 18, 19, and 20 raised in Mazandaran breeding center in the south Caspian Sea were used. To estimate the genetic variability of none linear regression parameter of growth traits, a Gibbs sampling of Bayesian analysis were used. The average body weight at day 1 (BW1), eighth week (BW8) and twelfth week (BW12) were respectively estimated as 36.05, 763.03, and 1194.98 grams. Based on the coefficient of determination, mean squares of error and Akaike information criteria, Gompertz model was selected as the best growth descriptive function. In Gompertz model, the estimated values for the parameters of maturity weight (A), integration constant (B) and maturity rate (K) were estimated to be 1734.4, 3.986, and 0.282, respectively. The direct heritability of BW1, BW8, BW12, A, B and K was respectively reported to be as 0.378, 0.309, 0.316, 0.43, 0.09 and 0.07. With regard to estimated parameters, the results of this study indicated that there is a possibility to improve the growth curve using appropriate selection programs.

**Keywords:** native poultry; heritability; Gompertz.

## **Performance of broiler chickens reared on reused litter**

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Poultry litter reuse is a common practice in some countries mainly due to production cost but this approach is not practiced in Saudi Arabia even if the scarcity of bedding materials and large quantities of these materials are imported from abroad. Therefore, the objective of this study was to investigate the effects of reused litter on broiler performance. A total of 900-day-old broiler chicks were randomly allocated to three treatment groups: reused non-disinfected litter (RL), reused disinfected litter (RDL) and new litter (NL: which also acted as control). Each treatment groups had five replicates and each replicate had 60 chicks. Weekly body weight (BW), weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) were measured. Relative weights of gizzard, heart, liver and dressing percentage were calculated at day of slaughtering. The results of the study showed that there were no significant differences among the broilers raised on 3 litter types for the performance. This study provided evidence that chickens raised on used litter showed a similar performance to that chickens raised on a new litter. The results indicated that broiler chickens could be reared successfully on reused litter either disinfected or not.

**Keywords:** broiler; litter; performance; dressing percentage.

*[O9-04]: Miscellaneous (ID: 120141)***[Belgium]****Effect of on-farm hatching in broiler chickens on mortality, performance and profitability****Sofie Cardinaels (1), Ine Kempen (2), Kris De Baere (3), Nathalie Sleenckx (4) and Johan Zoons (5)**

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For improvement of production parameters, quality of the 1-day old chick is important. Previous research showed that delayed feed access for 1-day old chicks decreased post-hatch performance. In general, delay before feed access is considered to be the time spent in the hatchery and the transportation time. In this study we investigated the effects of on-farm hatching (where the chicks have immediate access to feed and water,) on mortality performance and profitability. 8 climate independent compartments of the Experimental Poultry Center were used. Broiler chickens (Ross 308) were housed in 8 pens ( $\pm$  1150 chickens/pen) in 4 climate-controlled rooms; and 16 pens ( $\pm$  1550 chickens/pen) in 4 climate-controlled rooms. One group of broilers (Control, C) arrived from the hatchery, experienced standard hatchery procedures and transport and the other group (Hatched On Farm, HOF) eggs arrived at d18 of incubation and hatched on farm (same parent stock). Each room consisted of an equal number of C and HOF pens. 3 production cycles were included in the study. Mortality did not differ between C and HOF. However, the first cycle mortality was higher in C (5.28%) than in HOF (3.15%). The other cycles mortality was slightly higher in HOF, partly due to selection on farm. The average weight per bird was higher in the HOF chicks compared to the C chicks (respectively 2617g and 2572g). Feed conversion ratio were equal for HOF and C. The production efficiency factor was higher in the HOF compared to the C (respectively 428.4 and 420.0). The contribution margin (income meat minus costs for feed and chicks/eggs minus extra heating cost HOF chicks) was calculated. For on-farm hatching the costs for heating were estimated to increase with 10%. In a 7-week cycle the contribution margin from HOF broilers is €0.28 higher per broiler per year compared to C-broilers. When a farmer needs to extend his cycle to 7.5 weeks to manage on-farm hatching this shift to a loss of € 0.01. In conclusion, on farm hatching seems to generate benefits for chick development and for farmer's profitability, when cycle length can be maintained.

**Keywords:** on-farm hatching; broiler; profitability.

[O9-05]: *Miscellaneous* (ID: 120082)

[Italy]

**Copper and Iron cycle in goose rearing in organic vineyard: from soil to meat**

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Agroforestry is defined as a system where trees, agricultural crops and livestock animals are integrated into one ecosystem. Agroforestry brings several ecological and economic advantages. The study system corresponded to geese reared in an organic vineyard that is subjected to several copper (Cu) based fungicides (CE 834/2007 and 889/2008). The objective of the present study was to evaluate the impact of this agroforestry system, on the Cu and Fe cycle in the environment (soil, grass cover) and bird's tissues (liver, meat). In addition, the total content of Cu and Fe was analyzed in the liver and meat (breast and drumstick) of two groups of 10 geese of both sex at 180 days of age. One group was reared in organic vineyard and compared with the other group of geese conventionally reared (no pasture). The soil and the grass roots were sampled at two depths (0-5 and 5-10 cm) and the aerial part of the grass was also analyzed. The total content of Cu and Fe in the soil was in agreement with those reported in the literature. The aerial part of grass cover has a low level of these metals ( $11.08 \pm 0.09$  and  $1.03 \pm 0.14$  ppm for Cu and Fe, respectively), lower than what stated by European Food Safety Authority (EFSA). On the contrary, high level was found on the roots of grass ( $54.7 \pm 4.12$  and  $48.97 \pm 3.05$  ppm for Cu and Fe, respectively) These roots were not available as geese feeding. The estimated intake of Cu in vineyard and control geese was 4.4 and 1.3 (3.3-fold higher), respectively whereas the Fe was not significantly different. The concentration of Cu in the geese liver was 1.6-fold higher in vineyard group than in control geese, and it was partially excreted with feces (about the 39%), whereas in both meat cuts, it was not significantly different than control geese meat. The total Fe amount did not differ between groups. In conclusion the use of Cu based antifungals did not affect its concentration on geese meat. Further studies are needed to evaluate the role of geese in the Cu cycle of vineyard treated with antifungal.

Keywords: geese; agroforestry; organic; copper; iron.

[O9-06]: *Miscellaneous* (ID: 120165)

[Iran (Islamic Republic of)]

### **Effect of group size on the grazing behavior of breeding ostriches (*Struthio camelus*) in a free-range environment**

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An experiment was conducted to observe some behavioral traits of breeding ostriches under free-range condition in the Ostrich Land Farm, Iran. The observations have been carried during period 15 Jan to 25 Jan, 2018, for 8 equal time period, extending for 24 hours from 0700 hour to 0700 hour next day. Adult ostriches were assigned to a small group (group 1; 8M 12F), and a large group (group 2; 16M 24F). A commercial diet was formulated and provided ad libitum to birds during the breeding season. The bird flock was surrounded by a wire fence to allow for free movement. The recorded behavioral activities included: standing in the sun, standing in shade, laying in the shade, laying in the sun, staying in the cage, movement and sitting on the knees, feeding, drinking, quarrel, urination, defecation, ritual display, courtship, and preening. Both groups were mostly involved in similar activities, closed-wing walking and environment pecking. These behaviors took up 38.0% and 40.1% of time in the small group, respectively, and 40.3% and 42.7% in the large group, respectively. Walking, as a whole, plus running, as a whole, involved almost one half of observation time in both groups (12.8%). In large group, the birds spent 11.7% of time in standing in the sun, 1.5% in eating and 0.5% in raised-head resting. In small group, the ostriches were also spent 11.3% of time in standing in the sun, 1.4% in eating and 0.6% in raised-head resting. For the both groups, the shortest fraction of the time budget was spent in courtship maneuvers (3.15 min.), while the longest periods of the time budget were taken in laying in shade (247.2 min.) for the large group and in walking and running (255.3 min) for the small group. The main target of the study was to provide ostrich breeders with useful information for better management in free-range system.

**Keywords:** ostrich; free-range system; colony; behavior; rangeland.



[O9-07]: Miscellaneous (ID: 120046)

[Italy]

## **Tannin from chestnut wood as an antimicrobial feed additive**

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The problem of acquired antimicrobial bacterial resistance (AMR) is a global concern, not adequately considered so far. Since 2006, the use of antimicrobial as growth promoters in poultry production has been banned. For this reason, alternative additives could be adopted. Tannin from chestnut wood (CT) demonstrated to be efficient and reliable. CT exhibited a very strong antimicrobial action in vitro against *Clostridium perfringens*, *Salmonella typhimurium*, *Escherichia coli* and *Campylobacter jejuni* and in vivo with challenged birds. Moreover, its known antinutritional effect on the digestion of proteins was measured by means of a nitrogen balance trial with broilers. The overall effect of CT was surprisingly positive: the higher the level of CT in the diet, the better the body retention of nitrogen. Incidentally, the same effect was observed with pigs, in which faeces were separated from urines, thus highlighting that the advantage is exclusively metabolic. As a matter of fact, there are two limitations to the concentration of tannin in the feed: palatability and cost. According to our experience, 5 g/kg is the concentration not to be exceeded, but 3 g/kg is the ideal level. In order to find out possible negative side effects, a live performance growth trial was carried out with broilers. The expected depressing effect of tannin on nitrogen digestibility was not observed, obviously because the negative effect on faeces was masked by the positive effect on urines, as observed in pigs. Performance data, oxidative status and meat colour of breasts were statistically comparable for the treated and untreated birds. In conclusion: CT is recommended as a reliable antimicrobial feed additive, with no negative side effects.

**Keywords:** antibiotics; tannin; nitrogen balance.

[O9-08]: Miscellaneous (ID: 120127)

[Iran (Islamic Republic of)]

### **The effect of hydroalcoholic extract of angelica (*Heracleum persicum*) fruit on performance, immune response, small intestine histology, haematological parameters and carcass characteristic of broiler chickens**

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This study was carried out to investigate the effects of dietary supplementation of hydroalcoholic extract of *Heracleum Persicum* (HPE) fruit on performance, immune responses, small intestine morphology, haematological parameters and carcass characteristics of broiler chickens. A total of 300-day-old Ross 308 broiler chicks were used in a completely randomized design with five treatments and five replicates of 12 chicks each. The treatments consisted of five dietary levels of HPE at 0 (control), 100, 200, 300 and 400 mg/kg of diet. The diets were fed ad libitum from one to 42 days of age. A significant increase in average daily feed intake was observed by 100 mg/kg of HPE supplementation compared to control group during 1-42 days of age ( $P < 0.05$ ). Experimental treatments significantly decreased the level of cholesterol and LDL in blood serum compared to control group ( $P < 0.05$ ). The ratio of villus height to crypt depth (VH/CD) was increased by 400 mg/kg of HPE than control group at 42 days of age ( $P < 0.05$ ). The results of this study showed that *Heracleum Persicum* fruit extract improves small intestine morphometrical and haematological parameters and performance of broiler chickens.

**Keywords:** *Heracleum persicum* extract; immune response; carcass characteristics; intestinal histology; haematological parameters; broiler.

[O9-09]: *Miscellaneous* (ID: 120125)

[Italy]

**Efficacy of dietary globin, a protein-based emulsifier, in broiler feed****Joana Nery (1), Sihem Dabbou (2), Francesco Gai (3), Silvia Martínez (4), Josefa Madrid (5), Fuensanta Hernandez-Ruiperez (6), Laura Gasco (7), Achille Schiavone (8) and Isabelle D. Kalmar (9)**

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Globin (Actipro® 95PGS) is a protein-based emulsifier used in meat products and animal feed. The active compound is a hydrophilic protein manufactured from the red cell fraction of food-grade porcine blood. Poor digestibility of dietary fat in young chicks is attributed to low secretion and inefficient recirculation of endogenous emulsifiers. The objective of this study was to evaluate the effect of dietary globin on energy efficiency and digestibility of starter feed and on production performance during the complete rearing cycle in broilers. A total of 224 mixed-sex ROSS 708 chickens were allocated in 16 pens (14 birds/pen). Each pen was assigned to one of two dietary treatments for the whole rearing cycle (8 replicates/treatment). Birds were fed ad libitum with either basal control diets (C) or basal diets added with 0.05% globin (G) during the starter (S; d1-10), grower (G; d10-25) and finisher (F; d25-39) phase. Fat and energy contents of test diets (C/G) were 6.46/6.55, 5.39/5.82 and 6.66/6.79% fat, and 18.49/18.76, 19.29/19.00, 19.15/19.26 MJ GE/kg in S, G and F feed, respectively. Nutrient digestibility (aD), protein metabolizability (aMCP), energy efficiency (EE), net energy for production (NEp) were assessed during S phase. Growth performance (ADG and FCR) was measured throughout the trial. Data were analyzed using Student's t-test for independent samples. Significance was set at  $p < 0.050$ . Globin significantly improved aDfat (C:74.0%, G:78.6%,  $p = 0.021$ ) of S feed. Although aDCP was similar between groups ( $p > 0.05$ ), aMCP was higher in the G than in C group (C:63.9%, G:67.8%,  $p = 0.049$ ). Increased availability of dietary fat by globin possibly shifted fate of absorbed amino acids towards anabolic metabolism, explaining improved aMCP whilst similar aDCP. Dietary globin indeed significantly increased energetic value of S feed: EE +7.2% ( $p = 0.028$ ) and NEp +8.5% ( $p = 0.011$ ), compared with control. FCR was also lower in G than in C group (C:1.22, G:1.16,  $p = 0.02$ ), yet ADG was similar in S phase. Performance traits were similar in G and F phases. Improved FCR of starter feed is translated in an economic impact of -€32.87/kg globin used.

Keywords: broiler; digestibility; energy efficiency; fat; globin; performance.

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**Poster Sessions**

[P1-01]: Nutrition, gut health and feeds (ID: 120092)

[Spain]

## **The effect of the dietary free fatty acids and its saturation degree on the morphometry of intestinal mucosa in early age broilers**

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The composition of the diet may have a clear effect on the integrity of the intestinal mucosa of broilers. The objective of the present experiment is to study the influence of the free fatty acid level (FFA) and the degree of saturation of the dietary fat supplemented on the integrity of the intestinal mucosa in 14 days old broilers. In the trial, a 2x2 factorial design was used, with 2 fat sources added to 6% (saturated, palm P and unsaturated, S soy) and 2 levels of FFA (0 and 60%) for each of the fat sources. In the study, a total of 240 animals, one-day old, were randomly and homogeneously distributed in the different treatments (6 replicates / treatment and 10 chickens / replicate). For the sampling, 6 animals per treatment were slaughtered (1 animal per replicate) at 14 days of age. Samples of the proximal portion of the jejunum of these animals were collected. In each preparation, at least the height of 30 villi and the depth of 30 crypts of Lieberk3uhn was measured. The results show that the intestinal villi of the jejunum are longer in chickens fed unsaturated fats versus those fed with saturated fats (S: 1084.97  $\mu\text{m}$ , P: 1042.34  $\mu\text{m}$ ,  $p < 0.01$ ). Similarly, the level of FFA modified the length of the jejunal villi (1037.85  $\mu\text{m}$  in 0% of FFA vs 1087.62  $\mu\text{m}$  in 60% of FFA,  $p < 0.01$ ). A strong interaction was found between the FFA level and the degree of saturation in crypts depth ( $p < 0.01$ ) but not in villi length. The depth of the crypts in animals fed with S was reduced with a greater FFA level (210.53  $\mu\text{m}$  in 0% of FFA vs 187.00  $\mu\text{m}$  in 60% of FFA,  $p < 0.01$ ), while in animals fed with P it was increased with a greater FFA level (180.51  $\mu\text{m}$  in 0% of FFA vs 190.11  $\mu\text{m}$  in 60% of FFA,  $p < 0.01$ ). Also, at low FFA level (0%), broilers chicken fed S present deeper crypts than animals fed P ( $p < 0.01$ ), however, no differences were found at high FFA level (60%).

Keywords: broilers; fat; free fatty acids; intestinal mucosae; villi; crypts.

[P1-02]: Nutrition, gut health and feeds (ID: 120171)

[Pakistan]

### **Phytobiotics in broiler diets: an alternative to antibiotic growth promoters**

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Chicken broilers are fast growing birds and have genetic potential to convert feed into nutritious meat very rapidly; however intensive production systems and fast growth lead to stress on broilers and make them susceptible to many diseases. To eliminate or inhibit these microorganisms different antibiotic growth promoters (AGP) are used; however due to possibility of development of antimicrobial resistance and occurrence of drug residues in meat, the demand for reducing use of antimicrobial growth promoters is on the rise and the need for alternative products is growing. In this regard Phytobiotics (products of plant origin which are available in different forms like solid, dried, ground form or as extracts) have been found most potent alternatives due to presence of high content of pharmacological active compounds. The phytobiotics has been reported to increase in feed intake, stimulate digestive secretions, increase antioxidant activity and enhance immune response in broilers. Phytobiotics also known to have antibacterial, antiviral, antiparasitic and anti-inflammatory properties. Basically, herbs increase feed intake by enhancing flavor of feed and increased feed intake lead to increased digestive secretions like saliva, bile, mucus and digestive enzymes. The antimicrobial properties of phytobiotics are due to the presence of essential oils while presence of phenolic-terpenes in oils of some phytogetic products has been reported to give anti-oxidant properties. Phytobiotics stimulate immune system by stimulating growth of various immune organs (i.e. spleen, thymus and bursa). Despite of the fact that phytobiotic have many beneficial properties for poultry, they are not widely adopted in developing countries and their use is still limited. In conclusion phytobiotics can be important source of replacing antibiotic growth promoters from poultry feed however there is need to intensify research and development and create awareness among poultry farms to adopt them.

Keywords: poultry nutrition; immune system; disease control; human health.

[P1-03]: Nutrition, gut health and feeds (ID: 120015)

[United Kingdom]

## **The effect of dietary phosphorus and inositol contents on hepatic vitamin E and blood alkaline phosphatase of broilers**

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A study was conducted to investigate the response of male Ross 308 broiler chicks on hepatic vitamin E and blood alkaline phosphatase (ALP) fed two levels of dietary P and graded levels of myo-inositol (MYO). Two wheat-based basal diets were formulated to be nutritionally adequate for chicks at that age (12.90 MJ/kg ME, 216 g/kg CP), as one of them was designed to have the recommended available P content (4.8 g/kg non-phytate P) (RP), and the other diet was low in available P content (2.5 g/kg non-phytate P) (LP). The two basal diets were then split in three batches and each batch was supplemented with MYO at 0.0, 3.0 and 30 g/kg diet, respectively to give six experimental diets. At 7d age, 120 birds were allocated to 60 floor pens each holding 2 birds. Each diet was offered ad libitum to birds in 10 pens in a mash form following randomisation. The birds were fed the experimental diets from 7 to 21d age. At the end of the study, one bird per pen was electrically stunned and blood was obtained in heparin tubes from the jugular vein. The liver from the same birds was collected and frozen prior to analysis. A randomised block ANOVA was performed and a 2×3 factorial structure was used to investigate the main treatment factors (P×MYO inclusion levels) and their interaction. Feeding LP diets increased ( $P<0.001$ ) the hepatic vitamin E concentration (29 vs 22  $\mu\text{g/g}$ , respectively), although reduced growth performance variables, thus suggesting that the relatively low feed intake of these birds reduced the oxidative stress, thereby preventing vitamin E reserves from depletion. However, compared to LP diets, birds fed RP diets had an increased ( $P<0.001$ ) ALP concentration in blood (5817 vs 13446 U/ml, respectively). Dietary MYO did not influence ( $P>0.05$ ) the hepatic vitamin E concentration but increased ( $P<0.001$ ) the ALP in the blood of birds fed 30 g/kg MYO (11756 vs 8519 for 0 g/kg MYO). There were no available P x inositol interactions for the studied variables. This experiment has confirmed expected biological effects of diets that differ in available P and MYO contents.

Keywords: myo-inositol; phosphorus; hepatic vitamin E; alkaline phosphatase chicks.

[P1-04]: Nutrition, gut health and feeds (ID: 120164)

[Italy]

## Free range rearing system in chicken breeds: effect of bird density and sex on growth performance and welfare

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Avian breeds are fundamental genetic resources to diversify poultry production and products. Peculiar management guidelines for autochthonous birds need to be studied. The present study focuses on the management of autochthonous birds in free range system and different factors (sex, bird density) affecting bird welfare and growth performance are considered. Milanino chickens (n=160), hatched at the Poultry Unit (UniMI), were reared in indoor floor pens and sexed during the brooding period. Birds were transferred to outdoor free range pens during the growing period and randomly allotted to 4 experimental groups according to sex (F vs M) and density (2 vs 10 m<sup>2</sup>/bird). Body weight was recorded at hatch, 76 (age of transfer), 86, 122, 148, 178, 203 and 234 days of age. Feed consumption was also recorded at the same ages. Blood samples (n =10/group) were collected after the transfer to outdoor condition and at the end of the growing period to assess the following stress parameters: lyzosome (LYS), heterophil/lymphocyte ratio (H/L), total antioxidant activity (OXY). Body weight was significantly higher in males compared to females during the whole growing period. Mean body weight recorded at 234 days of age was 3105 g and 2435 g in males and females respectively. Bird density significantly affected the growth performance in male birds, whereas no effect was found in females. In particular, mean body weight was significantly ( $P < 0.05$ ) higher in males reared at 10 m<sup>2</sup>/bird compared to 2 m<sup>2</sup>/bird at 203 (3083 vs 2902 g) and 234 (3247 vs 2963 g) days of age. Stress parameters were not significantly affected by the treatments and similar mean values were recorded in all groups. In contrast, a significant variation was found between ages of sampling: the highest mean value of LYS (2.78 µg/mL) was recorded at 93 days of age and of H/L (0.33) and OXY (229 µM HClO/mL) at 203 days of age. In conclusion, results underline a different density requirement according to the sex in autochthonous birds reared in free range system. Male birds, in contrast with females, require low rearing density in order to reach the best growing performance.

Keywords: breeds; free range system; density; growth; welfare.



[P1-05]: Nutrition, gut health and feeds (ID: 120113)

[India]

## **Butyric acid as an alternate feed additive in broiler chicken**

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An experiment was conducted to study the effect of using butyric acid (BA) an organic acid to substitute antibiotic growth promoter (AGP) on immune response, blood biochemical parameters, and expression of nutrient transporter genes in broiler birds. One hundred ninety-two (192) day old broiler chicks were housed and distributed randomly in to twenty groups each of 8 chicks (4 treatments × 6 replicates). The experiment had a randomized block design. Birds were allowed to eat and drink ad libitum. A basal corn-soybean meal diet were formulated and served as a control treatment. Four experimental diets T1, T2, T3 and T4 were formulated to contain an additional 0, Bacitracin Methylene Di-salicylate (BMD) @ 20 mg, 0.3 and 0.4% BA /kg diet, respectively. Immune response in terms of humoral and cell mediated was increased ( $P<0.05$ ) by the feeding of diets containing different levels of BA but feed intake (g), feed conversion ratio (FCR) and mortality (%) did not differ significantly ( $P>0.05$ ). Serum protein, albumin, enzymes (AST, ALP and ALT), kidney function indices (creatinine, uric acid), minerals (Ca and P) and total cholesterol concentration were influenced ( $P<0.05$ ) by BA supplemented groups. Nutrient transporter genes i.e., GLUT5, PepT1 and SGLT1 expression, were down-regulated significantly in at d 7 and d 21 in T3 and T4 groups whereas, in antibiotic supplemented group (T2) were no specific trend were observed. From the above said results, it can be concluded that, BA could be a good alternative to antibiotic growth promoters for immune response, blood biochemical traits and expression of nutrient transporter genes in broiler chickens.

**Keywords:** butyric acids; antibiotic; broiler; immune response; gene expression.

[P1-06]: Nutrition, gut health and feeds (ID: 120073)

[Algeria]

## Comparison of three diagnostics methods (PCR, culture and serology) of avian mycoplasmas in Algeria

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Chronic respiratory diseases are a dominant pathology in poultry farming. Avian mycoplasmosis is one of the most expensive diseases for poultry farming. They cause heavy economic losses due to stunting, decreases in egg production, seizures in slaughterhouses and antibiotic treatments. It is essential to know the mycoplasma status of farms in order to establish strategies for controlling these infections. In this study, three avian mycoplasma diagnostic methods were evaluated and the results obtained were compared. Out of 40 samples tested by rapid slide agglutination (ARL), 15 were seropositive (37.5%). 10 were positive for *Mycoplasma synoviae* (66.7%) and 5 for *Mycoplasma gallisepticum* (33.3%). The PCR results give a positivity rate of 22.5% of the tracheal swabs (9/40): two *Mycoplasma gallisepticum* (22.2%) and seven *Mycoplasma synoviae* (77.8%). Positive cultures amount to three (7.5%) out of 40 tracheal swabs, distributed as follows: Two *Mycoplasma synoviae* positive cultures (66.7%) and *Mycoplasma gallisepticum* culture (33.3%). The results obtained show an average correlation between PCR, serology (ARL) and bacteriology. The ARL serological test is a screening tool for avian mycoplasma in farms in Algeria where there are currently no alternative methods (PCR)

Keywords: *Mycoplasma gallisepticum*; *Mycoplasma synoviae*; PCR; bacteriology; ARL.

[P1-07]: Nutrition, gut health and feeds (ID: 120168)

[Brazil]

## Effect of phytate and phytase on broilers diets at 21 days of age

Ricardo Vianna Nunes (1), Jomara Broch (2), Gene M. Pesti (3), Cinthia Eyng (4), Vaneila Lenhardt Savaris (5), Cleison de Souza (6) and Jessica Lima Damasceno (7)

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The objective of this study was to evaluate the effect of different levels of phytase in diets formulated based on products of plant origin on broiler performance from 0-21 days of age. A total of 2,625 male one-day-old Cobb 500 broiler chicks were distributed in a 3x5 factorial design (15 treatments) with each treatment containing 7 replicates of 25 birds each (the experimental unit). Three kinds of experimental diets were fed: high (HP, based on vegetable ingredients), medium (MP, vegetable plus animal ingredients), and low phytate (LP, animal ingredients) levels, and five levels of phytase include: a positive control diet, negative control diet, and negative control diet plus 100; 200 or 300 FTU kg<sup>-1</sup> of phytase. Data were analyzed by SAS - Version 9.1. Polynomial regression between levels of inclusion of the enzyme was performed excluding the positive control treatment. Dunnett's and Tukey's tests were performed with P<0.05 considered significant. The weight gain (WG) and feed intake (FI) of the birds fed the medium phytate diet (MP) showed an increasing linear response (P<0.05) with increased phytase supplementation. For birds receiving the low phytate ration (LP), WG and FI had a quadratic behavior (P<0.05) and the levels, of phytase inclusion that provided the maximum responses were calculated to be at 228 and 211 FTU kg<sup>-1</sup>, respectively. For feed conversion ratio (FCR), only the phytate and the enzyme effects were significant (P<0.05). Dunnett's test applied to WG and FI showed that birds on the MP and LP diets, that received the negative control (NC) had a WG and a FI lower than that of those of the positive controls (PC). Birds fed NC + 200 FTU kg<sup>-1</sup> of phytase in the LP diet had a WG 6.53% higher than that of birds that were fed the PC. When the effect of the phytate content on FCR was evaluated, birds on the HP diet had higher FCR when compared to birds on the medium and low phytate diets (P<0.05). The evaluation of the effect of phytase on FCR showed that birds supplemented with 200 and 300 FTU kg<sup>-1</sup> differed when compared to those on the PC treatment (P<0.05), showing a better use of nutrients from the diet for WG.

Keywords: aviculture; diets; enzyme; phytic acid.

[P1-08]: Nutrition, gut health and feeds (ID: 120169)

[Brazil]

### **Effect of phytate and phytase on blood parameters of broilers at 21 days of age**

**Ricardo Vianna Nunes (1), Jomara Broch (2), Gene M. Pesti (3), Cinthia Eyng (4), Lucas Wachholz (5), Patricia Nesello (6) and Gabriela Glaeser Sangalli (7)**

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The objective of this study was to evaluate the effect of different levels of phytase in diets formulated based on products of plant origin on broiler blood from 0-21 days of age. A total of 2,625 male one-day-old Cobb 500 broiler chicks were distributed in a 3x5 factorial design (15 treatments) with each treatment containing 7 replicates of 25 birds each (the experimental unit). Three kinds of experimental diets were fed: high (HP, based on vegetable ingredients), medium (MP, vegetable plus animal ingredients), and low phytate (LP, animal ingredients) levels, and five levels of phytase inclusion: a positive control diet, negative control diet, and negative control diet plus 100; 200 or 300 FTU kg<sup>-1</sup> of phytase. At 21 days of age, two birds per pen were randomly chosen, fasted for 6 hours and blood samples were collected via brachial puncture. Data were analyzed by SAS - Version 9.1. Polynomial regression between levels of inclusion of the enzyme was performed excluding the positive control treatment. Dunnett's and Tukey's tests were performed with  $P < 0.05$  considered significant. There was an interaction ( $P < 0.05$ ) between phytase supplementation and the different levels of phytate seen on blood phosphorus levels (P). Serum P of birds fed diets containing HP, MP, and LP had a quadratic behavior ( $P < 0.05$ ) and the levels that provided the maximum responses were 198, 199 and 213 FTU kg<sup>-1</sup>, respectively. Phytate and phytase effect ( $P < 0.05$ ) was observed on serum Ca levels. LP birds showed a lower concentration of Ca in the blood compared to the other groups. The means of Ca levels had a quadratic behavior, and the level that was determined as providing the maximum response value was 194 FTU kg<sup>-1</sup> phytase. For ALP, only the phytase effect was observed ( $P < 0.05$ ). The evaluation of the effect of phytase on HP, showed that birds receiving NC treatments from those of of the PC treatment, had a higher concentration of ALP in the blood. This variable had a linear behavior decreasing with the increase of phytase level.

Keywords: aviculture; enzyme; minerals; phytic acid.

[P1-09]: Nutrition, gut health and feeds (ID: 120022)

[Iran (Islamic Republic of)]

## **Effect of dietary calcium and phosphorus decrement with vitamin D3 or fennel extract on performance, some hormones, blood biochemistry in post molted Ross broiler breeder**

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This experiment was conducted to investigate the effect of dietary calcium and phosphorus decrement with different levels of vitamin D3 or fennel extract (FE) on productive performance, some hormones, blood biochemistry in post molted broiler breeder. The completely randomized design with seven treatments (1-Control, 2-Ten percent decrement in calcium and phosphorus, 3-Twenty percent decrement in calcium and phosphorus, 4-As the second treatment with twenty percent increase in vitamin D3, 5-As the third treatment with twenty percent increase in vitamin D3, 6- As the second treatment supplemented with 50mg/kg FE, 7-As the third treatment supplemented with 50mg/kg FE) were used in this experiment. Each treatment was assigned to 4 replicates. Eggs were manually collected 6 times a day. Thirty-six settable eggs were set for incubation biweekly per each pen. The effect of dietary treatments was significant on the egg production, egg mass, settable egg, shell quality, Estradiol and progesterone hormone, liver enzymes. The results of this experiments showed that up to 10% loss of calcium and phosphorus had not significantly affected the parameters evaluated, while, the 20% loss of calcium and phosphorus affected the above parameters. Supplementation of vitamin D3 to the diet with up to 10% deficiency in calcium and phosphorus improved the adverse effects of calcium and phosphorus losses. Additionally, supplementation of FE improved the adverse effects of calcium and phosphorus losses compared to the control diet but was not as high as with vitamin D3.

Keywords: calcium; phosphorus; fennel extract; broiler breeder; post molt.

[P1-10]: Nutrition, gut health and feeds (ID: 120023)

[Iran (Islamic Republic of)]

## **Effect of royal jelly nutrition on short term preservation and cryopreservation of rooster spermatozoa**

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The aim of the present study was to investigate the effect of royal jelly nutrition on short term preservation and the feasibility of rooster spermatozoa. For this purpose, different concentrations of royal jelly were fed for 2 months to the Mazandaran Native Roosters. Semen samples from 20 sexually-matured roosters were collected by abdominal massage after 4 weeks adaptation. The treatments were included control, and three different concentrations of royal jelly (100, 200 and 300 bases on mg/kgBW). We used the Beletseville as a basic extender for both short term preservation (48h at 4°C in the refrigerator) and freezing of rooster spermatozoa. Glycerol (7%) was used as a cryoprotectant for semen freezing. Following cooling and freezing-thawing, total motility (measured with light microscope), viability (measured with light microscope), dead spermatozoa (measured with Eosin-Nigrosin staining), abnormality (measured with light microscope), hypo-osmotic swelling test (HOST) were measured. The DNA damage and mitochondrial activity of sperm were assessed by DAPI and MitoTracker fluorescent dye, respectively. Results showed that the feeding of 100 mg RJ/BW increased the total motility, membrane integrity and viability after 24 and 48 h refrigeration. The roosters fed with 100mg/BW RJ had significantly increased intact plasma membrane sperm and decreased ( $P<0.05$ ) abnormal and dead spermatozoa at 24h. Also, at 48 h 100 mg/RJ significantly reduced abnormal and dead spermatozoa compared to other considered treatments. Moreover 100mg/RJ also significantly improved the post thawed motility, viability, intact plasma membrane and mitochondrial activity of spermatozoa and significantly decreased the dead, abnormal spermatozoa and damaged DNA in comparison to other considered groups. RJ is a super food which is extremely rich in nutrients, including proteins, free amino acids, carbohydrates, lipids, enzymes, antibiotic components, vitamins, mineral salts, sterols, phosphorous compounds, acetylcholine, and hormones. In conclusion the feeding of 100mg/BW improved the rooster sperm quality during the short and long-term semen storage.

**Keywords:** royal jelly; rooster; semen characteristics; sperm viability.

[P1-11]: Nutrition, gut health and feeds (ID: 120129)

[Iran (Islamic Republic of)]

## **Effect of dietary inclusion of olive leaf (*Olea europaea L.*) powder on performance, small intestine morphology and nutrient digestibility in broiler chickens**

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The effects of different dietary levels of olive leaf powder (OLP) as a natural antioxidant on growth performance, carcass traits, some blood parameters, small intestinal morphology and feed digestibility in broiler. A total of 300 one-day-old Cobb500 broilers were studied in a completely randomized design with 5 treatments, 3 replicates and 20 chicks for each replicate, up to 42d. The experimental diets included: corn-soybean meal basal diet (negative control), basal diet supplemented with 250 mg/kg of alpha-Tocopheryl acetate (positive control) and three basal diets containing 2, 2.5 and 3 percent OLP. The results showed that during total experimental period (1-42d), weight gain decreased ( $P<0.05$ ) in OLP groups in comparison to the positive control. Feed intake during 1-42d period was lower ( $P<0.05$ ) in the group which was treated by 3 percent OLP in comparison to the positive control group. In starter period, feed conversion ratio increased ( $P<0.05$ ) in all groups treated by OLP in comparison to negative and positive controls. Dietary inclusion of different levels of OLP increased ( $P<0.05$ ) length of villi, crypt depth and villus surface in comparison with the negative or positive controls. A significant decrease ( $P<0.05$ ) was observed in serum concentrations of the triglycerides, cholesterol and low-density lipoproteins in OLP treated groups in comparison to negative or positive controls. Based on the results, dietary inclusion of OLP (up to 2 percent) in the broiler diets is recommendable, because it reduces blood lipids and also improves intestinal morphology.

**Keywords:** blood lipids; broiler; feed conversion ratio; intestine villi; olive leaf; weight gain.

[P1-12]: Nutrition, gut health and feeds (ID: 120029)

[Italy]

## Meat quality traits as affected by current broiler breast abnormalities

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In the past decade, several studies have been carried out in order to evaluate the impact of the emerging muscular abnormalities (white striping – WS, Wooden breast – WB and Spaghetti meat – SM) on the main chicken meat quality traits. However, to our knowledge, there have been no studies carried out by simultaneously exploring the major current abnormalities of chicken breast meat (WS, WB and SM). For this purpose, 48 Pectoralis major muscles were selected from the same flock of female broilers (Ross 308, 46-day-old, 2.8 kg) and classified by visual evaluation as: Normal (NORM), WS, WB and SM. Then, the muscles were weighed and, to investigate the possible variations resulting from the sampling position, cut to separate the superficial and the deep portion that were used to assess colour, ultimate pH (pHu), NMR relaxation properties (water mobility and distribution) as well as proximate composition. The findings evidenced that, if compared to NORM, the Pectoralis major muscles affected by abnormalities exhibited a 16% increased weight thus confirming a growth-related origin for these abnormalities that mainly affect those birds having a more pronounced breast development. As for pHu and colour, if compared to NORM, the superficial portions of WB and SM muscles were paler ( $L^*$ : 58.4 and 57.3 vs. 54.8) and the WB cases also exhibited remarkably higher pHu values (5.87 vs. 5.75;  $P < 0.01$ ). In addition, the superficial portion of WB and SM exhibited a remarkably higher moisture content (77.1 and 76.8% vs. 75.0 and 75.3%;  $P < 0.001$ ) to the detriment of ash and protein (20.6 and 21.0 vs. 22.9 and 22.0%;  $P < 0.001$ ) levels, whereas the WS muscles did not differ from their NORM counterpart. In addition, both the relative intensity and the relaxation properties ( $T_2$ ) of the three proton populations ascribed to bound, intra- and extra-myofibrillar water fractions were remarkably affected by the occurrence of muscular abnormalities and this explains the impaired water-holding capacity of the abnormal meats. In conclusion, if compared to WS, the occurrence of WB and SM abnormality was associated to a more profound alteration of the main quality traits of meat of both the superficial and the deep portion of the muscle.

Keywords: broiler breast; white striping; wooden breast; spaghetti meat; meat quality.



[P1-13]: Nutrition, gut health and feeds (ID: 120030)

[Italy]

## Post mortem evolution of pH in broiler breast and leg muscles

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During the conversion of muscle to meat, the rate and the extent of pH decline are able to influence the final quality of meat. The ultimate pH (pHu) value reached at 24h post mortem varies inter- and intra-species and essentially depends on muscle's glycolytic potential. However, also the concentration of buffering compounds (i.e. anserine and carnosine) might play a role. Thus, a study was performed in order to investigate the post mortem acidification pattern in chicken breast (Pectoralis major), thigh (Extensor Iliotibialis lateralis) and drumstick (Peroneus longus) muscles, characterized by a different in vivo energy metabolism. For this purpose, 12 carcasses were selected immediately after evisceration and samples from each muscle were collected at 15 min, 2, 4, 8 and 24h post mortem, instantly frozen in liquid nitrogen and stored at -80°C in order to evaluate pH and R-value. Then, at 24h post mortem, fiber-typing, total heme pigments and concentration of histidine compounds were also assessed. The findings evidenced that leg muscles had a more rapid pH decline and a significantly higher pHu, if compared with breast. Accordingly, R-value data confirmed the same trend. Drumstick muscle exhibited the highest content of total heme pigments, whereas no differences were found between pectoral and thigh muscles, which showed similar fiber composition. Moreover, if compared to leg muscles, breast presented a remarkably higher concentration of histidine compounds (anserine and carnosine). In conclusion, muscles with a different fiber composition exhibit a dissimilar acidification pattern during post mortem time, which can be partially explained by the different concentration of anserine and carnosine having a strong buffering capacity. These results might also give a reason for the higher pHu of chicken breast, if compared to other meats with similar fiber composition (i.e. pork and rabbit loin).

Keywords: broiler; muscle; post mortem acidification; pH; histidine compounds.

[P1-14]: Nutrition, gut health and feeds (ID: 120203)

[Algeria]

## Prevalence and clonal relationship of ESBL-producing *Salmonella* strains from humans and poultry in northeastern Algeria

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The aims of this study were to investigate *Salmonella* contamination in broiler chicken farms and slaughterhouses, to assess the antibiotic resistance profile in avian and human *Salmonella* isolates, and to evaluate the relationship between avian and human Extended Spectrum  $\beta$ -Lactamase (ESBL)-producing isolates. *Salmonella* was screened in different sample matrices (water, feed, cloacal swabs, droppings, surface wipes, caeca, livers and neck skins) collected at thirty-two chicken farms and five slaughterhouses. The human isolates were recovered from clinical specimens at the University Teaching Hospital of Constantine (UTH). All suspected colonies were confirmed by MALDI-TOF (Matrix Assisted Laser Desorption Ionization Time OF light) and serotyped. Susceptibility testing against 13 antibiotics including, amoxicillin/clavulanic acid, ticarcillin, cefoxitin, cefotaxime, aztreonam, imipenem, ertapenem, gentamicin, amikacin, ciprofloxacin, colistin, trimethoprim/sulfamethoxazole and fosfomycin, was performed using the disk diffusion method on Mueller-Hinton agar. The results were interpreted according to the European Committee on Antimicrobial Susceptibility Testing (EUCAST), ESBL-production was screened by the double-disk synergy test and confirmed by molecular characterization using PCR (polymerase chain reaction) amplification and sequencing of ESBL encoding genes. Clonality of the avian and human strains was performed using the Multi Locus Sequencing Typing method (MLST). Forty-five isolated avian and 37 human *Salmonella* strains were studied. Five *S. enterica* serotypes were found in avian isolates (mainly Kentucky) and 9 from human ones (essentially Infantis). A total of 51.1% and 26.6% of the avian isolates were resistant to ciprofloxacin and cefotaxime, respectively, whereas 13.5% and 16.2% of human isolates were resistant to the former and the latter antibiotic. Eighteen (12 avian and 6 human) strains were found to produce ESBLs, which were identified as blaCTX-M-1 (n=12), blaCTX-M-15 (n=5) and blaTEM group (n=8). Interestingly, seven of the ESBL-producing strains (5 avian and 2 human) were of the same ST (ST15) and clustered together, suggesting a common origin. The results of the combined phenotypic and genotypic analysis of this study suggest a close relationship between human and avian strains and support the hypothesis that poultry production may play a role in the spread of multidrug-resistant *Salmonella* in the human community within the studied region.

Keywords: *Salmonella*; poultry; human; serotype; antimicrobial resistance; resistance genes; clonality.

[P1-15]: Nutrition, gut health and feeds (ID: 120114)

[France]

## Effect of protein, energy and their ratio on broiler performance in starter phase

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The final performance of broiler batches is determined very early during the starter phase. Feed formulation (level of protein in the diet and its ratio to energy) represents one of the major levers to improve zootechnical performances. This study was conducted to investigate the effect of 3 different levels of protein (196, 207, 230 g/kg), energy (2740, 2750, 3000 kcal/kg) and energy/protein ratio (13.04, 13.21, 14.03 kcal/g) in starter feed on the performance of broilers in starter period (0-10 days). A database of 146 lines was built from data obtained in 11 trials, run successively in the same barn and involving in total 2480 mixed-sex birds. Average weight per pen was measured at D10 (BWD10) and average daily gain (ADG0-10), feed intake (FI0-10) and feed conversion ratio (FCR0-10) per pen were calculated. Results were then expressed in percentage after comparison to values of standard genetic breed (Ross PM3 or 308). The effect of protein level (P), energy level (E) and their ratio ( $R = E/P$ ) on starter zootechnical performance was evaluated by linear regression analysis with BWD10, ADG0-10, FI0-10 or FCR0-10 as dependent variables and P, E or R as independent variables. The equations obtained were:  $BWD10(\%) = 0.015 \times P - 0.001 \times E - 0.23$  ( $R^2 = 0.63$ ,  $p < 0.001$ );  $BWD10(\%) = -0.251 \times R + 3.422$  ( $R^2 = 0.63$ ,  $p < 0.001$ );  $ADG0-10(\%) = 0.018 \times P - 0.001 \times E - 0.248$  ( $R^2 = 0.66$ ,  $p < 0.001$ );  $ADG0-10(\%) = -0.293 \times R + 3.992$  ( $R^2 = 0.66$ ,  $p < 0.001$ );  $FI0-10(\%) = -0.007 \times P + 0.001 \times E - 0.461$  ( $R^2 = 0.05$ ,  $p = 0.06$ );  $FI0-10(\%) = 0.071 \times R - 0.868$  ( $R^2 = 0.04$ ,  $p = 0.03$ );  $FCR0-10(\%) = -0.031 \times P + 0.002 \times E - 0.497$  ( $R^2 = 0.66$ ,  $p < 0.001$ );  $FCR0-10(\%) = 0.432 \times R - 5.749$  ( $R^2 = 0.65$ ,  $p < 0.001$ ). BWD10 and ADG0-10 were positively correlated to P and E but negatively to R, while FCR0-10 was improved with increasing P or E and downgraded with increasing R. In this study, P, E and R only slightly impacted FI0-10. The results of this study are in line with other publications showing that a diet combining high protein and low energy levels is beneficial for optimal zootechnical performance of broiler chicks in the starter phase.

Keywords: protein; energy; performance; broiler; starter.

[P1-16]: Nutrition, gut health and feeds (ID: 120102)

[Italy]

## Effect of age on caecal microbiota of broiler chickens fed diets supplemented with sodium butyrate

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A total of 768 chicks Ross 308 (half males and half females) were housed in 16 pens (48 animals/pen); half pens received a control diet, the other half the same diet supplemented with 150 mg microencapsulated Na-butyrate/kg diet. Growth performance was monitored until 45 d of age. At 11 d, 24 d, and 35 d of age, 32 animals per age were slaughtered to sample caecal content. Intestinal microbiota was evaluated by sequencing of V3-V4 region of the rRNA 16S gene using Miseq Illumina. Firmicutes was the most represented phylum, followed by Tenericutes and Proteobacteria; Bacteroidetes was the least represented. Out of classes, Clostridia was prevalent, followed by Bacilli and Grammaproteobacteria. The dietary Na-butyrate supplementation did not affect performance: final live weight averaged 3294 and 3266 g in the control and supplemented group, respectively, corresponding to 113 and 112 g/d feed intake, and 1.44 and 1.43 feed conversion ratio. The dietary treatment did not affect the composition or abundance neither the diversity of gut microbiota. Only some OTUs (26) had different distributions according to dietary treatment ( $P < 0.05$ ): some, mostly belonging to Firmicutes phylum and to Clostridiales order, were more abundant in samples from birds fed the control diet; others, such as Tenericutes of the RF39 order, were more present in samples from chickens supplemented with Na-butyrate. On the other hand, microbiota composition significantly changed with age ( $P = 0.001$ ). Among phyla, Proteobacteria and Firmicutes decreased as age increased, whereas Tenericutes increased from 11 to 24 d of age. Among classes, Mollicutes, X4C0d2, Bacterioidia, and Clostridia increased, whereas Grammaproteobacteria decreased with age. Among orders, Lactobacillales, Enterobacteriales, Erysipelotrichales, burkholderiales, Oceanospirillales, Alteromonadales, Pseudomonadales, Pasteurellales, and Unclassified beta Proteobacteria decreased. The biodiversity in each sample and among samples tended to decrease when age increased. The effect on biodiversity among samples was evident using both qualitative analysis (that considers presence/absence of sequences and phylogenetic distances) and quantitative analysis (that considers only sequence abundance). The results of the present study indicate that Na-supplementation did not affect caecal microbiota. On the other hand, bacterial groups of gut community decreased with age and the community became more similar among samples.

Keywords: growth performance; prebiotic supplementation; gut microbiota diversity.

[P1-17]: Nutrition, gut health and feeds (ID: 120052)

[Iran (Islamic Republic of)]

## **Effect of *in ovo* injection of copper nano particles on the hatchability performance and immuno system parameters of broiler chickens**

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The aim of this study was to evaluate the effects of *in ovo* injection of copper nanoparticles on the hatchability, the production traits and the immune system of broiler chickens. In this study 200 fertilized eggs of Ross 308 broiler breeder hens were used. The eggs were divided into 4 treatments consisting of: Control with sterile water injection, injection of 50, 75 and 100 ppm of copper in distilled water into the air cell at the first days of incubation. The experimental groups of hatched chicks were used in a completely randomized design with 4 treatments and 4 replicates for 42 days. *In ovo* injection of 50 ppm nanoparticles of copper increased the hatchability ( $P < 0.05$ ). The results of this study showed that the daily feed intake and average daily gain during whole the rearing period was higher in the 100 ppm *in ovo* nano-Cu injected group ( $P < 0.05$ ), while the feed conversion ratio for different treatments did not show any significant difference during the trial ( $P > 0.05$ ). There was no difference in antibody titers against the influenza virus at 10 days of age between the chickens from different treatments ( $P > 0.05$ ). The antibody titer against Newcastle virus in the group injected with 100 ppm nano-Cu was significantly higher than the 75 ppm nano-Cu injected group ( $P < 0.05$ ). The 10 days egg injection and *in ovo* injection of 50 ppm copper resulted in a significant reduction of total white blood cells ( $p < 0.05$ ), however, the lymphocytes of the same group (50ppm) was significantly increased ( $P < 0.05$ ). The hematocrit percentage of blood samples at 10 days of age in broiler chickens *in ovo* injection with 100 ppm copper was significantly decreased ( $P < 0.05$ ).

**Keywords:** *in ovo* injection; copper nano particles; hatchability; performance; immuno system; broiler chickens.

[P1-18]: Nutrition, gut health and feeds (ID: 120053)

[Iran (Islamic Republic of)]

## **Effect of *in ovo* injection of green tea extract and purslane extract on sex differentiation of broiler chicken**

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The aim of this study was to survey the effect of *in ovo* injection of green tea extract or purslane extract on sex differentiation in broiler chickens. Three hundred Ross 308 breeder flock fertile eggs were subdivided into five treatments with four replicates per treatment and were set in the incubator. On the 5th day of incubation, 0.1 ml of green tea or purslane extracts, Fadrozole hydrochloride or distilled water were *in ovo* injected into the fertile eggs and a control group left without injection. The hatched chicks were reared for 42 days as a completely randomized design with 4 treatments, 6 replicates and 10 chicks each. The injection of Fadrozole hydrochloride, green tea extract or purslane extract converted the female sex to male at 100, 80 and 40 percent ratio, respectively ( $P < 0.05$ ). The feed intake and body weight gain in chicks from Fadrozole or green tea- injected eggs were significantly higher than those of the control and purslane groups ( $P < 0.05$ ). No differences were observed in the carcass traits between the anti-aromatase- injected eggs and the control ones. The *in ovo* injection of anti-aromatase (green tea or purslane extracts vs Fadrozole hydrochloride) in this study, had no effect on the white blood cells and hematocrit. The results suggest that sex conversion of broiler chickens, using *in ovo* injection of green tea extract, improved the performance of the birds. The green tea extract showed a comparable anti-aromatase effect to that of a chemical drug, namely Fadrozole hydrochloride.

**Keywords:** aromatase inhibitors; sex differentiation; green tea extract; purslane extract; Fadrozole hydrochloride.

[P1-19]: Nutrition, gut health and feeds (ID: 120172)

[Pakistan]

## **Comparative efficacy of Neem, Aloe vera and Moringa leaf extract on immune response of chicken broiler**

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Neem (*Azadirachta indica*), Aloe vera and Moringa are native plants of subcontinent and known to have antibacterial, antiviral, anticancer, antimicrobial, antifungal, antitumor and ant malarial properties. This study was carried out to investigate the effect of supplementation of Aloe Vera and Moringa leaf extract on the immune response of broiler chicken. For this purpose, broiler chicks (n=120) were divided into four equal groups and administered with three treatments i.e. A (control), B (Neem extract given in drinking water at rate of 50ml per liter of water), C (Aloe leaf extract was given in drinking water at rate of 20ml per liter of water), and (Moringa leaf extract given in drinking water at rate of 30ml per liter of water). The chicks were vaccinated against New Castle Disease (ND) at day 5th and 22nd, and against Infectious Bursal Disease (IBD) at day 10th and 18th of broiler age. All birds were reared on similar condition of temperature, humidity, ventilation and light. Blood samples were collected at day 32nd of broiler age to determine antibody titers against above mentioned diseases. The treatment A had significantly ( $P<0.05$ ) lower antibody titers for ND and IBD diseases compared with all other treatments. However no significant differences were observed between treatments B, C and D for the antibody titers. We concluded that supplementation of broiler diet with herbal plants increases their immune response against ND and IBD diseases.

Keywords: immunity; herbal plants; leaf extracts; antibody titres.

[P1-20]: Nutrition, gut health and feeds (ID: 120058)

[Korea, Republic of]

## **Comparison of the effects of dietary available phosphorus vs feed restriction on performance, egg quality and yolk fatty acids at late phase of laying hens**

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This study was performed to evaluate the effect of available phosphorus (AP) and feed restriction (FR) on laying hens' productivity, external and internal egg quality and yolk fatty acids profile. A total of 432 commercial laying hens (Lohmann brown) which were 60 weeks old were assigned to six treatment groups each of four replications (two hens/cage) and feeding trial was conducted for twenty weeks. The trial was set up in a 2×3 factorial arrangement: two levels of AP (0.32 and 0.45%) and three levels of FR (90, 95 and 100%). All hens received 2750 kcal/kg ME, 15% CP and 4.5% Ca. The results show that egg production, egg weight, daily egg mass and feed conversion ratio were highly significant ( $P<0.01$ ) among the treatments and the restriction feeding levels. However, dietary AP levels had no influence on all of these production parameters. The egg production percentage was not statistically different between 95% and 100% levels of FR but a decrease was found at the 90% levels of FR. Egg weight, daily egg mass and feed conversion were gradually reduced by increasing levels of feed restriction. There was no difference in broken and cracked eggs among the dietary groups and the main effects of AP, and FR levels. Egg quality didn't differ among all treatment groups except for yolk color. Significantly ( $P<0.05$ ) higher albumen height, haugh unit and yolk color ( $P<0.01$ ) were obtained at 0.45% AP level in diet. Furthermore, eggshell breaking strength and egg shell thickness was positively influenced by high AP in diet. No difference was observed for the egg yolk fatty acid profiles at the main AP and FR levels, and their interaction. Based on the results of the present study, quantitative feed restriction levels 95% and 0.32% AP may be more beneficial for egg production for older hens while 0.45% AP in the diet is better for improving egg quality.

**Keywords:** available phosphorus; feed restriction; performance; egg quality; fatty acids; laying hens.



[P1-21]: Nutrition, gut health and feeds (ID: 120060)

[Croatia (Hrvatska)]

### ***Chlamydia gallinacea* in chickens**

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The obligate intracellular bacteria in the genus *Chlamydia* (C.) are globally widespread and represent pathogens that infect a wide range of animals as well as humans. At present, two chlamydial species were found to be associated with chickens, turkey and ducks, *C. psittaci* and *C. gallinacea*. Avian and zoonotic pathogenicity of *C. psittaci* is well documented for a long time. Being a new member of the family Chlamydiaceae since 2014, *C. gallinacea* became an emerging potential pathogen in chickens. A few studies showed its impact on poultry health and production performances, and its zoonotic potential. In this study, we summarized what has been researched so far on *C. gallinacea* in chickens based on our investigations and the published scientific literatures from 2014 to present. Based on published works, the prevalence rate of *C. gallinacea* in chickens ranges from 7.46-81.20% in Asia, Europe, and North America detected by quantitative polymerase chain reaction (qPCR) assay. In Croatia and in Bohol, Philippines, the prevalence rate is 46.30% and 75.00%, respectively. Two genomic studies uncovering the whole genome information were done for *C. gallinacea* strains 08-1274/3 from France and JX-1 from China. One study implicates *C. gallinacea* in the reduction of body weight in asymptomatic chickens. Moreover, its potential for being zoonotic was also revealed based on the study that shows the detection of *C. gallinacea* associated with the atypical pneumonia among poultry slaughterhouse workers. The above-mentioned reports suggest that *C. gallinacea* is an important emerging pathogen in poultry, thus, there is a need to further elucidate the pathogenicity and its zoonotic potential.

**Keywords:** *C. gallinacea*; avian chlamydiosis.

[P1-22]: Nutrition, gut health and feeds (ID: 120065)

[Greece]

## European COST Action CA15134 ‘GroupHouseNet’ for a successful transition to large group housing systems

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In laying hen industry, housing birds in large groups is associated with increased risks of damaging behaviours among the animals, such as feather pecking, aggression and cannibalism. The aim of this paper is to present the objectives, methodology and activities of the European COST Action CA15134 ‘GroupHouseNet’. The Action is a network of European scientists aiming to provide pig and poultry producers with innovations in breeding and management that are needed for a successful transition to large group housing systems without performing painful tail docking and beak trimming. Research focuses on three main topics, addressed by the three working groups: 1) Genetics and damaging behavior (WG1), 2) Pre- and postnatal effects on damaging behavior (WG2), and 3) Relationships between health and damaging behavior (WG3). More specifically, WG1 research focuses on the development of new techniques to measure relevant phenotypes (e.g. sensor technology) and investigate methods to link these sensor data to genomic data. Regarding prenatal effects (WG2), the network will review the effects of parental conditions on offspring behavior and explore the role of incubation conditions (light, noise, temperature) and early-life conditions in the development of damaging behavior. On the relationship between health and damaging behavior (WG3), interesting relationships are found between health and development of damaging behavior that merit further research. WG3 also explores the complex interplay between the immune system, the HPA-axis, microbiota, gut and brain. Recent activities supported by the project are have been Training Schools (Belgrade, 7-9 November 2016, Bilbao, 6-8 November 2017) and Short Term Scientific Missions of young researchers hosted by partner Institutions. Currently 30 European countries and the USA (as an international partner country) collaborate on the topic of reducing damaging behavior while new countries and new individual scientists are very welcome to join this open network.

**Keywords:** group housed hens; damaging behaviours; beak trimming; welfare.

[P1-23]: Nutrition, gut health and feeds (ID: 120093)

[Egypt]

## **Effect of *Spirulina platensis* algae (SPA) inclusion in broiler chicken diets on productive performance, lipid profile and calcium-phosphorus metabolism**

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(1, 2) poultry production

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Identifying high quality alternative replacements for soybean meal at a reasonable price is of importance in poultry production. *Spirulina platensis* algae (SPA) is a natural feed product with 40-45% crude protein (CP), 2.44% Calcium (Ca), and 6.27% Phosphorus (P). The effects of dietary inclusion of SPA on broiler productive performance, serum lipid profile, Ca and P content in serum and tibia bone was investigated. A total of 480 (Cobb 500) chicks were randomly distributed into 3 experimental groups with 4 replicates each of 40 chicks per replicate. Three diets with 0% (control), 3% (SPA3) and 6% (SPA6) replacement levels of soybean meal with SPA were formulated (Starter diet: 23% CP, and finisher diet: 20.5% CP). Body weight at slaughter age (day 42) and body weight gain (1-6 weeks) were significantly ( $P < 0.05$ ) and ( $P < 0.01$ ), respectively higher in SPA6 than the control group. The inclusion of SPA to broiler diet significantly ( $P < 0.05$ ) improved feed conversion ratio (1-6 weeks) compared to the control group. Serum levels of total lipid, triglyceride, cholesterol and low density lipoprotein (LDL) were significantly ( $P < 0.01$ ) decreased in both SPA groups as compared to the control group. Both SPA fed groups had a significantly ( $P < 0.05$ ) increased high density lipoprotein (HDL) whereas higher ( $P < 0.001$ ) Ca and P serum levels were observed in the SPA6 group as compared to the control group. Tibia ash Ca and P % were significantly ( $P < 0.05$ ) increased in both SPA groups. Economically, SPA3 and SPA6 total feed cost was reduced down to 90.1 and 94.4%, respectively of that of the control diet cost. Moreover, SPA3 and SPA6 diets improved the relative economic efficiency reaching 118.8 and 127.4%, respectively compared to that of the control. Results indicate that partial substitution of SBM by SPA can improve productive performance, serum lipid profile, and Ca-P metabolism of broilers chickens. Being a good source of Ca and P, SPA was also able to improve the structural strength of skeleton. Substituting SBM with 6% SPA in broiler diets resulted in an overall better economic efficiency.

**Keywords:** *Spirulina platensis*; algae; soybean meal; broiler performance; lipid; Ca; metabolism.

[P1-24]: *Nutrition, gut health and feeds* (ID: 120196)

[Iran (Islamic Republic of)]

## **Influence of dietary vitamin A levels on tibial dyschondroplasia in broiler chickens**

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Tibial dyschondroplasia (TD) is a disease that affects birds with accelerated growth. The condition is characterized by the presence of an unmineralized cartilage mass that extends distally from the growth plate of the metaphysis at the proximal end of the tibia and occasionally to the distal end of the tibia, proximal end of the tarsometatarsus and proximal ends of femur and humerus which results in bone deformity and lameness. It is a consistent observation that broilers and turkeys are most susceptible to development of TD under environmental conditions that maximize the growth rate and treatments that eliminate the occurrence of TD are those restrict growth. The symptoms can range from subclinical to severe bone deformities and lameness. The severity of the disease is usually scored on the basis of the size and location of the lesions. A range of nutritional, environmental and genetic factors may be cause TD. One of investigated nutritional factors is vitamins and their interaction. Although, vitamin A is considered to be essential for normal skeletal tissue development, this fat-soluble vitamin has been reported to cause a decrease in bone ash and an incidence in leg problems when fed at high levels. Apparently, pharmacological levels of vitamin A interfere with metabolism and utilization of the other fat-soluble vitamins. It is possible that interactions with vitamin D cause a decrease in calcium absorption and influence the development of TD in broilers. Also, vitamin A competitively inhibits utilization of the other fat-soluble vitamins such as vitamin D3.

**Keywords:** broiler; vitamin A; tibial dyschondroplasia.

[P1-25]: Nutrition, gut health and feeds (ID: 120195)

[Iran (Islamic Republic of)]

## **Efficacy of natural zeolite and glauconite dietary supplementation on carcass characteristics, gut pH and performance of broiler chickens**

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An experiment with 300 one-day old Ross male broiler chicks was conducted to determine the effects of glauconite and zeolite on the broiler's carcass characteristics, gut pH and performance. In this experiment, glauconite added for first time in broiler diet as new feed additive. Five experimental treatments [control, glauconite (2 & 4 percent), and zeolite (2 & 4 percent)] were used in a completely randomized design with 4 replicates. During the experiment energy efficiency ratio (EER), protein efficiency ratio (PER), European efficiency ratio (EEF) and European broiler index (EBI) were measured periodically. At 42 days of age, one chick per replicate was slaughtered to determine carcass characteristics and gut pH. Analysis of variance and separation of means by Duncan's multiple range tests were conducted by SAS software. The results indicated that adding zeolite and glauconite to diet do not affected EER, PER, EEF and EBI at total rearing phase ( $P>0.05$ ). Also, by adding 4% glauconite to diet, carcass percentage and breast relative weight was increased ( $P<0.05$ ) in relation to control and 2% glauconite group. For thigh relative weight, there were no significant differences between treatments ( $P>0.05$ ). Supplementation of diets with glauconite and zeolite did not have effect duodenum, jejunum and ileum pH at the end of experiment ( $P>0.05$ ). In conclusion, we can use glauconite on broiler diet without any side effect whereas some beneficial effects were seen in carcass characteristics.

Keywords: broiler; glauconite; zeolite; gut pH; carcass.

[P2-01]: Health/housing/miscellaneous (ID: 120014)

[Croatia (Hrvatska)]

## The length of collection period affects the estimate of total tract nutrient retention coefficients in broilers

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The aim of the study was to evaluate the effect of two collection periods, 48h and 96h on total tract dry matter (DMR), nitrogen (NR) and fat (FR) retention coefficients of three dietary treatments with different energy density when fed to broiler chickens. A basal diet containing 499.5 g/kg of wheat, 235.0 g/kg soybean and 100.0 g/kg of maize, as major ingredients, was mixed. The basal diet was then split into 3 batches and one of them was used as a control (Diet 1), a second lot had 100 g/kg of vegetable oil added (Diet 2), and the third lot had 100 g/kg of soy hulls added (Diet 3). The diets were fed as mash and did not contain any coccidiostat, antimicrobial growth promoters, prophylactic, or other similar additives. A flock of birds was reared in a common pen and fed a standard diet until 24 d of age. One hundred forty-four male Ross 308 broiler chickens were then randomly allocated to 48 raised floor pens (0.36 m<sup>2</sup>), giving three birds per pen, each diet being replicated 16 times. The birds were fed the experimental diets for 4 days adjustment period prior to their allocated collection period (48 hours (8 replicates per dietary treatment) or 96 hours (8 replicates per dietary treatment)). Water and food were supplied ad libitum throughout the study via a cup drinker. At the start of the collection period when birds were 28 d age, the solid floor of each pen was replaced with a wire mesh and all excreta were collected for 48, or for four 96 hours, respectively, immediately dried at 60°C and then milled. Feed intakes were also measured for the same period as excreta collection. Data were statistically analyzed by ANOVA using a 2 x 3 factorial arrangement of treatments. The main effects were the collection period (48 or 96 h) and the dietary treatment used. The determined DMR and NR for 48h collection period were higher compared to 96h collection period ( $P < 0.05$ ), 0.701 vs 0.682 (SEM=0.0054) and 0.591 vs 0.559 (SEM=0.0107), respectively. There was no difference ( $P > 0.05$ ) for FD regarding time of collection. Diet 2 had the highest DMD ( $P < 0.001$ ) and ND ( $P < 0.05$ ) coefficients, followed by diet 1 and diet 3, i.e. 0.727, 0.692, 0.656 (SEM=0.0066), and 0.600, 0.578, 0.549 (SEM=0.0131), respectively. Feeding high energy diets produced relatively high DMR and NR, although FR was also influenced by fibre supplementation. Diet 1 had lower FD ( $P < 0.05$ ) compared to diet 2 and diet 3, 0.847, 0.878, 0.881 (SEM=0.0092), respectively. There were no ( $P > 0.05$ ) collection period x dietary treatment interactions. There were no differences ( $P > 0.05$ ) in average daily bird feed intake. The results demonstrated that length of collection period has an impact on the estimate of dietary nutrient retention coefficients.

Keywords: nutrient retention; length of collection; broilers

[P2-02]: Health/housing/miscellaneous (ID: 120086)

[Turkey]

## **The effects of breeder's age on fertility, embryonic mortalities and poulthatching weight in bronz turkeys**

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This research was carried out with the aim of determining the effects of breeder age (according to peak stages) on the hatching characteristics of Bronz turkeys. A total of 450 turkey eggs were used in the study and the eggs were obtained from the same flock but at different age periods as pre-peak stage (35-36 wk, S-I), peak stage (45-46 wk, S-II) and post-peak (55-56 wk, S-III) period. The egg weight were 68.8, 77.4 and 82.1 g in S-I, S-II and S-III groups, respectively ( $P=0.001$ ). Hatchability of fertile eggs and hatchability of total eggs were found to be the highest in S-II group (89.6 and 80.7%, respectively,  $P<0.05$ ). The early, mid and late term embryonic mortalities were found to be higher in S-III group, with values of 5.1, 2.9 and 11.7%, respectively ( $P<0.05$ ). On the other hand, poulthatching weight was the highest in S-III group (56.6 g), compared to S-I (46.6 g) and S-II (53.5 g) groups ( $P=0.011$ ). The ratio of poulthatching weight and egg weight was lower in S-I group than S-II and S-III groups (67.8% vs. 69.2 and 69.0%,  $P=0.043$ ). In conclusion, hatching characteristics and poulthatching weight showed an alteration according to age of breeders flock. Turkey eggs from breeders at peak stage period (45-46 wk) would be offered to obtain better hatchability and poulthatching weight.

Keywords: hatchability; fertility; egg weight; embryonic mortalities; turkey.

[P2-03]: Health/housing/miscellaneous (ID: 120087)

[Turkey]

## **Relationship between yolk absorption and growth of chicks submitted to in-ovo glutamine injection**

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This study was carried out with the aim of determining the relationship between yolk absorption and growth of broiler chicks submitted to in-ovo glutamine injection. Eggs were obtained from Ross 308 at 36 wk of age with a range of 62-64 g. Fertile eggs (n=450) were weighed and randomly distributed into two groups as control and in ovo glutamine injection. On day 17th of incubation, half of eggs were injected with glutamine (40 mg glutamine) and the other eggs were used as un-injected control group. At hatching, chicks were randomly sampled to measure chick weight, yolk absorption, yolk free body mass and chick length. Significant positive correlations between chick weight and yolk free body mass ( $r=0.771$ ), relative yolk absorption and yolk free body mass ( $r=0.748$ ) were observed in control group. Chick length was significantly correlated with chick weight ( $r=0.653$ ), relative yolk absorption ( $r=0.514$ ), yolk free body mass ( $r=0.770$ ) and relative yolk free body mass ( $r=0.579$ ) in the control group. In in-ovo glutamine injection group, a significant positive correlation was observed between chick weight and yolk free body mass ( $r=0.990$ ). Also, relative yolk free body mass was significantly correlated with chick weight ( $r=0.511$ ), relative yolk absorption ( $r=0.711$ ) and yolk free body mass ( $r=0.627$ ). In conclusion, in-ovo glutamine injection changed the chick growth pattern by chick weight, yolk absorption, yolk free body mass and chick length.

Keywords: broiler; glutamine; in-ovo injection; chick length; yolk free body mass.



[P2-04]: Health/housing/miscellaneous (ID: 120091)

[Turkey]

## **The effects of heat and cold stress during late incubation period on embryonic development and yolk absorption in turkeys**

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The aim of this study was to determine the effects of heat and cold stress during late incubation period (after 25th day) on embryonic development and yolk absorption in turkeys. A total of 210 turkey hatching eggs were randomly divided into three groups as control, heat and cold stress before incubation process. 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. At d 25 of incubation, hot and cold groups were transferred to another hatcher where they were submitted to heat and cold challenge at 39.0-39.2°C and 35.0-35.2°C, respectively for 3h daily, until the end of the incubation period. After this challenge, eggs were returned to the first hatcher containing the control eggs. For control treatment, eggs were maintained at 37.0°C temperature and a relative humidity of 72% during hatching period. At the end of heat or cold challenge on day 25, 26 and 27 days of incubation, 15 eggs were randomly sampled from each group to measure yolk weight, embryo body weight and length. At d 25 of incubation, embryo development parameters were similar among the treatment groups. At d 26 and 27 of incubations, embryos in heat stress group had a lower yolk weight (14.2 and 10.5 g) and relative yolk weight (20.4 and 15.6%, respectively), compared to control and cold stress groups ( $P<0.05$ ). Also, a higher embryo weight and relative embryo weight were also observed in heat stress group at days 26 and 27 of incubation. These results showed that heat stress accelerated the embryo growth, whereas cold stress retarded yolk absorption and embryo growth compared to control treatment during late incubation of turkey eggs.

**Keywords:** turkey; heat stress; cold stress; yolk absorption; embryo growth.

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[P2-05]: *Health/housing/miscellaneous* (ID: 120175)

[Italy]

## **Evaluation of Astrovirus transmission in a Piedmont hatchery**

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Runting-stunting syndrome (RSS) is an enteric disease that causes significant economic losses to poultry producers worldwide. A wide variety of RNA and DNA viruses have been identified as agent of RSS. One of the most abundant viral family identified in RSS was the Astroviridae (Devaney et al., 2016, Smyth et al., 2017). Recently, chicken astrovirus (CAstV) strain has been associated with a hatchery disease, which symptoms and lesions resemble to RSS: lesions in the kidneys and liver, runting/poor development and weakness, and abnormal feathering. Moreover, an increase in mid to late embryo deaths and reduction in hatchability was reported (Smyth et al., 2013, Sajewicz-Krukowsk et al., 2016). In the light of this report, a vertical transmission was hypothesized. Taken in consideration all the data recently reported on CAstV, we focused our attention on a Piedmont (Italy) hatchery, where RSS problems were present in chicks. This hatchery is specialized in backyard poultry production (since 1956) and high quality industrial production (organic production, cockerel, slow growing chickens). The aim of this study was to evaluate the CAstV excretion in newborn chicks for one year. The paper used in chicks transport boxes was collected from two types of layer poultry farming: cage and cage free layer. In this last farm, we considered the chicks derived from egg collected from nests and from the ground. Moreover, the serological status of the breeders was evaluated by the application of an indirect ELISA test. At present, 100 paper and 114 sera were tested by real time PCR and by ELISA respectively. The excretion results (mean copy numbers of CAstV) showed no significant difference based on the type of layer farming or on nest/ground collected egg (ANOVA,  $p=0.2$ ). Indeed, a significant difference was observed based on the egg breeding origin ( $p=0.04$ ). These preliminary data indicate high copy numbers of CAstV, not associated to the breeding type, but to the infection of the breeders. This finding consolidates the hypothesis of CAstV vertical transmission but further analyses are necessary to better clarify the role of the hatchery in CAstV epidemiology.

**Keywords:** Astrovirus; chicks; hatchery; RSS.

[P2-06]: Health/housing/miscellaneous (ID: 120189)

[Colombia]

## Comparison of electrocardiographic components in Hy Line brown hens at 70 and 90 weeks of age

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In order to characterize the sympathovagal balance at different stages of life, 2 groups (70 vs 90 weeks old) of 24 clinically healthy Hy Line brown were subjected to an electrocardiography (ECG) test. The ECG records were made with Power Lab 26T, using Lab Chart Pro software, after standardization of the procedure with disposable electrodes. Records of ECG were taken within 2 minutes until homogeneous and uniform graphics were obtained. In lead II, SS interval, heart rate, amplitude (mV) and duration (s) of P wave, QRS complex and T wave were analyzed. The P wave measurement could not be performed in 16.5% of the records as it was fused with the T wave, so it was measured as a single TP wave. Heart rate variability (HRV) was analyzed in the time domain with standard deviation of SS (SDSS) and the root mean square successive differences (RMSSD); the analysis in the frequency domain was done with Low Frequency/High frequency ratio (LF/HF). Outputs were compared using Student's T test. As compared to the younger birds, the SS interval became significantly longer in the 90 weeks old birds whereas their heart rate decreased and the QRS complex showed a lower amplitude and duration ( $P < 0.05$ ). The other electrographic components analyzed in this study did not demonstrate a significant difference including indicators of HRV.

Keywords: electrocardiographic components; heart rate variability; stress indicators.

[P2-07]: Health/housing/miscellaneous (ID: 120207)

[Czech Republic]

### **Preliminary evaluation of the efficacy of an autogenous *Escherichia coli* vaccine in laying hens in field conditions**

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Acute colibacillosis is an emerging condition in laying hens and turkey breeders. Effective vaccination against avian pathogenic *E. coli* (APEC) may be an essential step for protection of poultry flocks depending on the region where they are raised. Our field study was partially blinded and parallel group designed. Group 1 included 24 000 laying hens vaccinated by Poulvac® (in spray, 2 times, at 12 and 20 weeks of age). Group 2 comprised 12 000 laying hens vaccinated by Poulvac® (in spray) and additionally with an autogenous *E. coli* vaccine via i. m. application before transfer to laying facilities (at 18 weeks of age). The efficiency of vaccination of both groups was assessed by evaluation of gross pathology lesions and by bacteriology findings. Based on pathology, the occurrence of polyserositis, yolk peritonitis and haemorrhagic septicaemia in Group 2, in comparison with Group 1, was found to be significantly decreased (20 vs. 44 %; 5 vs. 10 %; 5 vs. 10 %, respectively). The proportion of isolated serotype O78, among *E. coli* isolates, from Group 1 and Group 2 was 46 and 7 %, respectively. These preliminary results should be verified by future experimental studies.

Keywords: broiler breeders; colibacillosis; APEC; autogenous vaccine.

[P2-08]: Health/housing/miscellaneous (ID: 120142)

[Iran (Islamic Republic of)]

## **AMEn content of amaranth grain with or without enzyme in adult Leghorn roosters by regression method**

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This study was conducted to evaluate AMEn content of amaranth grain (*Amaranthus hybridus chorostachys*) with or without enzyme (0 and 250 mg/ton) in adult leghorn roosters by regression method. Two types of amaranth, Raw Amaranth Grain (RAG) and Autoclaving Amaranth Grain (AAG) in a 2×2×5 factorial arrangement based on completely randomized design (20 groups with 4 replications and 1 bird each replicates) were used. A corn based diet with 3000 kcal/kg metabolizable energy and 12 percent crude protein was formulated and substituted with 0, 15, 30, 45 and 60 percent of both RAG and AAG with or without enzyme. AMEn values of experimental diets determined with total excreta collection method. Also, AMEn content of each 20 samples were calculated by difference method and energy prediction equations were obtained. Results showed that mean content of AMEn for RAG and AAG were 2810 and 3195.75 kcal/kg, respectively ( $P \leq 0/05$ ). Gross energy has more accuracy and the best variable for predicting AMEn content of amaranth. The highest gross energy was observed for 45 and 60 percent of AAG with enzyme ( $P \leq 0/05$ ). Estimated values for RAG and AAG without enzymes for AMEn content were obtained 2723.49 and 2726.34 kcal/kg respectively. Also, AMEn estimates values for RAG and AAG with enzyme were obtained 2793.62 and 2824.60. The confidence limits (R2) for RAG and AAG without enzymes were 0.86 and 0.71. Furthermore, R2 for RAG and AAG with enzymes were 0.98 and 0.86 respectively.

**Keywords:** amaranth; AMEn content; regression method; rooster.

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[P2-09]: *Health/housing/miscellaneous* (ID: 120097)

[Saudi Arabia]

## **Outbreak of Avian Influenza-H5N8 in Saudi Arabia and its impact on domestic poultry industry**

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The Saudi poultry industry is producing poultry meat and eggs to cope up to 45 % and 100 % of nation's consumption, respectively. However, Saudi Poultry industry faces many challenges including disease out breaks which results in high mortality. The harsh climate with high temperature and very low relative humidity makes the poultry flocks, especially in their early age, an easy target for pathogens causing respiratory diseases, like Infectious Bronchitis, Mycoplasmosis, Infectious Coryza, and Avian Influenza. The broilers are more prone to such respiratory problems. Recently, the attack of avian Influenza H5N8 has been reported in Saudi commercial as well as backyard flocks. In December 2017, the H5N8 was reported in a flock of ducks near the capital, and then in a number of commercial broiler flocks. The presence of H5N8 in commercial broiler flocks, especially in the chicks hatched from imported eggs, has been reported. Many flocks showed respiratory symptoms associated with avian influenza even at day one of their age. The H5N8 seems not native to middle-east but to the Europe and Southeast Asia. The contaminated eggs, contamination in hatchery, poor biosecurity measures at farms, and migratory wild birds from Europe and Asia might be a potential source of introduction of H5N8 infection to Saudi Arabian poultry. The current outbreak of H5N8 is resulting into heavy financial losses to Saudi poultry producers. The zero-tolerance policy is adopted by the government to depopulate the infected flocks. On the other hand, local as well as international market has shrunk. The UAE and Kuwait – the main export markets for Saudi poultry industry – have banned the import of Saudi poultry products. The local consumption is also dropped due to the fear of potential zoonosis. To overcome this problem, a strict policy is needed to allow the import of hatching eggs. The rigorous screening for the disease like IB, AI, Mycoplasma, Salmonella etc., must be done to clear the imported shipments of broiler hatching eggs. Secondly, there is also a need to adopt strict bio-security measures to protect the commercial poultry flocks and to check the spread of infection.

**Keywords:** Avian influenza; H5N8; Saudi Arabia; poultry.

[P2-10]: Health/housing/miscellaneous (ID: 120099)

[Italy]

### **Mitochondrial diversity of two Nigerian indigenous chicken ecotypes**

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Many indigenous poultry breeds often represent a greater genetic resource in comparison with commercial strains. Advantages of raising indigenous chickens in Nigeria are notable; native chickens play an important role as household food supply in rural areas and they serve as fast means of bridging the protein deficiency and providing additional income to the generally resource-poor farmers, thereby helping to alleviate poverty. The aim of this study is to investigate on the extant genetic diversity of two native chicken ecotypes (Fulani and Yoruba) of Nigeria, in order to obtain a more comprehensive picture of these important genetic resources and their phylogenetic relationships. A total of 96 mitochondrial control region sequences (48 Fulani and 48 Yoruba) were assembled and aligned to the chicken reference mitogenome sequence. Mitochondrial DNA (mtDNA) sequence variation parameters were estimated and the evolutionary relationships among haplotypes were found through the construction of median-joining network. Eleven distinct mtDNA haplotypes were detected; 84.4% of the total sequences represented the predominant haplotype (identified in 41 Fulani and 40 Yoruba, respectively), while only three haplotypes were shared among the two ecotypes. Neighbor joining tree suggested that the sampled populations belong to the most common haplogroup E, therefore indicating that the studied indigenous chicken ecotypes originated from Indian sub-continent. These results lead to suppose that there is still the chance for conservation and improvement of Fulani and Yoruba indigenous chickens. Suitable conservation strategies must be planned out before their gene pool could be diluted by uncontrolled breeding with other exotic chickens.

Keywords: mitochondrial variability; phylogeny; genetic resources; local populations.

[P2-11]: Health/housing/miscellaneous (ID: 120162)

[Italy]

## **Carcass yields and breast meat composition of male and female Italian slow-growing chicken breeds**

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Carcass yields and chemical composition on the breast meat of two autochthonous Italian poultry breed, namely Bionda Piemontese (BP; n=64) and Bianca di Saluzzo (BS; n=64), were evaluated by a two-way ANOVA considering breed, sex and their interaction during four consecutive slaughter ages (5, 6, 7 and 8 months of age). Data were analyzed by one way ANOVA and Duncan test to investigate the differences between slaughter ages. Males showed heavier final live weight (LW; 2626 g), carcass weight (CW; 1522 g) and thigh yield (39.95%) than females (1872 g, 1026 g and 32.40%, respectively). Females displayed greater breast yield (19.11% CW on average) during the different slaughter ages ( $P < 0.001$ ) than males (17.03% CW on average). Breeds significantly affect carcass yield at the first (60.25 vs 58.49% LW in BP and BS, respectively), third (59.56 vs 56.70% LW in BP and BS, respectively) and fourth slaughtering (57.85 vs 54.97% LW in BP and BS, respectively) ( $P < 0.05$ ). Carcass yield of BS females showed the highest value at 5 and 6 months of age (59.03 and 57.58 % LW, respectively). Breast yield of the two breeds was influenced by the slaughter age and showed the lowest value at 6 months of age (59.57 % CW in BP and 57.58% CW in BS). Breast moisture, protein, ether extract (EE) and ash contents were not affected by breeds, except for ash at 6 months of age (1.18% vs 1.15 % in BP and BS, respectively) and EE at 8 months of age (0.43 % vs 0.28% in BP and BS, respectively). Sex influenced mainly moisture (on average 74.26% for males and 73.35% for females) and EE (0.27% for males and 0.82% for females on average). Slaughter age influenced mainly moisture and EE of breast meat with the highest values at 5, 6 and 7 months of age, respectively. Considering carcass parameters, slaughtering age at 7 and 8 months showed the best results in males and females of BP and males of BS. Five and six months were the best slaughter age in females of BS for carcass yield.

Keywords: breed; sex, Bionda Piemontese; Bianca di Saluzzo; carcass yield; ether extract.



[P2-12]: Health/housing/miscellaneous (ID: 120019)

[Iran (Islamic Republic of)]

## Evaluation of *Origanum vulgare* extract to improve egg production and egg quality in laying quails

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A total of 2500 one day old Japanese quail were obtained from a local commercial hatchery and raised over 43 weeks. On week 30, quails were selected according to their weight and egg production percentages and divided into the experimental groups. Experiment was conducted as a completely randomized design with 4 treatments (control, 0.04% bacitracin methylene disalicylate (BMD), 0.05 and 0.1% *Origanum vulgare* extract) of 10 replicates and 12 quails in each. Feed consumption and egg production were recorded daily on a cage basis, whereas BW was obtained at the start of 30 and at the end of 43 wk of age and body weight changes were calculated. The results showed that egg production, egg mass and egg shell percent in the group receiving *Origanum vulgare* 1% increased significantly. But the egg weight was significantly increased in the group receiving BMD. Feed intake significantly increased in the group receiving *Origanum vulgare* 1% and FCR significantly decreased in treatment 4. Studies showed that adding 0.1 and 0.05 percent of Oregano extract to layer hen diets improved significantly FCR and performance parameters [Lee et al., 2003]. Used oregano extract in laying hens diet had positive effects and improved the features of eggs [Abd EL-Motaal et al., 2008]. Conclusion: The results of this study demonstrated that using the *Origanum vulgare* extract at two levels (0.1 and 0.05%) did not affect the performance in laying quails.

Keywords: Japanese quail; egg production; egg quality.

[P2-13]: Health/housing/miscellaneous (ID: 120020)

[Iran (Islamic Republic of)]

## **Comparison study of *Origanum vulgare* ethanolic extract with bacitracin methylene disalicylate on blood biochemical and immune response of laying quails**

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A total of 2500 one day old Japanese quail were obtained from a local commercial hatchery and raised over 43 weeks of ages. On week 30, quails were selected according to the weight and the egg production percentages and divided into 4 groups. Experiment was conducted as a completely randomized design with 4 treatments (control, 0.04% bacitracin methylene disalicylate (BMD), 0.05 and 0.1% *Origanum vulgare* extract) of 10 replicates and 12 quails in each. Feed consumption and egg production were recorded daily on a cage basis, whereas BW was obtained at the start of 30 and at the end of 43 wk of age and body weight changes were calculated. Eggs were collected daily and the weight of all the eggs produced was determined per replicate. Quails were weighed individually before feed distribution at the beginning of the experimental period and at the end of week 43 and BW changes were calculated. Eggs were broken weekly and yolk weight measured after gentle rolling on paper towel to remove adherent white. Determined values were used to calculate fractional yolk weight. Egg quality was measured in two eggs per replicate chosen at random from eggs produced at 43 weeks of age. Eggshell breaking strength was measured with an eggshell force gauge (model-II, Robotmation Co. Ltd., Tokyo, Japan) and shell thickness with an ultrasonic thickness gauge (Echometer 1062, Robotmation Co. Ltd.). Haugh units were measured with automatic egg multi-tester equipment (EMT-5200, Robotmation Co. Ltd.). The *Origanum vulgare* extract significantly ( $P \leq 0.05$ ) decreased plasma cholesterol content and LDL levels and increased HDL concentration. Using the *Origanum vulgare* extract and BMD in diets improved antibody response against Newcastle disease (ND) and avian influenza (AI) significantly ( $P \leq 0.01$ ).

Keywords: Japanese quail; biochemical; immune response.

[P2-14]: Health/housing/miscellaneous (ID: 120108)

[Iran (Islamic Republic of)]

## **Genetic effects of VIP gene polymorphisms on reproductive traits of turkey hens**

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Vasoactive intestinal peptide (VIP), a neurotransmitter, is widely distributed in the body. Reports show that VIP plays important role in avian productive and reproductive traits. In the present study, polymorphisms of VIP and association of the SNPs with egg production, age of first egg, egg weight, laying period and brooding of Iranian indigenous turkeys were investigated. Genomic DNA of 130 turkeys was isolated from whole blood. A 433 bp of exon 6 and a part of 3'UTR of VIP gene (VIPe6) was amplified by standard PCR, using specific primers. Analysis of the results of PCR product sequencing showed a novel SNP, A5846G, of VIP gene. The frequencies of the genotypes were 0.85, 0.11 and 0.04 for AA, AG and GG respectively. The genotypes of VIPe6 showed significant associations with egg number, total egg weight, and age at first egg. The results showed that the AG genotype increased significantly egg number and total egg weight compared to AA turkeys ( $p < .05$ ). The GG turkeys also showed the highest age at first egg ( $p < .05$ ). No association between the VIPe6 variants and egg weight mean, weight of first egg, laying period and brooding was found. Overall, the genotypes of VIPe6 showed significant association with egg production traits and may be considered a candidate gene in selection programs of Iranian indigenous turkeys to improve egg production traits.

Keywords: vasoactive intestine peptide; SNP; egg production; brooding; turkey

[P2-15]: Health/housing/miscellaneous (ID: 120158)

[Korea, Republic of]

## Abundance of eggshell proteins affected by hen's age

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The primary objective of this study was to determine the effects of hen's age on abundance of eggshell proteins. Eggs were collected from hens kept in floor, fed the same formulation of feed, but with different ages of 180, 324 and 430 days. Egg quality was determined for egg weight, albumen height, Haugh unit (HU), yolk color, shell color, shell weight, shell thickness, and shell strength. Egg weight, shell color, shell weight, and shell thickness were increased in an age-dependent manner whereas albumen height and HU were decreased. No such changes were, however, observed in shell strength and yolk color. Proteins were then extracted from the eggshell of 15 eggs each age after the mineral portion was removed. SDS-PAGE and two-dimensional electrophoresis (2DE) were performed with the eggshell protein. Image analysis showed that hen's age affected abundance in eggshell proteins ( $P < 0.05$ ). Analysis with matrix-assisted laser desorption ionization (MALDI) - time of flight (TOF) mass spectrometry (MS)/MS identified 12 proteins. The results suggest that hen's age affects abundance of eggshell proteins.

Keywords: protein abundance; eggshell; hen's age.

[P2-16]: Health/housing/miscellaneous (ID: 120112)

[Iran (Islamic Republic of)]

## **Antibiotic susceptibility of potential probiotic *Lactobacillus* strains isolated from native poultry of Iran**

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The aim of this study was to determine the antibiotic susceptibility of 38 lactobacilli isolates with probiotic potential from native poultry of Iran. From the 38 isolated potential probiotic lactobacilli 26, 4, 3 and 5 isolates were belonging to *L. reuteri*, *L. johnsonii*, *L. crispatus* and *L. salivarius*, respectively. According to the EFSA vision all bacterial products intended for use as feed additives must be examined to establish the susceptibility of the component strain(s) to a relevant range of antimicrobials of human and veterinary importance. In this study all the *L. reuteri* isolates were susceptible to Ampicillin, Gentamicin, Kanamycin and Streptomycin. Three isolates of *L. reuteri* were resistant to Erythromycin and Chloramphenicol and four isolates were resistant to Clindamycin and Tetracycline. All the *L. johnsonii* isolates were susceptible to Ampicillin, Gentamicin, Streptomycin, Erythromycin. One isolate of *L. johnsonii* was resistant to Kanamycin and three isolates were resistant to clindamycin, Tetracycline and Chloramphenicol. All *L. salivarius* isolates were susceptible to, Gentamicin, kanamycin, Streptomycin, Erythromycin, Clindamycin and Chloramphenicol. One isolate of *L. salivarius* were resistant to Ampicillin and three of them showed resistance to Tetracycline. All the isolated *L. crispatus* strains were susceptible to Gentamicin, Streptomycin and Chloramphenicol and different isolated *L. crispatus* were resistant to Ampicillin, kanamycin, Erythromycin, Clindamycin and Tetracycline. According to the experimental results, all the isolates were phenotypically susceptible to Gentamicin and Streptomycin and the most phenotypic resistance was observed for Tetracycline. Among isolated lactobacillus, 15 (39.47%) isolates displayed single resistance and 8 (21.05%) isolates displayed multiple resistance for at least two and maximum four tested antibiotics. Our results demonstrate the presence of phenotypic antibiotic resistance in a number of potential probiotic bacterial isolated from native poultry of Iran. Therefore, due to the possibility of transferring antibiotic resistance genes, candidate bacteria for use as probiotics should be taken from phenotypically antibiotic-susceptible bacteria or after a survey the nature of the antibiotic resistance isolates with probiotic potential based on the EFSA (2012) protocol.

**Keywords:** antibiotic susceptibility; phenotypic resistance; probiotic potential; *Lactobacillus*.

[P2-17]: Health/housing/miscellaneous (ID: 120138)

[Italy]

## **Precision livestock farming in poultry: a bibliometric study.**

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Nowadays several devices using different technologies are available in the market in order to help farmers with decision making using a continuous automated monitoring of their animals. These technologies are known as Precision Livestock Farming (PLF). This study aims to look at the relevance of PLF in research by analyzing the published papers. SCOPUS ([www.scopus.com](http://www.scopus.com)) and ISI Web of Knowledge (WoK) ([www.webofknowledge.com](http://www.webofknowledge.com)) data bases were used on this analysis. Results of data query terms in article title, Abstract and keywords field in the case SCOPUS and topic field in the case of Wok, and during the period from 1990 to 2018, were downloaded for further analysis. The analysis of data using the R package Bibliometrix revealed a total of 226 scientific papers published in 156 sources. During the period 1993-2004 the number of publications ranged between 1 and 4 papers/year. While in 2005 the number of publications was 14 papers and reached a maximum of 26 papers in 2015. During the last year, 25 papers were published about PLF in poultry. The analysis of words used in title, abstract or keywords revealed that sensors monitoring environmental parameters such as ammonia and temperature were more studied than those for monitoring animal welfare or animal health. Similar results were observed when co-occurrence analysis of title and abstract contents and author keywords were done. The most relevant sources are papers published in technological journals as Computers and Electronics in Agriculture. In addition, results of analysis of sources coupling and title content co-occurrences networks revealed that PLF field is still under development from the technological point of view. This could explain the importance of technological journals as sources of PLF studies. Animal Production and/or Agriculture sources such as Poultry Science are less referred, and that could be explained by the lack of studies confirming or validating the usefulness of PLF. The impossibility to download data from other bibliographic resources (i.e. google scholar) could represent a limitation of this type of studies, but we can consider that the two data bases used in this study include a large part of published scientific peer-reviewed papers.

**Keywords:** poultry; precision livestock farming; bibliometric.

[P2-18]: Health/housing/miscellaneous (ID: 120139)

[Italy]

## Effect of regrouping on welfare of two Italian autochthonous breeds

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Italian autochthonous avian breeds. 110 chicks of Bionda Piemontese (N=55) and Bianca di Saluzzo (N=55) were reared homogeneously for 12 months divided in 5 subgroups for each breed, 10 females and 1 male for each. In this phase, birds were reared in pen (2.2 x 3.5m) with outdoor access (2.2 x 4.5m). At the age of 12 months, birds were regrouped on breed basis in two pens with same previous animal density by removing the internal fences between indoor and outdoor pens. Tonic immobility duration (TI) and heterophil to lymphocyte ratio (H/L) were evaluated at 1 week (T0) before and 3 (T3), 15 (T15) and 30 (T30) days post regrouping. Split-plot repeated measure ANOVA was used to examine differences using one within-subject variable (time of sampling) and one between-subject variable (breed and sex) and considering the interaction between these main effects. Effect of regrouping was significant only for time, whereas neither breed nor sex and their interaction showed significant differences. In particular, TI showed lower value at T0 (101.61±60.76 sec, P<0.05) and greater values at T3, T15 and T30 (175.97±21.72 sec, 157.29±45.56 sec and 152.35±48.32 sec, respectively); this trend confirmed that social stress after regrouping occurred. Respect to H/L ratio, at first (T0) and final (T30) evaluations similar values were found (0.81±0.30 and 0.86±0.31, respectively), while the highest value was showed at T15 (1.09±0.35, P<0.05); regard to T3 this value was found equal to T0 and T15 (0.94±0.51). As for TI also, H/L confirmed that regrouping produced social stress, being evidenced by the increasing ratio at T15; after the establishment of new social hierarchies (T30), this stress was solved producing the reduction of H/L ratio. In conclusion, after regrouping social stress occurred, independently by breed and sex, but during time the effect of social stress on TI and H/L was different; in fact, after 30 days birds reacted positively in terms of increased lymphocytes production, whereas under behavioral point of view birds still showed fear.

Keywords: autochthonous poultry breeds; regrouping; welfare parameters.

[P2-19]: Health/housing/miscellaneous (ID: 120115)

[France]

## **Improvement of zootechnical performance in broilers raised in standard farm conditions and supplemented with *Saccharomyces cerevisiae boulardii***

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The evaluation of zootechnical performance and health status is the major parameter investigated on farms to assess the final technico-economic performance of broilers batches. It has been demonstrated previously that specific probiotic yeast, *Saccharomyces cerevisiae* var. *boulardii* CNCM I-1079 (Levucell SB (LSB), Lallemand), is able to reduce the incidence of *Salmonella*/*Campylobacter* challenge or intestinal necrotic enteritis on birds' performance and to limit the negative impact of *Clostridium perfringens* development. This probiotic has a triple effect in the intestine by impacting positively gut microflora, intestinal wall structure and by stimulating natural defense mechanisms. The objective of this study was to assess zootechnical performance of broilers supplemented with LSB (incorporated into pelleted feed, 109 cfu/kg feed) during 35 days in standard farm conditions. 208 Ross PM3 mixed-sex broilers were randomly allocated to 2 batches (control and LSB) and housed in 1m<sup>2</sup>-pens (104 birds per batch separated into 8 pens of 13 animals each). Feed and water were provided ad libitum and the feeding program was composed of 3 diet phases: starter (0-10d), grower (10-25d), finisher (25-35d). The resistance of LSB to pelleting process was also investigated by CFU plate counting. All bird weights were recorded at placement (day 0) and bird weights and feed intake were recorded by pen on days 10, 25 and 35. Average daily gain (ADG) and feed conversion ratio (FCR) were then calculated for starter, grower and finisher phases and for the whole period (0-35d). An unexpected viral challenge (infectious bronchitis virus, IBV) occurred in finisher phase. LSB improved the bodyweight at D35 by 2.7% compared to control group ( $p < 0.1$ ). ADG was increased in starter (+4.8%), finisher (+27.8%,  $p < 0.1$ ) and for the whole period (+9.4%,  $p < 0.1$ ) with LSB. FCR also benefited from LSB supplementation in starter (-1.5%), finisher (-33.7%,  $p = 0.1$ ) and for the whole period (-7.1%,  $p < 0.1$ ). LSB induced better weight homogeneity (lower CV%) at D10 (-2.6%), D25 (-2.3%) and D35 (-1.6%) (starting with higher heterogeneity than control group at D0: +0.9%). LSB induced better resistance to IBV contamination ( $p = 0.1$ ): 30 animals died during the trial (19 in control group: 18.3%; 11 in LSB group: 10.6%). In conclusion, LSB supplemented birds showed an improvement of all parameters investigated compared to control group.

**Keywords:** *Saccaromyces cervisiae boulardii*; performance; broilers.



[P2-20]: Health/housing/miscellaneous (ID: 120160)

[South Africa]

## Genetic diversity assessment and origin estimation of Kwa-Zulu Natal native chickens using mitochondrial DNA

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Commercialization of breeding in chickens has gradually favored the use of high productive exotic breeds and consequently led to lower population sizes of indigenous, low performing native breeds. South African local chicken populations are no exception to that. Indigenous chickens (*Gallus gallus*) are recognized as an important component of the rural household livelihood by providing a source of income. Furthermore, these breeds have a very important feature, which is being able to convert available feed around village into highly nutritious, well-appreciated and good quality meat and eggs. Characterization of these important chicken genetic resources can be the first step for their effective management and utilization, which will facilitate their conservation. The objective of the present study is to investigate the mitochondrial genetic diversity of five Kwa-Zulu Natal indigenous populations in order to reconstruct their maternal origins and develop appropriate tools and strategies to safeguard the current genetic diversity. A sequence analysis of the mtDNA control region (from np 1 to 550 np) was performed on a total of 62 samples (14 Jozini, 13 Pietermaritzburg, 11 Portshepstone, 12 Ladysmith, and 12 Newcastle). The average nucleotide diversity was  $0.009 \pm 0.003$  across the five chicken populations studied; the haplotype diversity ranged from a minimum of 0.527 (in Jozini) to a maximum of 0.848 (in Ladysmith) with an average value of  $0.626 \pm 0.141$  in all the sample. Results suggested that the sampled populations belong to two haplogroups: one is the most common haplogroup E and the other one is B. The presence of the haplogroup E could indicate that the studied indigenous chicken populations originated from Indian sub-continent. The second haplogroup B was the most common in purebred broiler and layer lines and some Northwest European native chickens. This clade was very rare in African chickens and could demonstrate the introgression in the local population of high productive exotic breeds, that the farmers are using in crossbreeding practices. These results highlight that plans for improvement and conservation of Kwa-Zulu Natal native chickens are requested. Suitable conservation strategies must be planned out before their gene pool could be diluted by uncontrolled breeding with other exotic chickens.

Keywords: mitochondrial variability; phylogeny; genetic resources; local populations.

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[P2-21]: *Health/housing/miscellaneous* (ID: 120122)

[Italy]

### **Stunted Chick Syndrome in a psittacine species – a case report**

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Runting and stunting syndrome is a transmissible disease of uncertain aetiology affecting poultry (broiler chickens) early in life, characterized by growth retardation, ruffled feathers, and diarrhoea, resulting in considerable economic losses. Due to the absence of a known aetiology, identification of the disease is commonly based on clinical signs related to malabsorption. This syndrome is also reported in ornamental birds such as parrots. This case reports a 5-month old Gold and Blue Macaw (*Ara ararauna*) showing different clinical symptoms and poor growth, compared to the other chicks of the same clutch, born after artificial incubation and kept in the same manner. The main clinical symptoms were related to a gastro-intestinal disorder with intermittent regurgitation, diarrhoea and an obvious poor nutrition state. Dermatological signs like crusty skin lesions in the flat portion of both paws, stress-line and slow growth of the plumage were also reported. The breeder suspected dwarfism or other hereditary defects. Microbiological investigations, by sampling of crop, showed the presence of *E. coli* and *Shigella* spp. in high quantity, suggesting a multi-bacterial infection, complicated by the presence of *Candida albicans*. The antifungal and antibiotic treatments rapidly resolved the clinical symptoms but did not solve the persistent growth problem compatible with a Stunted Chick Syndrome. Even if many studies on this disease are reported in chickens and turkeys, further studies need to be performed in parrots, in order to better clarify the etiopathogenesis of this syndrome.

**Keywords:** macaw; neonatal disorder; stunted chick syndrome.

[P2-22]: *Health/housing/miscellaneous* (ID: 120136)

[Spain]

### **PP.AVA.AVA201601.16 Project. An initiative for the characterization, rescue and valuation of the Utrerana chicken breed**

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Utrerana chicken breed is one of the most ancient Mediterranean chicken of Spain. The four varieties forming the breed (Perdiz, Negra, Franciscana and Blanca), reached a high development in the middle of the 20th Century, then their census started to decrease displaced by the expansion of the commercial hybrids and the extreme intensification of the poultry production. At the end of the nineties, the breed was seriously endangered and its extinction was saved by the interest of a breeder who used these animals for shows and standard concourses. Recently, national and regional institutions, with the support of EU, funded an ambitious project to do a within and between-breed genetic characterization. The double purpose (eggs, meat) functional characterization, the valuation and breed traceability of the products, and the creation of permanent structures (hatcheries, nurseries, etc) in order to promote the conservation and development of this and other local breeds. A first action is centered in the analysis of a set of 30 microsatellites in 256 biological samples to characterize the breed and define the internal substructure of the breed (varieties). Furthermore, a tool for assignment of individuals to the breed is under development to be used in the traceability of the products, according to the Spanish rules. On the other hand, a functional characterization is ongoing in a closed nucleus including all varieties. For this purpose, egg production is being controlled in two sets of 50 hens per variety, recording both quantitative and qualitative characteristics of the eggs. At the same time, two sets of 40 both sexes animals for each variety are under growth recording. Additionally, two trans-variety sets of castrated males are also inside the growth recording. Quali-quantitative characteristics of the eggs and the meat are being employed in the definition and differentiation of the breed products to support the development of a specific protected trade mark. Finally, the intention of the project is to use their infrastructures as the base for permanent hatchery and nursery to disseminate the breed and other local chicken breeds.

**Keywords:** local breeds; microsatellites; eggs; meat; productive performance.

[P2-23]: *Health/housing/miscellaneous (ID: 120188)*

[Iran (Islamic Republic of)]

## **Performance, antioxidant status and immune response of Hyline W36 laying hens fed Organomin-Forte**

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In order to investigate the effects of Organomin-Forte on the performance, antioxidant status and immune response of laying hens, an experiment was carried out using two hundred White Leghorn W36 laying hens (55 weeks old) in a completely randomized design manner with 2 experimental treatments, 5 replicates and 20 hens per replicate. Experimental treatments were 1: control and 2: Organomin-Forte (0.035%), which were fed to hens for 3 periods of two weeks each and 42 days in total. Organomin-Forte was into the diet along with existing inorganic mineral sources. Data on all studied parameters were recorded, calculated and presented at the end of the each period. Results showed that using Organomin-Forte improved the overall performance traits including feed conversion ratio, egg weight, egg quality, shell weight and egg specific gravity and serum oxidant activities such as glutathione peroxidase, superoxide dismutase, vitamin E and selenium compared to control group, significantly ( $P < 0.05$ ). Based on the obtained results, application of Organomin-Forte can be recommended in the diet of commercial laying hens.

**Keywords:** antioxidant activities; immune status; performance; laying hens.

[P2-24]: Health/housing/miscellaneous (ID: 120201)

[Argentina]

## **Replacement of antibiotics in feed by a blend of Quebracho and chestnut extracts preserves broiler productivity and improves gut health**

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The removal of antibiotic growth promoters (AGPs) from animal diets has resulted in search for alternative which are cost effective. A blend of hydrolysable and condensed tannins (Silvafeed® Nutri-P), derived from the Italian Chestnut (*Castanea sativa*) and Argentinean Quebracho (*Shinopsis lorenzii*) has been shown to improve productive parameters and prevent infectious disease, e.g., necrotic enteritis, under different commercial conditions. The objective of the study was to compare a “standard” commercial AGP (COM) and a program replacing AGP with Nutri-P added at 0.1% in the diet. Three of 6 tunnel ventilated commercial broiler houses (20,000 birds) were assigned to COM (AGP rotation) and other three to Nutri-P. This assignment was kept during 7 production cycles. Complete necropsies were performed in 10 birds from each treatment at 21 and 35 or 42 days of age in each cycle, and footpad and intestinal lesions were analyzed. Caecal contents were taken and microbiota analysis was performed by 16S sequencing. Body weight (BW) and mortality (MR) were obtained weekly and feed consumption was obtained at the conclusion of each cycle. Average body weight (BW), feed intake (FI), and mortality-corrected feed conversion ratio (FCR) were calculated. Averaged over the seven cycles, intestinal health was improved by the addition of NP. The severity and the number of animals with gross intestinal were reduced by Nutri-P. The number of animals with duodenal lesions were not statistically different between treatments (COM: 6.6%; Nutri-P: 4.4%) but significant differences ( $p < 0.05$ ) were observed in number of animals with jejunal (COM: 18.8%; Nutri-P: 12.2%) and ileal lesions (COM: 6.6%; Nutri-P: 3.3%). Footpad lesions observed during necropsy were reduced by the use of Nutri-P ( $p < 0.05$ ). Intestinal morphology was improved by Nutri-P as birds showed higher villus height/crypt depth ratio ( $p < 0.05$ ). No differences were observed in performance. However, BW was 2.72 % higher in Nutri-P fed birds, without increasing FCR. Total mortality and 1° week mortality were reduced (8.28 % and 10.76% respectively). The average Production Efficiency Factor was 1.4 % higher on Nutri-P treated birds. These results suggest that addition of Nutri-P can be an alternative for a healthy and sustainable poultry production.

**Keywords:** antibiotic alternatives; quebracho; chestnut; broilers.

[P2-25]: Health/housing/miscellaneous (ID: 120202)

[Argentina]

### **Efficacy of quebracho and chestnut extracts to control *Salmonella* in poultry.**

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*Salmonella* infection is a major cause of bacterial enteric illness in both humans and animals; and this food-borne microorganism is usually associated with poultry production. Among other measures, antimicrobials are traditionally used to control *Salmonella* which provides a selection pressure resulting in the selection and spread of resistant microorganisms. Therefore, new alternatives to antimicrobials are needed to guarantee the safety for the consumers. The aim of this study was to determine the activity against *Salmonella* of chestnut or quebracho tannins and their efficacy to control the pathogen. The minimal inhibitory concentration (MIC) for both tannins was determined by broth microdilution method on 15 *Salmonella* strains isolated from poultry. MIC values for chestnut were of 2 mg/mL in all tested strains whereas MIC for quebracho ranged from 4 to 1 mg/mL. In addition, an augmented inhibitory effect on *Salmonella* was observed when both tannins were combined. The efficacy of the tannins to reduce the excretion of *Salmonella enteritidis* was assessed in an experimental infection model in 1-day old broiler chicks. Groups of 15 chickens were fed from the first day of life with regular feed added with 0.1% of chestnut, quebracho or a blend of both tannins. A control group of non-treated birds was also included. At day 6, chickens were individually challenged by oral gavage with 10<sup>7</sup> CFU of *S. enteritidis* and individual samples were taken by cloacal swabbing at the 5th and 12th day post-infection (dpi) to determine the excretion of the microorganism. In the control group, 70.5% and 82% of the birds were positive for *Salmonella* at the 5th and 12th dpi respectively. Significant reduction of the excretion of the pathogen was only observed when the birds were treated with quebracho tannins: 23% at the 5th dpi ( $P < 0.05$ ) and 30.7% at the 12th dpi ( $P < 0.01$ ). The results show that while both tannins have in vitro inhibitory activity against *Salmonella*, but only quebracho tannins were effective to reduce the excretion. Future studies should evaluate the efficacy of quebracho and other tannins additives to evaluate the future applications of these natural compounds to control the food-borne microorganisms.

**Keywords:** *Salmonella*; tannins; chestnut; quebracho.

[P2-26]: Health/housing/miscellaneous (ID: 120208)

[Algeria]

## **An investigation on the predominant diseases, its diagnosis and commonly used drugs in the poultry farms in the North-Eastern regions of Algeria**

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An investigation was carried out to assess the occurrence of diseases, its method of diagnosis and commonly used drugs in poultry farms in North-eastern regions of Algeria. A total of 265 veterinary doctors were surveyed to obtain information on the dominant diseases, its frequency of occurrence, method of diagnosis and commonly used drugs in poultry farms. Study revealed about 68% of bacterial diseases are due to colibacillosis, mycoplasmosis, tandemic salmonellosis, 22% of viral diseases are due to Newcastle, Gumboro, Infectious bronchitis and 10% others including coccidiosis and ascites syndrome. The study also showed that about 57% of cases were diagnoses by clinical signs, 36% by necropsy findings and remaining 7% through therapeutic and laboratory analysis. Antibiotics, a predominance of the anarchic veterinary drugs were massively used to control the diseases. Hence, there is a need for strict regulations on the use of veterinary drugs in order to guarantee food safety. These results remain non-exhaustive but contribute strongly to determine the state of health of the birds in the region.

**Keywords:** Algeria; poultry; diagnosis; pathology; veterinary drugs.



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