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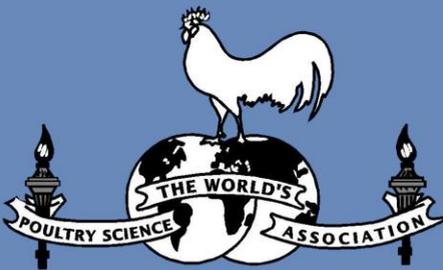
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**ASOCIACIÓN
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(AECA - WPSA)**

Book of

ABSTRACTS

Splitfeeding

La alimentación más eficiente y sostenible

que mejora la calidad de la cáscara

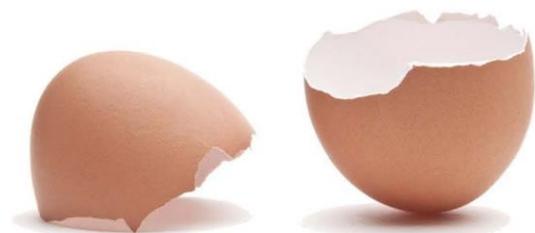
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**7th Mediterranean Poultry Summit
Of the Mediterranean Poultry Network of the WPSA
Cordoba - Spain
June 08 – 10, 2022**

Book of abstracts

**Poultry Mediterranean Network of the WPSA
Mediterranean Poultry Science Journal**

Editors

C. Garcés Narro, J. A. Játiva and G. Sayegh

Hosted by the:

**AECA - WPSA: Asociación Española de Ciencia Avícola
Spanish Branch of the World's Poultry Science Association**



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Email: secretaria@wpsa-aeca.es

Website: www.mpn-wpsa.org

Welcome to the 7th MPS



As Chairman of the Scientific Committee of the 7th Mediterranean Poultry Summit of the WPSA, I want to welcome all attendees to this event.

The Mediterranean Poultry Summit (MPS) is one of the major events of poultry science in 2022. After two years of postponements, delegates from more than 30 countries meet in Córdoba to share their research work and scientific and technical experiences.

This MPS builds on previous successful summits in Chalkidiki (Greece, 2008), Antalya (Turkey, 2009), Alexandria (Egypt, 2012), Beirut (Lebanon, 2014), on a cruise on the Italian-Spanish-French Sea (2016) and Turin (Italy, 2018).

The Scientific Committee has prepared an interesting high-level scientific program with more than 15 invited speakers from all over the world, but mainly from the Mediterranean area, who give the keynote lectures. The selected topics reflect the challenges of current poultry concerns, with a special focus on Reproduction, Genetics, Economy, Management, Nutrition, Pathology, Food safety and Product quality. We hope that this multidisciplinary approach allows the poultry experts to discuss the latest scientific findings and to work on a practical application.

Industry, producers, researchers, university professors and students are present at the Summit. The place of students interested in poultry sciences is essential because they are the future. That's why two specific workshops have been prepared for them.

In addition, almost 160 short communications (in oral or poster presentation) have been chosen by the scientific committee; they are those published in this book of abstracts. The selected works have a high scientific quality, which makes this biennial event one of the best in world poultry science.

This edition of the MPS has been organized by the Asociación Española de Ciencia Avícola (Spanish branch of the WPSA) and the Universidad de Córdoba. Both institutions have provided great support to achieve a successful meeting. In addition, scientific success would not be possible without the hard work of organizing and local committees. Sponsors are also crucial in organizing this event. They all deserve my greatest recognition and gratitude.

We are looking forward to a very successful summit with the participation of many attendees of the Mediterranean region and beyond.

Sincerely,
Prof. Carlos Garcés-Narro.

Chairman of Scientific Committee of the 7th MPS of WPSA.

Welcome message of the Mediterranean Poultry Network



As President of the Mediterranean Poultry Network (MPN), I would like to extend to all participants of the 7th MPS my heartiest welcome.

This summit, arriving after two years of world pandemic disease of COVID-19, represent a re-born of our scientific community and it will held at CORDOBA CONFERENCE AND EXHIBITION CENTRE (C/ Torrijos, 10, 14003, Cordoba, Spain) at June, 8-10, 2022.

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 Mediterranean region and to spread knowledge in the poultry sciences through education, research and services.

I want to take this opportunity to thank the Spain Branch of WPSA for hosting this summit, especially the president and all his colleagues for all their hard work for making this 7th summit a success. I also want to thank all members of the scientific committee, headed by Prof. Carlos Garcés Narro, all members of the organizing committee, headed by Juan Antonio Játiva, and Ghassan Sayegh from the Mediterranean Poultry Summit steering committee for a very well-done job. We expected a very large and qualified participation.

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.

Martino Cassandro,

President of the Scientific Committee of the 7th MPS of WPSA

Bienvenida del Comité Organizador Local



Con una demora de más de dos años debido a las circunstancias sanitarias derivadas de la pandemia que azotó al planeta y que obligó a la humanidad a tomar conciencia de la importancia que tiene la salud y la solidaridad entre pueblos, ha llegado la hora de la celebración de la 7ª Cumbre Avícola Mediterránea.

Esta cumbre constituye uno de los acontecimientos de mayor relevancia en el sector avícola del año 2022. Se celebrará en Córdoba los días 8, 9 y 10 de junio. Siguiendo los patrones anteriores, esta séptima convocatoria pretende acercar hasta nuestro entorno a todos aquellos industriales, investigadores, profesionales, docentes y estudiantes que tengan alguna contribución con respecto a los problemas que afectan a los sectores avícolas de nuestra región, siendo este un foro de exposición y discusión en el que se pueden mostrar los avances en este campo.

Quiero agradecer a la WPSA y a la AECA su ofrecimiento para la organización de la cumbre en nuestra ciudad, de la mano de la Universidad de Córdoba. No cabe duda que los escenarios en los que se va a desarrollar serán del agrado de los participantes. Por último, deseo invitar a todos a disfrutar de Córdoba, una ciudad milenaria por la que han pasado muchos pueblos y en la que han llegado a convivir las culturas judía, musulmana y cristiana, lo que le ha valido la denominación de la Ciudad de las Tres Culturas. Sin duda, podréis deleitaros con la arquitectura, gastronomía y la calidez de sus gentes.

Es deseo de este Comité Local que disfruten al máximo de esta reunión y que vuestra estancia en Córdoba sea agradable y provechosa.
Gracias a todos.

Un afectuoso saludo,

Prof. Dr. Rafael Gómez Díaz
Presidente del Comité Organizador Local
Universidad de Córdoba

A handwritten signature in blue ink, appearing to read 'Rafael Gómez Díaz', written over a horizontal line.

**Welcome message of the
Local Organizing Committee of the
7th Mediterranean Poultry Summit**



With a delay of more than two years due to the health circumstances derived from the pandemic that hit the planet and forced humanity to become aware of the importance of health and solidarity between peoples, the time to celebrate of the 7th Mediterranean Poultry Summit has come.

This summit is one of the most important events in the poultry sector in 2022. It is going to be held in Córdoba on June 8, 9 and 10. Following the previous patterns, this seventh edition aims to get closer all those researchers, professionals, professors, students, and companies who have some contribution regarding the problems that affect poultry of our region. This event is meant to be an exhibition and discussion forum in which advances in this field will be shown.

I want to thank the WPSA and the AECA for their offer to organize the summit in our city, hand in hand with the University of Córdoba. I have no doubt that the backdrops in which the MPS is going to unfold will be liked by the participants.

Lastly, I would like to invite everyone to enjoy Córdoba, a millennial city through which many peoples have passed and in which Jewish, Muslim and Christian cultures have come to coexist. Córdoba has gained the name of the City of Three Cultures. Without a doubt, you will be able to delight yourself with the architecture, gastronomy, and the warmth of its people.

It is the wish of this Local Committee that you enjoy this meeting to the fullest and that your stay in Córdoba be pleasant and profitable.

Thank you all.

Warmest regards,

Prof. Dr. Rafael Gómez Díaz
Chairperson of Local Organizing Committee
University of Córdoba

A handwritten signature in blue ink, appearing to read 'Rafael Gómez Díaz', written over the printed name and title.

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Program Outlook

CÓRDOBA CONFERENCE AND EXHIBITION CENTRE

Wednesday 08 June 2022

10h00	15h00	Registration		
15h00	16h00	Plenary Session I Auditorio Embajadores	<i>Slot K1 - Poultry Economics</i>	
16h00	17h00	Plenary Session II Auditorio Embajadores	<i>Slot K2 - Reproduction and genetics</i>	
17h00	18h30	Poster Session I Patio Medina Azahara	<i>Slot P1</i>	Parallel sessions
17h00	18h30	Oral Session II Auditorio Embajadores	<i>Slot O2 - Reproduction and genetics</i>	
17h00	18h30	Oral Session III Sala Julio Romero de Torres	<i>Slot O3 – Quality of products</i>	
19h00	20h00	Mosque-Cathedral visit		
20h30	22h00	Opening Session and Ceremony (Welcome Cocktail) –Caballerizas Reales de Córdoba		

Thursday 09 June 2022

09h00	10h00	Plenary Session III Auditorio Embajadores	<i>Slot K3 - Poultry nutrition and alternative feed additives</i>	
10h00	10h30	Plenary Session IV Auditorio Embajadores	<i>Slot K4 - Poultry environment and management</i>	
10h30	11h00	Coffee break		
11h00	13h30	Workshop III Auditorio Embajadores	<i>Slot W3 - Poultry environment</i>	Parallel sessions
11h0	13h30	Oral Session IV Sala Julio Romero de Torres	<i>Slot O4 - Poultry Health</i>	
11h00	13:30	Poster Session II Patio Medina Azahara	<i>Slot P2 – Poultry nutrition and management</i>	
13h30	15h00	Lunch break		
15h00	16h00	Plenary session V Auditorio Embajadores	<i>Slot K5 - Poultry Health</i>	
16h00	18h00	Workshop IV Auditorio Embajadores	Round Table: Cooperation among Mediterranean countries in managing diseases	Parallel sessions
15h30	18h00	Oral session V S. Julio Romero de Torres	<i>Slot O5 - Poultry Nutrition</i>	
16h00	18h00	Poster Session III	<i>Slot P3 - Housing, Management, and quality of products</i>	
18h00	19h00	General assembly AECA		

20h30 23h00 Gala Dinner – Real Círculo de la Amistad**Friday 10 June 2022**09h00 10h30 Plenary Session VI *Slot O6 Food safety and quality products*

Auditorio Embajadores

10h30 11h00 Coffee break

11h30 13h00 Workshop V *Slot W5 Meat Quality*
Auditorio Embajadores11h30 13h00 Oral session VI *Slot O6 Poultry Nutrition*
Sala Julio Romero de Torres11h00 13h00 Poster Session IV *Slot P4 Poultry Health*
Patio Medina Azahara

Parallel sessions

13h00 14h30 Lunch break

14h30 15h00 Plenary session VII *Slot K7 Poultry Genetics*
Auditorio Embajadores15h00 15h30 Plenary session VIII *Slot K8 Poultry Health*
Auditorio Embajadores15h30 17h30 Oral session VII *Slot O7 Poultry Health and Food Safety*
Auditorio Embajadores15h30 17h30 Oral session VIII *Slot O8 Environment and Management*
Sala Julio Romero de Torres

Parallel sessions

17h30 18h00 **Closing ceremony**



Keynote Speakers
(In alphabetical order)

Xavier Asensio**Nutritionist at Aviagen**

Presentation **Feeding fibrous diluted diets to broiler breeder pullets.**
Title
Session III **POULTRY NUTRITION AND ALTERNATIVE FEED ADDITIVES**
Slot **K3-02 - Thursday 09 June - 09:30 - 10:00**

Xavier ASENSIO works as a Nutritionist at Aviagen, providing support in the TMEA area. Graduate in Veterinary, Animal Production specialty (Universidad de Zaragoza. Spain). Master of Science, Specialization in Poultry Production (CFPPSA. France). Ph.D. in Veterinary, Animal and Food Science (Universidad Autónoma de Barcelona. Spain). Before starting at Aviagen, Dr Asensio worked in two poultry production companies and was associate professor in the Department of Animal Health and Anatomy of the UAB Veterinary School.

Avigdor Cahaner



Professor (Emeritus) of Quantitative Genetics, Statistics and Experimental Design,
The Hebrew University of Jerusalem, Faculty of Agriculture, Rehovot, Israel

Presentation title **70 years of broiler breeding for rapid growth - achievements, negative consequences, and their genetic mitigation.**

Session VI BROILER GENETICS and BREEDING: PAST and PRESENT

Slot K7-01 - Friday 10 June 2022 - 14:30 - 15:00

Avigdor Cahaner obtained his PhD in Quantitative Genetics and Breeding at the Faculty of Agriculture of the Hebrew University of Jerusalem (Israel), in 1977.

In 1979, after two post-doc years at the University of California in Davis, he started to work at the Faculty of Agriculture as a Lecturer and researcher. He was promoted to Senior Lecturer in 1987, Associate Professor in 1992 and Full Professor in 1997.

In all his research projects over the years, Cahaner studied the consequences of broilers' breeding for rapid growth and high breast meat yield and looked for potential genetic mitigation of negative consequences. Some of his research projects were conducted outside of Israel (Turkey, France, USA, Vietnam, Nigeria, Ecuador, Ethiopia, China) in collaboration with local poultry scientists and industry organizations.

Prof. Cahaner was Vice-President of the World Poultry Science Association (WPSA) for 3 terms (1996-2008), especially involved in supporting branches and activities in developing countries, mainly in Africa. He has been very active in the Israeli branch of WPSA since the 1980's, and currently (since 2015) he serves as the Branch President.

After his retirement (2015), Prof. Cahaner has been mentoring poultry researchers, from the academia and industry, in Israel and also globally (e.g., Ethiopia, China), helping them in their research projects. He also offers training and consultation in experimental design and data analysis to researchers from international academia and industry organizations in the agricultural sector and related biological sciences.

Vincent Coustham



Scientist at INRAE

Centre Val-de-Loire, Nouzilly, (France)

Presentation **Mitigating the effects of high temperatures in birds: involvement of epigenetic mechanisms.**
Title
Session V **POULTRY HEALTH**
Slot **K5-01 - Thursday 09 June - 15:00-15:30**

Vincent Coustham is a scientist at INRAE (Centre Val-de-Loire, Nouzilly, France) focusing on environmental epigenetics. Between 2002 and 2006 he carried out a doctoral thesis on the epigenetic control of the nematode *C. elegans* development at the Laboratory of Biology and Modelization of the Cell (Lyon, France), before exploring the field of plant environmental epigenetics during two FP7 EU-funded postdoctoral positions at the John Innes Center (Norwich, United Kingdom) and at the INRAE Jean-Pierre Bourgin Institute (Versailles, France). He notably highlighted epigenetic mechanisms controlling the response to cold (vernalization) of different natural ecotypes of *Arabidopsis thaliana* adapted to varying lengths of winters. He joined the INRA Avian Biology and Poultry Research Unit (BOA) at the end of 2012 to carry out environmental epigenetics research on the process of bird acclimation to heat. In particular, his research programs funded by INRAE and the French Research Agency (ANR) aim to understand the molecular impact of thermal manipulation during embryogenesis on the epigenome of two avian species, chicken and quail. Since 2015 he is in charge of the animation of an epigenetics scientific network of the INRAE Animal Physiology and Breeding Systems Department.

Michael Czarick**Senior Public Service Associate.**

University of Georgia

Presentation **World Trends in Poultry House Environmental**
Title **Control**
Session IV **POULTRY ENVIRONMENT AND**
MANAGEMENT
Slot **K4-01 - Thursday 09 June - 10:00-10:30**

Mr. Czarick has been the leader in the development of the use of tunnel ventilation to keep poultry cool during hot weather. The poultry industry in the U.S. and internationally considers him to be the father of tunnel ventilation. Tunnel ventilation allows poultry producers to quickly exchange the air in their houses and provide a constant breeze that provides a wind-chill effect of ten degrees or more as well as facilitates the use of evaporative cooling pads. Prior to the introduction of tunnel ventilation, the U.S. broiler industry would lose millions of birds each summer to heat stress. In addition to the cost of the birds lost, hundreds of millions of dollars would be lost each summer due to reduced weight gains and increased feed conversions.

In 1985 when Mr. Czarick began his career at the University, tunnel ventilation was an unproven concept. Tunnel ventilation was used on just a couple of farms in Georgia, the design of which was done by trial and error and as a result the benefits varied widely. Some producers found tunnel ventilation beneficial, but many others found it inferior to traditionally curtain-ventilated houses. Through research and numerous field trials Mr. Czarick brought an engineering perspective to poultry house ventilation and developed the science of tunnel ventilation. Air speed guidelines were determined as well as fan selection, installation, and operation guidelines. Tunnel inlet and pad guidelines were also developed as well as basic tunnel ventilation management techniques that are in wide use by the poultry industry around the world today. Through Mr. Czarick's guidance, bird performance in tunnel-ventilated houses has improved to the point today that no one seriously considers building a broiler house that is not tunnel ventilated, whether in South Georgia, Pennsylvania, or Australia.

Mr. Czarick has become a world leader in the movement of the poultry industry to modernize controlled environment housing. The modern broiler house is designed to allow the producer to precisely control the environment throughout the year. Through the use of tunnel ventilation during warmer weather, and negative pressure/inlet ventilation during the remainder of the year, producers can provide optimal growing conditions within a house regardless of outside weather conditions.

Mr. Czarick has worked with every major poultry company in the U.S. as well those in dozens of countries on the development of poultry house specifications to insure a proper level of environmental control. In order to properly control the environment throughout the year, an environmental control system is required. A house needs a heating system, a minimum ventilation system, a transitional ventilation system, tunnel ventilation, and an evaporative cooling system. These systems must be properly designed and coordinated in order to maximize bird performance and keep energy costs to a minimum.

Mr. Czarick's knowledge of controlling poultry environments is widely recognized by the scientific community. Mr. Czarick designed the environmental control systems for UGA's five-million-dollar Poultry Research Complex expansion. He has also designed the environmental control systems for new research facilities for the USDA Lab in Beltsville, Maryland, University of Arkansas, Auburn University, two of the industry's primary poultry breeder companies, four poultry companies and for a major poultry pharmaceutical company. With ever-increasing energy costs, energy usage is a major area of concern for most poultry producers. Mr. Czarick has spent a large percentage of his time over the years working to keep poultry house energy usage to a minimum. He has conducted numerous field studies on various energy conservation techniques, many of which are used in poultry houses around the world today. Mr. Czarick has conducted numerous programs across the state as well as across the nation on educating poultry producers on how to keep their operating costs to a minimum.

Mr. Czarick is considered by the poultry industry and the academic community as the leading authority on the design and operation of poultry house environmental control systems. Since 1985, Mr. Czarick has written over 190 monthly Poultry Housing Tip newsletters. Each newsletter covers a different aspect of poultry house environmental control and energy conservation. Over 3500 copies of the newsletter are distributed each month to poultry producers, county agents, and poultry companies around the world. Most of the people that receive the newsletters are poultry company managers/supervisors that are responsible for hundreds of growers. The managers/supervisors copy the newsletters and distribute them to their growers increasing the actual distribution into the thousands. Countless other individuals download new as well as past newsletters from Mr. Czarick's UGA Poultry Science Website, www.poultryventilation.com.

Mr. Czarick's website is a very popular source of information on poultry house ventilation and energy conservation. At the site users can find over 350 past Poultry Housing Tips as well as Powerpoint notes from many of the presentations he has given at recent educational meetings.

Mr. Czarick's unique ability to explain relatively complex ventilation concepts in an easy-to-understand way has made him a highly sought after speaker world round. Over the past 36 years Mr. Czarick has given presentations on poultry house environmental control and energy conservation in 56 different countries on six different continents.

Nuhad Dagher**Dean Emeritus**

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

Presentation Title	Contribution of the Poultry Industry to Food Security in the MENA Region: A Review
Session VI Slot	FOOD SAFETY AND QUALITY PRODUCT K6-01 - Friday, 10 March 2022 / 09:00-09:30

Dr N.J. Dagher was born and raised in Lebanon, where he received his primary and secondary education. In 1954, he lived and worked on poultry farms in the states of Indiana and Arkansas as the first Lebanese participant in the International Farm Youth Exchange Programme. He received his BSc from the American University of Beirut (AUB) and was immediately appointed by AUB to provide agricultural extension services to the central and northern Beqa'a region in Lebanon, where he introduced commercial poultry production. He earned both his MSc and PhD degrees from the Iowa State University. In 1962, he helped establish a Lebanese branch of the World Poultry Science Association and became president of that branch until 1984.

Dr Dagher has served as a consultant to poultry companies in Lebanon, Jordan, Syria, Iraq, Iran, Egypt, Kuwait, Tunisia, Saudi Arabia and Yemen. He has published over 100 articles in scientific journals and several chapters in books and compendia. The second edition of his book “Poultry Production in Hot Climates” was published in 2008 by CABI. His research has covered a wide range of subjects, such as factors affecting vitamin requirements of poultry, nutrient requirements of poultry at high-temperature, and plant protein supplements of importance to hot regions. He has served in many administrative positions at the university, such as Chairman of the Animal Science Department, Associate Dean and Dean of his Faculty. From September 1986 to June 1992, he served as Director of Technical Services at the Shaver Poultry Company in Cambridge, Ontario, Canada. He served as Dean of the Faculty of Agricultural Sciences and Professor of Poultry Science 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 the American University of Beirut, from 1996 to 2006. He is at present Dean Emeritus at the same University. He has been serving as President of the WPSA-Lebanon Branch since his return to Lebanon in 1996. He has received many honors and awards and in 2012 was inducted in the International Poultry Hall of Fame. In 2018 he received the Golden Medal from the President of Lebanon for his services to the Education and Agriculture sectors in the country.

Vincent Guyonnet



DVM, Ph.D, Dipl. ACPV.

Managing Director, FFI Consulting Ltd.

Brockville, Ontario, Canada

Vincent.guyonnet18@gmail.com

Presentation **Development of egg production and consumption
in low-income countries of Africa**
Title
Session I **POULTRY ECONOMICS**
Slot K1-02 - Wednesday 08 June 2022 - 15:30 - 16:00

A native of France, Vincent obtained the degree of Doctor in Veterinary Medicine in 1987 in Lyon, France and a Ph.D degree in Poultry Science from The University of Georgia, Athens, GA, USA in 1991. He was accepted as a diplomate of the American College of Poultry Veterinarians (US board certification) in 1994.

During his career, Vincent has worked closely with the Poultry sector, first from the Animal Health side with Pfizer Animal Health (now Zoetis) and then from the production and food processing side with Burnbrae Farms Ltd. Vincent has worked in the area of New Product Development, International Market Development and Quality Assurance for the largest integrated egg producer and processor (grading, breaking and further processing) in Canada. Concurrently, he has served as the scientific advisor for the International Egg Commission (London, UK), working with intergovernmental organizations (OIE, FAO, World Bank) on global issues such as animal welfare, greenhouse gas emissions, food safety, nutrition and food security and the overall sustainability of animal production.

As part of FFI Consulting Ltd., Vincent is a consultant to the Poultry sector, with emphasis on egg production, market development and the role of eggs in human nutrition. His work also focuses on international development programs to assist poultry farmers to use the latest knowledge and technologies available to further contribute to the challenges of global food security and nutrition.

Vincent has authored 4 book chapters, several peer-reviewed scientific papers and is a regular invited speaker at international conferences and Poultry industry events. Vincent writes also regularly editorials in international Poultry journals. Vincent enjoys teaching Poultry science and egg-related food science topics and has been a guest lecturer at the World Veterinary Education in Production Animal Health (WVEAPH), Jilin University, Beijing Agriculture University, China Agricultural University and the Chinese Academy of Agricultural Sciences (China).

Hafez M. Hafez**Professor Dr. Institute of Poultry Diseases**

Free University Berlin Berlin, Germany

Presentation Title Poultry production and health: Current and future challenges.**Session VII POULTRY HEALTH****Slot K7-01 - Friday 10 June 2022 - 15:00 - 15:30**

Professor Hafez obtained his Master of Veterinary science in poultry diseases in 1967 from the faculty of Veterinary Medicine, Cairo University, Egypt, and his Dr. med. vet. degree from Giessen University, Germany in 1981. He obtained his Dr. med. Vet. habilitation from the faculty of Veterinary Medicine, Munich

University, Germany in 1994.

From 1982-1996, he served as Veterinary Poultry Disease Specialist, Veterinary Microbiology Specialist, and Veterinary Animal Hygiene Specialist that was granted to him by State Veterinary Medicine Chamber of the State of Baden-Württemberg, Germany. He was elected as a Diplomat of European College of Veterinary Public health (Dipl. ECVPH), and as a Diplomat of European College of Poultry Veterinary Science (Dipl. ECPVS) in 2005 and 2009, respectively.

Between 1981 to 1985 he worked at Poultry Health Service Stuttgart, Epidemic Veterinary Division, State of Baden- Württemberg. Then after until 1997 he served as a head Poultry and Virology Department at State Veterinary Laboratory Stuttgart. From 1997- 2016, he served as the Head of the Institute of Poultry Diseases at the Free University, Berlin. Following his assignment as the Head of this institute, he was named and served as Guest “Senior” Professor until 2021. In addition, he was selected as an Honorary Professor at the University of Hohenheim, Germany, and at Alexandria University, Egypt in 1996 and 2009., respectively. Professor Hafez served as the President of the World Veterinary Poultry Association (WVPA) from 2005-2011, and as the Vice President from 2011-2015. He is currently an Honorary President of WVPA.

From 1998-2020, Professor Hafez served as the Chairman of Poultry Scientific Committee of the German Veterinary Chamber, and the German Branch of the World Veterinary Poultry Association (WVPA). Also, he has been serving as Chairman of Working Group 10 (Turkey) of European Branch of World Poultry Science Association (WPSA) from 1999 until present. Hafez’s research interest has been focused on diagnosis and control of poultry diseases, and on foodborne diseases, management, and animal welfare and hygiene. Since 2015, he has been serving as an advisor of the Arab Federation for Food Industries (AFFI). Since 2020 he is Member of the Hall of fame of World Poultry Science Association (WPSA)

He served as the Major Advisor for 80 candidates for Dr. med. vet., and two candidates for Dr. med. vet. habil. theses in the field of basic and applied poultry production and diseases. In collaboration with his colleagues, Professor Hafez published one textbook on Turkey diseases, and a second book on primary diseases on poultry farms. He authored or co-authored, 277 scientific articles, plus 54 book chapter. In addition, he served as the Editor of 12 proceedings books of the International Symposium on Turkey Diseases, and 10 proceedings on Turkey Production and Health Meetings held over the last two decades in Berlin, Germany.

Professor Hafez received numerous invitations as Keynote Speaker at International Scientific Congresses, and he gave 561 presentations in 59 different countries around the world.

Gonzalo G. Mateos**Professor of Animal Science**

Departamento de producción Agraria. Universidad Politécnica de Madrid, Spain

Presentation Title **The challenges of poultry nutrition in different productive systems.**

Session_IV POULTRY NUTRITION AND ALTERNATIVE FEED ADDITIVES

Slot **K3-01 - Thursday 09 June 2022 - 09:00-09:30**

Gonzalo G. Mateos holds a BS in Animal Production for the Universidad Politécnica de Madrid, a PhD in Veterinary Science for the Universidad Autónoma de Barcelona, and a PhD in Animal Science (Poultry) and a post-doc position for Iowa State University. He has published 140 papers in SCI Journals and given more than 460 seminars, lectures, communications, and posters at International congresses in more than 40 countries. He was Editor in Chief of the Scientific Journal Animal Feed Science and Technology (2005-2013) and a member of the Editorial Board of Poultry Science and Animal Feed Science and Technology, in recent years.

Joaquín Narro**CEO and Founder of Alcazar**

Presentation Title **The Commodity Price Crisis - Threats and Opportunities.**

Session I Slot **POULTRY ECONOMICS**
K1-01 - Wednesday 08 June - 15:00 - 15:30

Joaquin founded Alcazar in 2012, a market-focused research and analysis company specializing in unfolding strategic trading opportunities associated with the energy transition. He specializes in monetizing opportunities in climate change, renewables generation, hydrogen ecosystem, energy storage, energy distribution and electrification. He is a pioneer of the energy transition and one of the earliest participants in the carbon markets. His experience encompasses investment management, trading, quantitative analysis, risk management, business development and entrepreneurship. He has worked for various leading energy firms, including Aquila Energy, Vattenfall and Nuon, as well as being a founding partner of hedge fund sponsor Cumulus Asset Management. He has a PhD in nuclear physics and a bachelor's degree in theoretical physics. He divides his time between London and Madrid.

At Alcazar, Joaquin has experience of:

- **Quantitative research and analysis**
 - Predictive analytics and business intelligence
 - Uncovering investment opportunities associated with the decarbonization process
 - Climate change risk management
 - Carbon intensity impact analysis
 - Model development within the renewable energy landscape
 - Developing proprietary derivatives trading strategies
 - ESG investing and analytical due diligence
 - Academic research at Imperial College London and practitioners' lectures at Imperial College London, London School of Economics and King's College London
 - Managing complex and interlaced financial risks in commodity markets
- **Fund management**
 - Fund management and structuring in multiple jurisdictions
 - Investment management including portfolio analysis, trading and execution, risk management and optimisation
 - Managing relationships with investors
 - Capital raising
- **Trading and risk management in commodity derivatives markets**
 - Electricity, Carbon, Coal, Natural Gas, Wheat, Rapeseed, Corn, Iron Ore, Oil
 - ICE, EEX, Euronext, MATIF, CME, Nasdaq, MEFF

Yves Nys**Director of research**

INRA, Poultry Research unit (Bird Biology and Adaptation),
37380 Nouzilly. France

Presentation **Understanding in hen mechanisms of ionic supply,
Title eggshell mineralization, and Ca metabolism to
control shell defect**
Session VI **FOOD SAFETY AND QUALITY PRODUCTS**
Slot **K6-02 - Friday 10 June - 09:30-10:00**

Dr Y Nys completed his PhD in the Agronomic School and University of Paris, in Animal Nutrition in 1975. He has been working on the INRA Poultry Unit in Nouzilly (France) for 42 years, until 2020. He worked on calcium metabolism in laying hens and in mineral nutrition (calcium, phosphorus and trace elements in broilers and hens). He also focused his activity on eggshell quality and fabric, in particular on the role of eggshell matrix proteins in the bio-mineralization of eggshell. He coordinates two European projects, Eggdefence 2001-2004 and RESCAPE 2006-2009 and has been working in collaboration with the industry in the area of hen nutrition and egg quality (eggshell quality, yolk colour, genetic selection on egg quality, nutritional value of eggs) and mineral nutrition (phosphorus and calcium, phytase and trace elements). From his research in Poultry Nutrition, he was given the Nutrition Award 2011 (international DSM grants, ESPN 2011). He has been director of the INRA Poultry Units (2002-2007) and has been involved in the WPSA organisation (working group 4 on egg quality and 2 in Nutrition, president of the European federation 2010-14, vice-president of the WPSA since 2016). He is the author of more than 200 publications and reviews.

Achille Schiavone



Full Professor of Poultry Science

Department of Veterinary Science, L.go Paolo Braccini 2 –
10095 Grugliasco (TO) (Italy)

Presentation **Workshop: How does poultry defend itself from**
Title **insults**
Workshop_2 Producers' Workshop
Slot **W2-01 - 08 June 2022 - 12:00-13:30**

Since obtaining my PhD in Poultry Science (2002) at The University of Pisa (Italy), the prime focus of my research career has continued to address the various aspects of poultry science, especially nutrition, welfare, and biodiversity preservation. I have also dedicated considerable time and energy to numerous projects carried out in developing countries and in association with the industrial sector, with the primary scope of skill transfer. My research interests and desire to interact with the scientific community in international contexts has led me to attend a multitude of congresses (worldwide) and complete several research secondments at INRA Poultry Unit in Nouzilly (France), Universitat Autònoma de Barcelona (Spain), and Universidad de Murcia (Spain). Since 2002, I have been teaching bachelor, master, and PhD courses in animal nutrition and poultry science. During the last 10 years, I have expanded my scientific panorama by applying to international research programs related to the avian biodiversity preservation, innovative poultry nutrition strategies and poultry welfare in different national and EU context (H2020, PRIMA call and Core Organic). For 20 years, I am member of the WPSA supporting the WG2 on poultry nutrition. I am co-author of over 110 ISI papers and section editor of *Animal* and *Journal of Animal Physiology and Animal Nutrition*. I was the local chair for the 6th Mediterranean Poultry Summit and member of the scientific and/or organizing committee of over 10 international congresses.

Alessandro Scolari**DVM. Avian Pathology Specialist**

Round Table: Cooperation among Mediterranean Neighbouring countries in Managing diseases
09 June 2022 - 16:00-18:00

Education:

- 1987 – Master in Avian Pathology
- 1979 – Degree in Veterinary Medicine.

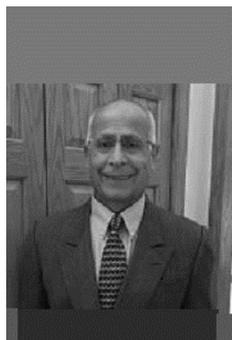
Professional positions

- Director of the Accredited Veterinary Laboratory Vallerana Srl, specialised in Avian Pathology and Quality Control of Food
- Private Poultry Practitioner Pathology (Broiler Breeders, Broilers, P.S. and commercial layers, game birds, guinea fowls, ducks geese, meat turkeys)– Aviagen Consultant.
- 2013 to 2020 . Organizer of International Poultry Forum – International Zootechnical Fair – Cremona (Italy).
- 2006-2011 – Participations to the activities of Federation Europeenne pour la Santè Animale et la Securità Sanitarie (F.E.S.A.S.S) and DG-SANCO – Bruxelles.
- 1988 – 2012. Responsible of Animal Health – Veterinary Sanitary Authority Cremona District – Lombardia Region (Italy)
- 1979 – 1988. Health Director in an integrated poultry company in Northern Italy

Education and training

- 1981 to date. Member of the Poultry Veterinary Study Group for the E.U. Committee Member from 1988 to 1993.
- 1979 to date – Member of the WVPA (Italian Branch) – Committee Member from 2016 to 2018.

Mamduh Sifri



PhD Poultry Nutrition and Biochemistry
PSA Emeritus Fellow AUB Distinguished Alumni

Presentation title: How does poultry defend itself from insults?

Workshop: Youth program

SIFRI SOLUTIONS LLC

Consultant, Advisor, and Facilitator: The primary focus is nutrition and metabolism and their interrelationship with immunity and microflora of the digestive system.

Retired:

ADM: Director - Poultry, Marketing & Technical Support, USA

Education:

Bachelor of Science, Agricultural Engineering and Master of Science- Poultry Nutrition & Management from the American University of Beirut, Lebanon.

Ph.D. in Poultry Nutrition and Biochemistry from North Dakota State University, Fargo, ND, USA

Research Fellow at the University of California, Davis (NASA Project) and Biochemistry at the University of Wisconsin, Madison.

Social and Scientific Associations

American University of Beirut Distinguished Alumni in 2018.

Journal of Applied Poultry Research Nutrition Section Editor as of September 2018.

Chair of PSA Informal Nutrition Symposium committee for 26 years and currently the Co-Chair.

Poultry Science Association EMERITUS FELLOW for distinguished contribution to the field of poultry science.

Member of the committee of the Poultry Industry Hall of Fame Award.

Member of review boards for a few scientific journals.

He is a member of the Scientific Committee of the Mediterranean Poultry Summit

Published in many prestigious scientific journals such as Comparative Physiology and Biochemistry, Agriculture and Food Chemistry, Poultry Science and Applied Poultry Research.

Lectured at many universities, industry functions and international symposia in the USA and Internationally about business conduct, research and the application of science in business.

Volunteer for SCORE to help small businesses, Habitats for Humanity and YMCA.

Mamduh believes in multiplying the learning ability for people so they can achieve their ultimate goals and make an impact on others to do the same.

Wim Tondeur



Poultry meat quality advisor

DVM

Presentation **Quality defaults in slaughtering**
Title

Session VI **FOOD SAFETY AND QUALITY PRODUCTS**

Slot **K6-03 - Friday 10 June - 10:00-10:30**

Wim Tondeur is veterinarian by profession, with specialization in poultry health and production. In the past 16 years he runs his own independent consultancy company under the name of TONDEUR VTCA, providing training, consultancy and advice. He was for 21 years a senior trainer at Aeres/PTC+, Barneveld College in the Netherlands. This training centre offers national and international practical training courses on poultry production, pig production and animal feed technology. He was coordinator of various training courses for persons involved in poultry meat quality and inspection. In the last ten years he advises regularly in various poultry abattoirs on carcass quality aspects, like in the Netherlands, Belgium, UK, France, Italy, Spain, Portugal, Ireland, Poland, Greece, Austria, Switzerland, Russia, Middle East and South Africa. During many years he has trained and advised veterinarians and meat inspectors on ante- and post-mortem inspection. Recently he developed the handbook “Broiler Meat Quality” published by Roodbont Cie; beside the English version there will be a Spanish and a Russian version available soon. He participated in the development of the Perfect Carcass model of Zinpro Ltd, with a visual guide for scoring of broiler carcass lesions and with a monitoring programme in various abattoirs. Dr. Wim Tondeur is an active member of the World Poultry Science Association (WPSA) in the Netherlands and was secretary of the Dutch branch of the World Poultry Veterinary Association (WVPA). He is a regular speaker at WPSA congresses and gives presentations at poultry seminars.

Matthias Voss**Veterinary Scientific**

Director LOHMANN BREEDERS GmbH

Presentation Title Emergent diseases affecting poultry in different production systems.

Session V POULTRY HEALTH

Slot K5-02 - Thursday 09 June - 15:30 - 16:00

- **Education** Study of veterinary medicine at the Free University of Berlin
- 1985 Examination as veterinarian
- Dissertation: “Detection of type-specific antibodies against Infectious Bronchitis Virus
- 1987 Graduation and degree of Dr.med.vet.
- 1997 Qualification as “Veterinary Specialist for Avian Diseases”

Key qualifications

- Health control in primary poultry breeders populations
- Control of SPF populations
- Diagnostic laboratories
- Development & quality of poultry vaccines
- Technical service world-wide
- Since 1986 36 years veterinary expert at LOHMANN BREEDERS GmbH

Additional activities

- President of PVSGEU (Poultry Veterinary Study Group of the EU)



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PREVEXXIONTM

RN

EL FUTURO YA ESTÁ AQUÍ...
LA VACUNA DE LA ENFERMEDAD
DE MAREK, DE LA EMPRESA
EN LA QUE CONFÍAS

PROTECCIÓN

VALOR

INNOVACIÓN



PREVEXXION RN es una vacuna quimérica de última generación que contiene la cepa viva del serotipo 1 del herpesvirus aviar. Este producto puede usarse como ayuda en la prevención de cepas muy virulentas del virus de la Enfermedad de Marek.



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Nuevo

Pollitas **Booster**

para lotes de pollitas con retraso

El nuevo pienso de recría **Pollitas Booster** está diseñado para recuperar los lotes de pollitas que van retrasados en su crecimiento y conseguir que alcancen su peso corporal estándar





Plenary Sessions
(Keynote Speakers)

The Commodity Price Crisis - Threats and Opportunities

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Challenging threats and profitable opportunities lie ahead as a new commodity price paradigm engulfing agricultural, energy, metals and environmental commodities is unfolding in front of our eyes. Immediate availability and affordability concerns amid severe security of supply issues are rocking unprepared businesses. Planning and optimization under multiple complex scenarios is crucial for long-term business profitability and sustainability. In this presentation you will learn through examples related to agricultural feedstocks and energy markets, how the current commodity price crisis is overlapping with a commodities super-cycle that has been emerging for quite some time, underpinned by clearly defined structural factors. We will foresee the consequences of the European response to the commodity price crisis, which is strongly oriented towards tackling climate change, highlighting the rising importance of environmental commodities and their transversal role within the energy complex. As we progress through the price crisis, we expect price volatility to remain high.

We will learn what threats and opportunities lie ahead in an enduring higher price volatility environment, as well as what tools are available to adapt to, and potentially benefit from, this new price paradigm. Finally, we will forecast the potential duration of the crisis.

Keywords: Energy, uncovering investment opportunities associated with the decarbonization process Climate change risk management Carbon intensity impact analysis

Development of egg production and consumption in low-income countries of Africa

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Between 2010-2020, egg production in Africa increased by 30.8%, slightly less than the global production (35%). The 3 largest African egg producing countries in 2020 were Nigeria, South Africa and Egypt, ranked as #23, 27 and 32, respectively, on the list of top egg producing countries. The production of eggs in Africa is not keeping up with the demographic boom to provide more eggs. While egg production is closely related to population in Asia (60.2% world production and 59.8% world population) and Latin American (11.4% production and 8.6% population), the African continent represents only 4.1% of the global egg production for 17.2% of the world population. And the COVID19 pandemic added more challenges to the production of eggs in Africa, with -1.3% less eggs produced between 2019 and 2020, while the global production increased by 2.7% during the same period. Low-income food deficit countries (LIFDCs) are defined by the Food and Agriculture Organization of the United Nations (FAO) as countries having at the same time a food deficit and a low income, meaning that these countries lack the resources not only to import food but also to produce sufficient amounts domestically. There are currently 47 nations listed as LIFDC with 36 from Africa, some affected by chronic food production problems while others have seen functioning food value chains devastated by years of war. While the production of eggs in African LIFDCs increased by 2.1% between 2019-2020, most of this growth was observed in Kenya and Tanzania and 20 countries out of 36 experienced either no growth or a reduction in production during the same period. In the LIFDCs, the nutritional status of vulnerable populations like young children, pregnant women or older generations has the potential to be greatly affected and eggs are known to contributing to the alleviation of food insecurity in these same populations. This deficit in production vs. population is highlighted also by the presence of 41 African countries where people consumed less than one egg per week, compared to 12 in Asia and 2 in Latin America/Caribbean. The average annual consumption in Africa has remained around 40-44 eggs over the past 20 years. In 2020, 149 million children around the world suffered from stunting, with the prevalence in Africa (61.4 million children) rising by 12.8% over the past 20 years while it has decreased in all other regions except Oceania. And the COVID19 pandemic strengthens to add another 2.6 million stunted children by 2022. The lack of availability of eggs in Africa is truly a missed opportunity given the great nutritional value of eggs as convincingly demonstrated in a recent study in Ecuador when the stunting in young infants was significantly reduced with the daily consumption of eggs during a 6-month study. Egg production in Africa is affected by a number of challenges: access to quality day-old chicks and pullets, availability of well formulated feeds, management practices, biosecurity and disease prevention. Concerted efforts for the marketing and promotion of eggs are also lacking in most African countries. Successful approaches used in Latin America and Asia must be adapted to the African continent and used to raise the production and consumption of eggs to levels comparable to the rest of the world (215 eggs).

Keywords: egg production, Africa, malnutrition, consumption

Using high throughput phenotyping of growth and feed intake to improve adaptation of chickens to sustainable diets

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As feed cost is representing the largest part of production cost in poultry, feed efficiency is since decades one of the most important criterion of selection. Until recently however, this criterion was recorded in conditions that differed from commercial production conditions, as animals had to be reared in individual cages to obtain individual measurement of feed intake. Moreover, while feed intake had to be collected on several consecutive days to be reliable, feed efficiency was calculated only for a limited period of time (usually one or a few weeks).

We thus developed an electronic feed station that enables individual and continuous measures of feed intake and body weight of chickens reared on floor and in group. The originality of the design is coming from the fact that i) it can be used from a few days post-hatch to adult age and ii) animals are not restrained nor isolated from each other when feeding, and thus can express more natural feeding and social behaviors together with higher physical activity. Chicks are equipped with a RFID chip at hatch to be detected at every visit to the feed station. One feed station can be used for 100 birds.

We used this feed station in two successive experiments. Experiment 1 aimed testing the capacity of adaptation to sustainable diets of slow- and fast-growing chickens (40 birds/genotype/diet). Experiment 2 aimed at deciphering the genetics determinism of daily feed intake in 2 experimental lines of fast-growing chickens divergently selected for ultimate pH of breast meat. In the first experiment, birds were fed either with a corn-soy diet or with a diet containing local feedstuffs (rapeseed, sunflower and field bean) or feedstuffs not in competition with human food (wheat DDGS). Diets were adapted to birds nutritional needs. The alternative diet designed for fast-growing chickens in experiment 1 was also used in experiment 2. Chickens were reared until market weight, i.e. 35 d and 42 d for fast-growing chickens in experiment 1 and 2, respectively, and 84 d for slow-growing chickens in experiment 1. Results of experiment 1 showed that animals have a good capacity to adapt to alternative diets. In both genotypes, growth was similar between diets or even better with the alternative diet, while feed intake was similar or lower with the alternative diet. As a consequence, feed conversion ratio did not differ between diets in standard chickens. In label rouge chickens, feed conversion ratio was even better with the alternative diet until 40 d. Moreover, variability of feed intake and feed efficiency is lower in birds fed with the alternative diet, indicating a better homogeneity of performances with this diet than with the corn-soy diet. Most between-diet differences are observed just before or after dietary transitions, showing that transition ages could be optimized in some cases. Carcass composition was slightly improved with the alternative diet, with a higher thigh percentage in Label Rouge chickens and a lower abdominal fat percentage in standard chickens. Meat quality was moderately affected only in Label Rouge chicken, breast meat being less acidic and less yellow with the alternative diet. Results of experiment 2 showed that profiles of heritability of feed intake and feed efficiency varied strongly with age and with the line. For example, heritability of feed conversion ratio varied with age from 0.08 to 0.63 in the low pH line and from 0.08 to 0.49 in the high pH line. As for the phenotypic study in experiment 1, dietary transitions appeared as critical

periods of evolution of the genetic determinism of studied traits. The genetic correlations between final feed efficiency and daily performances highlighted the possibility of using early performances as selection criterion of final performances. The strong differences of genetic correlations between daily or final feed efficiency and meat pH between the two lines confirmed the existence of differences of metabolism already observed between the two lines. Finally, our results showed that improvement of feed efficiency would rely mostly on a decreased feed intake in the high pH line and through a higher weight in the low pH line. This new tool offers large perspectives both for nutrition and genetics. It allows a better modelling of growth and feed efficiency over time and gives access to the flock average and homogeneity. On the other hand, it makes it possible to evaluate feeding behavior which is another important component of the bird's adaptability to dietary changes or other environmental fluctuations.

Keywords: throughput phenotyping, feed intake, adaptation, sustainable diets

Optimising layer breeding using dual purpose marketing

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In many countries the percentage of chicken meat and table eggs produced by small scale farming using native breeds is steadily declining. At the same time the number of small scale and independent breeding companies is also in decline, resulting in reduced availability and diversity of traditional layer type chickens, from which all chicken meat was traditionally produced. This lack of availability and diversity creates opportunities for niche marketing of traditional chicken meat. In particular, traditional dual purpose breeding where female chicks are used for egg production and male chicks for meat, has good value added opportunities. The combination of highly productive breeding stock and the ability to market up to 100% of chicks hatched, offers significant cost advantages over standard layer or broiler breeding, giving small scale and independent breeding companies the ability to compete in a competitive commercial marketplace. The availability of traditional heavier body weight layers that have been selected and improved for this type of farming, from primary breeding companies offering global export, makes it a viable alternative farming method in all countries. Separation of male and female day old chicks is done by colour or wing feather sex link methods that require no specialist training for farm or hatchery staff. This approach is very successful where there is a demand for traditional carcass characteristics and heavier layers suitable for extensive egg production especially in sub optimal environmental conditions. Typical increases in male chicks sold when compared to standard layer breeding ranges from 40% in lower demand developed economies to 100% in countries where traditional farming methods are more prevalent. A large range of coloured pure lines gives breeding companies the ability to produce chickens similar to native breeds, satisfying local demands. Eggs and meat from this type breeding programme can be marketed as premium value products. No increase in investment is needed for this farming method compared to other systems, however significant gross margins can be obtained from value added sales. When compared to standard layer breeding it is typical to achieve over 40% increase in gross sale revenue in European countries where male chicks have lower value than females. In countries where male chicks have equal value to female chicks and non industrial chicks are considered premium product, such as Mexico, Philippines and USA, gross sales revenue can be more than doubled. In addition to this, where breeder farms integrate the growing of the male chicks for direct sales, other valuable markets can be opened. Spent hen carcasses are typically 10% heavier than standard layers with an improved meat to bone ratio, with locally desirable plumage colour these hens have increased demand, well fleshed black feathered spent hens can obtain higher price than their replacement pullets in some African and Asian countries. Local preferences vary widely from country to country with slaughter age ranging from 8 to 20 weeks with live weights of 1 – 3 kg being desirable. Marketing influences also vary geographically with meat qualities, plumage colour, ethical breeding and local sustainability being common factors. This dual purpose approach to layer breeding will remain a small percentage of overall production but its impact supporting small scale farming, local sustainability and diversity is significant and therefore needs continued support and promotion.

Keywords: Dual purpose marketing, traditional breeding

The challenges of poultry nutrition in different productive systems.

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The use of conventional cages was banned in the European Union (EU) in 2012. Since then, a clear trend to use new alternatives systems for egg production has been evident in all the EU countries. These systems have 3 main objectives: a) optimize egg production while keeping production cost under control, b) meet the social demands of the consumers (food safety, poultry welfare, and sustainability), and c) maintain the quality of the eggs throughout the egg cycle. The ban on hen moulting and beak trimming, together with the use of these alternative systems, have changed bird behaviour which needs to adapt flock management. Under the new systems are attracted by new activities with less interest for eating and drinking, which affect feed intake and flock uniformity. Better knowledge on certain areas of nutrition and feeding strategies such as a) feed form, particle size and texture of the diet, b) inclusion levels of fibre and crude protein in the diet, and c) control of the mineral content of the diet (Ca, P, and electrolytes), is needed.

Keywords: Poultry production, alternative productions systems, Bird welfare

Feeding fibrous diluted diets to broiler breeder pullets.

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Reducing the concentration of the broiler breeder pullet diets by including low energy and nutrient raw materials, diluents, is a nutritional strategy to increase feed allocation and improve uniformity. This is essential to obtain correct technical results and profitability for a broiler breeder operation.

Growth rate control is essential during the rearing period of broiler breeder pullets. At the same time, energy and nutrient supply must be adequate to promote the correct development of the skeleton, feather cover, and digestive, immune and cardiovascular systems. Feed intake control is necessary to control growth rate; therefore, diluting Grower and Pre-breeder pullet diets is a helpful strategy to increase daily feed allocation. Raw material sources of fiber are the most common diluents used to dilute pullet diets.

Increasing feed allocation is an important tool to promote the feeling of satiety, and to facilitate homogeneous feed distribution and lengthen feed clean-up time. This will result in more uniform access to the ration and therefore will prevent aggressive birds from out-competing timid ones. Accordingly, feed dilution contributes to reducing BW variation, to produce uniform flocks. The following are the advantages of good uniformity:

- Facilitates that energy and nutrient intake meet the requirements of a higher proportion of birds within flocks.
- Reduces birds below the standard BW (light birds), which might have gone through under consumption periods, from being exposed to nutritional deficiencies.
- Promotes correct and uniform body condition among the birds, which regarding modern breeders means controlling lean meat deposition reducing heavy birds.
- Birds arrive synchronized at sexual maturity; this supports high peak of laying, and production and hatchability persistency. Apart from the advantages explained previously of diluting pullet diets, fiber diluted diets have the following benefits for the digestion process:
 - If fibrous ingredients are consumed, their particles are retained for a long time in the crop (Vergara et al., 1989), provoking a feeling of satiety. Apart from this, a considerable moisturization takes place in the crop; therefore, any exogenous enzymes and other components that are activated by moisturization, will potentially be able to exert their effect in the crop. The time needed for soaking may be a critical factor in determining the efficacy of an exogenous enzyme, provided that the crop is indeed a major site of enzyme activity (Svihus, 2014). Consequently, longer retention time mediated by fibrous ingredients will aid enzyme activity.
 - Feed particles mixed with the proventriculus secretions arrive at the gizzard. Several published studies report beneficial effects of fiber on gizzard function, mostly due to mechanical stimulation (Hetland et al., 2005; Hetland and Svihus, 2007). The high lignin content of most insoluble fiber sources leads to a longer retention of the feed in the gizzard, improving its muscular development and thus its function (Hetland and Svihus, 2001; Hetland et al., 2003; Jiménez-Moreno et al., 2010).
 - Once feed particle size is reduced by the gizzard, the digesta passes to the small intestine where there are intensive gastroduodenal refluxes to compensate for its small dimensions and fast transit rate. Fiber inclusion in the diet is thought to improve the number and intensity of these refluxes (Hetland et al., 2003). Throughout the small intestine, nutrients are digested and absorbed; however, the poultry gastro intestinal tract does not produce the necessary enzymes to digest fiber and thus,

different fiber fractions enter into the caecum by antiperistaltic movements. In this organ a large bacterial community breaks down indigestible plant material; in fact, these microorganisms ferment part of the fiber, obtaining short chain fatty acids that reduce caecum pH and may be used as a preferential source of energy by the colonocytes and thus by the bird.

As was explained previously, increasing feed allocation promotes the feeling of satiety, which in turn may help to avoid abnormal behaviors. Asensio et al. (2020) studied the effects of fibrous diluted diets, fed to broiler breeder pullets, on grasping feather pecking and non-food object pecking. At 22 weeks of age, compared to the standard-control diets, the pullets fed the diluted diets showed a significant reduction of these abnormal behaviors. Breeding companies use diluted diets to increase feed allocation and facilitate uniform access to the ration during the rearing period; this is intended to reduce flock BW variation. However, feeding fibrous diluted diets has also effects on enhancing the digestion process and reducing abnormal behaviors.

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Keywords: Feeding, fibrous, diluted diets, broiler breeder, pullets feeding

[K5-01]: POULTRY HEALTH (ID: 130148)
[France]

Mitigating the effects of high temperatures in birds: involvement of epigenetic mechanisms.

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In recent decades, broilers have been selected on growth performance criteria, but the significant improvement in body weight and muscle growth has not been associated with a similar increase in specific visceral organs such as the heart and lungs. As a result, broilers have a reduced ability to cope with extreme environmental temperatures. To improve temperature tolerance and welfare without affecting growth, methods of early heat exposure (thermal conditioning) have been developed to improve heat tolerance in chickens later in life. For example, thermal manipulation during embryogenesis, corresponding to an increase in egg incubation temperature, has been shown to improve survival of male broilers exposed to thermal challenge at slaughter age. Another strategy, corresponding to postnatal heat exposure of chicks on day three or five of life, also promoted heat tolerance later in life.

Recently, it has been shown that the molecular mechanisms contributing to the enhancement of heat tolerance in embryonic and postnatal strategies involve epigenetic reprogramming of gene expression. Epigenetics refers to modifications of gene activity that do not involve alterations in DNA sequence, such as covalent modifications of DNA and histone proteins. Epigenetic modifications are inherited from the cell cycle, are reversible in nature and are recognized as major contributors to environmental phenotypic plasticity.

To date, several enduring epigenetic mechanisms have been suggested to contribute to the heat response in chickens, including histone post-translational modifications in the thermal manipulation model and DNA methylation and hydroxymethylation, histone post-translational modifications and miRNAs in the postnatal model.

The transmission of epigenetic modifications induced by perinatal heat exposure to the offspring is also under investigation. In this context, we are studying the transgenerational impact of embryonic thermal manipulation on another model bird species, the Japanese quail. Preliminary results suggest that embryonic thermal manipulation has transgenerational phenotypic impacts beyond the thermally manipulated generation. Genome-wide characterization of DNA methylation, histone marks, and gene transcripts is underway and preliminary data suggest that transgenerational epigenetic mechanisms are likely involved.

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Keywords: epigenetics, environment, phenotype programming, transgenerational

Emergent diseases affecting poultry in different production systems

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Poultry as an important source of protein is globally accepted and increased demand has compelled the poultry industry to intensify its production. This has led to a higher poultry density due to the ever-increasing number of farms; in turn, this has enhanced the transmission of pathogen agents and makes the eradication of some of these pathogens such as Avian Influenza, which is a big global threat to the industry, nearly impossible. On the other hand, in countries that are moving away from conventional systems, and establishing alternative housing systems, layer flocks are facing a huge challenge to control some of the re-emerging diseases believed to have been eradicated in conventional systems. In these systems, the birds also have an increased and often constant exposure to litter and other substrates which can be contaminated with the bird's faeces. This increased exposure to pathogens alongside medicinal restrictions is one of the biggest challenges for the poultry industry in European countries. This presentation is intended to offer a brief overview on Avian Influenza as a global emergence disease as well as some of the current emerging and re-emerging diseases in European countries such as *Campylobacter*, *Erysipelothrix Rhusiopathiae* and *Histomonas Meleagridis*.

Keywords: Emergent diseases

[K6-01]: FOOD SAFETY AND QUALITY PRODUCTS (ID: 130040)
[Lebanon]

Contribution of the Poultry Industry to Food Security in the MENA Region: A Review

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The Middle East and North Africa (MENA) region covers five countries in North Africa, six countries in the Near East and seven in the Gulf region. Although the beginning of modern intensive poultry production only dates back to the second part of the 20th century, producing poultry of various species for food production in the region has been going on since the days of ancient Egypt. Since 1960, poultry production has been increasing steadily and moving to a highly sophisticated industry. Several factors have been contributing to this expansion including population growth, improvement in per capita income, reduced cost of poultry products and health considerations. The MENA region production of eggs is about 5.0 million metric tons which constitutes over 6% of World production, while chicken meat production is over 8.0 million metric tons constituting 8% of World production and turkey production is nearly 300,000 metric tons which is about 5% of World production. The top producing countries in both chicken meat and eggs are Egypt and Iran while the top producing countries in Turkey meat are Algeria and Israel. Poultry meat and eggs contribute significant amounts of animal protein to the populations of the region. In North Africa, 27% of total protein comes from poultry meat and eggs, while in the Near East it is 32%. In both North Africa and the Near East, 1.8 g of protein consumed/capita/day, comes from eggs. In the case of poultry meat, 4.0 g are consumed/capita/day in North Africa and 6.5 g in the Near East. Increases in poultry meat consumption in the region has also contributed to increased kcal consumption, particularly in the Gulf area. Poultry production is expected to continue increasing in the region to meet population growth. This increase in production will be influenced by many factors, the most important of which is political instability and wars such as in Iraq and Syria where there were severe decreases in production in the 1980's and 2011, respectively. Besides the political environment, poultry production will be facing other constraints, such as availability of capital and willingness to invest, availability of adequate supplies of grains and protein supplements, development of supporting industries (drugs, vaccines, packaging material, etc...), availability of skilled people for middle management positions, biosecurity measures implemented and disease control.

Keywords: MENA, North Africa, Near East, Gulf region, Eggs, chicken meat, Turkey meat

[K6-02]: FOOD SAFETY AND QUALITY PRODUCTS (ID: 130112)
[France]

Understanding in hen mechanisms of ionic supply, eggshell mineralization and Ca metabolism to control shell defect

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Eggshell formation challenges hen calcium homeostasis because of the intensity of the daily uterine supply of Ca. Hens develop numerous physiological adaptations for providing the shell calcium and carbonate by increasing in mature laying hens by 6-fold the intestinal calcium absorption, by stimulating the active metabolite of vitamin D in the kidney and by developing the uterine capacity to transfer great quantities of Ca²⁺ and HCO₃⁻ ions. Proteomics and transcriptomics have allowed, by comparing protein synthesis between tissues or physiological stages, to identify the proteins involved in intestinal Ca absorption, in uterine Ca secretion and shell mineralization. In addition, these approaches contributed to explore the regulation of Ca transfer. More than 30 ionic transporters have been identified in the intestine and uterus epithelium. It is noteworthy that the Ca, Na, K, Cl and H⁺ intracellular transporters are quite similar in both tissues but are differently regulated. The active metabolite of vitamin D stimulates at sexual maturity and in laying hen the intestinal Ca absorption by increasing gene expression of some transporters but is ineffective to stimulate uterine Ca secretion. In the intestine, Ca absorption also occur by the paracellular pathway. In the uterus, Ca secretion largely occurs through the intracellular pathway controlled by unknown regulators associated with the ovary cycle and by the dilation of the egg. Recently, an additional mechanism of Ca secretion has been revealed in the uterus: amorphous CaCO₃- (ACC) are deposited in vesicles produced in uterine cells and are secreted by exocytosis. ACC is an unstable form of CaCO₃- involved in the nucleation of crystals, this step being a precursor of calcite formation which growth competitively to constitute the eggshell. Both steps are controlled by eggshell matrix proteins. Semi quantitative transcriptomic and proteomic analyses have been used to explore the effect of hens age on efficiency of Ca transfer in the intestine and reveals a lower expression of some genes coding ionic transporters possibly as a consequence of lower production of the active metabolite of vitamin D and higher production of FGF23, a phosphaturic hormone recently identified in birds. A similar approach allowed to identify some target proteins affected by some nutrients allowing a better understanding of their mechanism of action.

Keywords: poultry product quality; cellular ionic transporters; Layers; Laying hen; Egg shell

Quality defaults in slaughtering.

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Besides lesions and abnormalities that are under veterinary inspection in broiler abattoirs there is a substantial loss of parts and full carcasses due to lesions with no public health risks. It mainly concerns lesions that have economic impact in sales quality, like many consumers are not interested to purchase meat with an hematoma in the breast fillet for example. A monitoring program has been developed under the name of “Perfect Carcass®” tool. In total twenty-seven (27) different carcass lesions have been identified and defined in 3 grades of severity: normal, mild and severe. In a visual guide there is a standard description for each of these carcass lesions. Very common skin lesions are skin tears near tail and on the breast, nail scratches with wounds, dermatitis, and cellulitis. Common vascular lesions are wing bleedings in various sizes, breast, and drum bleedings. Among skeletal lesions dislocations in wings (“pop-outs”) are most common. More recently Bacterial Chondronecrosis and Osteomyelitis (BCO) is included in the carcass surveys. The scoring on incidence of the various myopathies is standard: white striping, wooden breast, spaghetti meat, deep pectoral myopathy, dorsal cranial myopathy, and PSE-like meat. On basis of all the data collected for these lesions one can apply them for benchmarking and analyzing the critical points in the production process. An economic calculation model is linked to it for calculating the financial impact of the various lesions. On basis of monitoring broiler flocks in poultry abattoirs in Europe the average economic loss varies between 2% and 8%, with an average of 4%. For an abattoir processing 100,000 birds per day an economic impact of 4% equals to an amount of €4,250 per day, and on annual base this is goes up to €1,100,000. Often with relatively small interventions this can be reduced by a tailor-made plan of action for individual abattoirs and poultry integrations. This monitoring system will act as well for an early warning system in a gradual increase in certain carcass lesions, the presence of subclinical abnormalities or the occurrence of a type of carcass lesion.

Keywords: broilers, carcass, lesions, monitoring, benchmarking

[K7-01]: *BROILER GENETICS and BREEDING: PAST and PRESENT* (ID: 130256)
[Israel]

70 years of broiler breeding for rapid growth - achievements, negative consequences, and their genetic mitigation

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In the 1950's, with the increasing demand for chicken meat in North America and Europe, meat production became an important breeding objective. Rapid growth is essential for efficient meat production, due to efficient utilization of feed, facilities and labor, whereas slow-growth leads to lower efficiency, higher production costs, and higher prices of products. Higher growth rate is driven by higher rate of feed consumption, therefore the selection for rapid growth actually elevate the rate of feed consumption. With higher intake of dietary energy, already in the 1970's excessive fat deposition became a problem for the broiler industry, due to negative attitude of consumers towards carcass fat. Positive correlation between high fatness and high body weight (BW) supposedly hinder combined selection for high BW and low fat, led the primary breeding companies to suggest nutritional and processing practices to mitigate the excessive fatness in commercial broiler flocks. However, the association between fatness and BW was not symmetrical, allowing selecting heavy & lean genotypes, once identified. Because FCR for growth improves as the broilers deposit less fat and more muscles, excessive fatness has been successfully mitigated by the commercial selection for better FCR and for higher breast meat yield. Leg problems emerged in 1980's as broilers grew faster to higher BW. Tibia Dyschondroplasia (TD) was identified as the main cause for these problems. This heritable 'defect' affects the legs only in heavy broilers but is not related genetically to BW. Indeed, successful breeding against TD has been conducted, without compromising rapid growth and high BW. The increasing rate of feed intake elevated broilers' metabolic rate and consequently their demand for oxygen. During the 1980's and 1990's, increasing proportion of broilers failed to meet this higher demand, and developed the ascites syndrome, which hinder growth and leads to death. Also in this case, the genetic 'defect' in the cardiopulmonary system that leads to ascites due to insufficient supply of oxygen, is not associated genetically with rapid growth, but it affects the phenotype only in fast growing broilers. The breeders managed to select individuals with high growth rate combined with high cardiopulmonary capacity, successfully reducing the incidence of ascites while continuing to improve growth rate. In recent years, breast muscle myopathies are showing up, mainly in flocks of 'high-yield' broilers, when reared under conditions allowing very rapid growth to high BW and breast yield. If the tendency to develop myopathies is heritable, and if myopathy-free individuals can be identified and are not genetically inferior in growth and yield, also the myopathies are expected to be mitigated by breeding.

Keywords: Genetics, broiler breeding, rapid growth, high meat yield, myopathy, achievements, leg problems, negative consequences, genetic mitigation

Poultry production and health: Current and future challenges.

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Currently several factors and problems are influence the poultry production worldwide. These include strong global competition, continuous changes of consumer perceptions with regard to food safety, animal welfare and environmental protection. The loss of consumer confidence and trust in the quality and safety of poultry meat and poultry products will remain a major challenge. Many human foodborne bacterial infections are linked to poultry. Control and/or elimination of these organisms present a great challenge. The development of antibiotic resistant bacteria will also be a continuous public health hazard. The future concept of animal health will cover not only the absence of disease in birds, but also the relationship between the health of animals and their welfare. It will also consider the social, economic and ethical aspects and environmental protection. Emergence and re-emergence of infectious poultry diseases will remain an important non-ending challenge. Currently, only a few authorized pharmaceutical veterinary products will be available for the treatment of poultry as food producing animals. The development of efficient vaccines against bacterial infections will lead to a reduction of the use of antibiotics and subsequently will reduce the development of resistant bacteria. Genetic resistance and selective breeding to improve production traits and health is a long-standing goal of the poultry industry. Improvement of rearing technology, management and nutrition will help to maintain bird comfort. Recently, in 2020 the World Health Organization (WHO) announced the official name for the disease that is caused by this new coronavirus (COVID-19), which was named severe acute respiratory syndrome coronavirus type 2 (SARS-CoV2). which it is rapid spread across many countries. It is important to know that chickens are not susceptible to intranasal infection by the SARS-CoV-2 (COVID-19) virus. However, the COVID-19 pandemic indirectly affects poultry consumption, transport, and the economics of poultry farming. Finally, all the partners of the poultry production chain should be involved in the current situation to ensure food und human safety.

Keywords: coronavirus, COVID-19, SARS-CoV2, foodborne bacterial infections

Strategies and practices to prevent keel bone damage in poultry industry

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The extremely high frequency and severity of keel bone damage (KBD) represents one of the greatest welfare problems facing the poultry industry with an estimated 30 to 90 % of a flock having some level of damage to the keel by 45 weeks of age. Despite the extent of the problem, the research community remains uncertain as to the causes and influencing factors of KBD. Recent reports suggest that KBD, while highly variable and likely dependent on a host of factors (including age, rearing environment, nutrition, genetic line, housing system), extends to all housing systems (including traditional battery cages, furnished cages and non-cage systems), genetic lines, and management styles.

The aim of this paper is to review current knowledge about risk factors for keel bone damages of laying hens and provide innovative strategies and practices in housing and management, genetics, and nutrition, necessary to prevent the problem of keel bone damage in order to meet the high standards of welfare and productivity demanded by the European Community. Each strategy or practice is considered on its own merits as related to the production phase (rearing or lay) and whether the adaptation may affect other aspects of the flock. The paper concludes by highlighting the key areas where innovative research is needed.

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Keywords: Keel bone



Oral Communications Sessions

Phenotypic characterization of two native Italian chicken (*Gallus gallus domesticus*) breeds for quantitative semen production and behavioural reactivity.

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The aim of the present work was to characterize and compare bird reactivity and semen production in the native Italian chicken breeds Bionda Piemontese (BND) and Bianca di Saluzzo (SLZ). Reactivity was assessed by behavioural tests related to fearfulness: Tonic Immobility (TI) and Emergence Test (ET). Thirty-five roosters, 17 BND and 18 SLZ, were housed in single cages in controlled environment and ejaculates were routinely collected twice per week. Twelve different phenotypical parameters were tested: body weight (LW), semen volume (VOL), semen concentration (CON), total sperm output (TSO); in TI: number of induction (N, max 3; TINI), TI duration (s, max 180 s, TIDU), number of vocalization (n, TIVO); in ET (max latency time 180s): head emergence out of the box latency (s, ETHE), first step out of the box latency (s, ETFS), bird's complete emergence out of the box latency (s, ETCE), number of vocalization (n, ETVO), defecation (n, ETDE). Data have been analysed using Proc GLM of SAS® 9.4 (source of variation: breed) and PCA (Past@4.05). Significant differences were found between breeds in LW and ET parameters. BW was heavier in BND compared to SLZ roosters (3290 g vs 2840 g). SLZ roosters showed higher latencies in ETHE, ETFS, ETCE and ETVO. Higher vocalisation frequency was recorded in BND birds (2.9 vs 0). PCA analysis revealed high breed-based clustering ability of the birds on PC1 and PC2. PC1 described the 90.29% of the variance and it was influenced by LW and TIDU (99.89%, 4.29%). In conclusion, the two breeds significantly differed in relation to their behavioural reactivity and body weight, whereas smaller difference was found in relation to semen production ability. The SLZ roosters combined lighter LW with higher fear response. These behavioural traits should be taken into consideration not only for phenotypical characterization, but also as objective information useful to optimize bird handling for semen collection in rare poultry breeds in order to implement the ex situ in vitro technique in conservation programs.

Keywords: Semen; Biodiversity; Welfare; Behavioural Reactivity.

Effect of feed consumption and age at light stimulation on broiler breeders' performance up to 50 wk of age

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A trial was conducted to study the influence of feed intake from 0 to 29 wk and the pullets age at light stimulation on Cobb 500 Broiler Breeders hens' productivity. The trial was divided in phases: starter from 0 to 4 wk, development from 5 to 17 wk, pre-laying period from 18 to 24 wk and production from 25 to 50 wk of age. The experimental design was completely randomized with 4 factorially organized treatments with two main effects: intake levels with high feed intake (HFI) and low feed intake (LFI), and age of the pullets at light stimulation with early age (144 d) and late age (154 d) and their interaction. A common standard feed as Cobb 500 breeder guide was used in all the trial phases, and the difference between HFI and LFI was the quantity of feed adjustment. High feed intake pullets received the standard Cobb 500 feeding program, however, LFI pullets received 8% less feed from 0 to 24 wk and 2,2% less feed from 25 to 29 wk. From 30 to 50 wk of age, all hens received the same amount of feed. Each treatment was replicated 8 times and the experimental unit was the department (5,37 × 2,42 m) with 72 birds each and a stocking density of 5,5 pullets/m². The main effects were statistically analyzed, as well as the possible interactions. Live body weight (BW) of the birds was determined individually at 24 wk of age and BW uniformity calculated. The number of total eggs laid and the laying index were determined in the laying period. At 24 wk of age, pullets fed the standard Cobb treatment showed higher BW than pullets with a LFI (3.440 vs. 3.204 g; P < 0,0001) and had a better BW uniformity. From 25 to 50 wk of life (production), pullets receiving an adequate amount of feed according to the Cobb standard reached peak production earlier (30,7 vs. 31,4 wk; P < 0.05) and tended to produce more total eggs per hen housed at 50 weeks of age (125 vs. 123 eggs; P = 0.08) than pullets feed LFI. However, laying index was not affected by feed intake level. Pullets receiving early light stimulation tended to produce more total eggs per hen housed at 50 weeks (125 vs. 123 eggs; P = 0.09) than pullets receiving late light stimulation. It is concluded that supplying a standard quantity of feed and early light stimulation did not affect peak production, but both effects tend to increase total eggs produced per breeder hen housed because pullets coming earlier into production.

Keywords: Breeder hens; feed intake; light stimulation; laying index; egg production.

Assessing of Runs of Homozygosity in indigenous poultry breeds of the Veneto region

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The availability of single nucleotide polymorphism (SNP) assays allows the determination of segments based on runs of consecutive homozygous genotypes (ROH). The aim of this study was the characterisation of ROH in 8 local Italian chicken breeds (Ermellinata di Rovigo (PER), Millefiori di Lonigo (PML), Polverara Bianca (PPB), Polverara Nera (PPN), Padovana (PPD), Pepoi (PPP), Robusta Lionata (PRL), and Robusta Maculata (PRM)). A total of 152 animals were genotyped using the Affymetrix 600 K Chicken Array. The following parameters were used to define the ROH: (i) the minimum length of 1Mb, (ii) two missing SNPs and up to one possible heterozygous genotype, (iii) the minimum number of SNPs that constituted the ROH was set to 100. Inbreeding (F) based on runs of homozygosity (FROH) was estimated. PPP breed showed the highest mean value of inbreeding (FROH = 0.478), followed by PRM (FROH = 0.413), whereas PML showed the lowest one (FROH = 0.161). A total of 19,548 ROH segments > 1 Mb were detected. The mean number of ROH per individual ranged from 55,45 (PML) to 172,27 (PRM). Each ROH segment was categorized based on its physical length in five categories, and the mean sum of ROH per breed was also calculated. All breeds showed the majority of ROH segments <4 Mb in length. PPN had a larger mean portion of their genome (11.4 Mb) covered in longer ROH (>16 Mb). High coverage within the short category of ROH may indicate a relatively high contribution of ancient inbreeding in the breeds, whereas the higher coverage of long ROH suggests a more recent inbreeding effect. Finally, the percentage of SNP residing within a ROH was estimated to identify the genomic regions of high homozygosity. Six genomic regions were identified among all breeds, with candidate genes involved in multiple morphological phenotypes as breast muscle, muscle dry matter content and body weight. The results are of significant importance because they will help design and improve conservation plans, especially for breeds with a reduced population size and high inbreeding level (e.g. Pepoi).

Keywords: Poultry Veneto, Affymetrix 600 K, Runs of consecutive homozygous, Genetic characterization

Genetic characterization of indigenous chicken breeds of Italian North-central region

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Local breeds are an important biodiversity source, especially for genetic features; indeed, those populations show unique alleles or allelic combination coding for specific traits. This study aimed to assess a genome-wide comparative analysis of 13 autochthonous Italian chicken breeds, to understand their genetic diversity and distance, and population structure. A total of 312 animals (24 per breed, 12 males and 12 females) were analyzed using Affymetrix Axiom 600 K Chicken Genotyping Array. The studied breeds were: Ancona (ANC), Modenese (MOD), Romagnola (ROM), Ermellinata di Rovigo (PER), Millefiori di Lonigo (PML), Polverara Bianca (PPB), Polverara Nera (PPN), Padovana Dorata (PPD), Padovana Camosciata (PPC), Padovana Argentata (PPA), Pepoi (PPP), Robusta Lionata (PRL), and Robusta Maculata (PRM). Blood samples were collected between December 2018 and April 2019 in conservation centres of Ceregnano (Rovigo), Feltre (Belluno), Castelfranco Veneto (Treviso), Padova and in different private and academic farms in the countryside around the cities of Nonantola (Modena), Bologna, Perugia, Ascoli Piceno, Ancona and Frosinone. The individual SNPs profiles were statistically analyzed to determine the following parameters: expected and observed heterozygosity (He, Ho), MAF average, genetic distances between breeds, molecular co-ancestry. In order to clarify the genetic relationship among studied breeds, a multidimensional scaling analysis was carried out. PRL and PRM breeds grouped together in the same cluster, as also PPB and PPN according to their similar origins. PPP and PRM are the two most separated breeds, while PPD is closed to the two Polverara breeds due to the same evolutionary history as PRL and PRM that are characterized by common ancestors. In the neighbour-joining tree, based on the Reynold's genetic distance, the longest branch belongs to PPP. The He and Ho are similar in all the breeds, however, in PML are both clearly higher. Genetic variability was slightly larger for all breeds but we can distinguish two groups: the first with PER, PML, PPB, PPD, PPP and PPN; the second one including PRL and PRM. This is the first exhaustive genome-wide study of these Italian local chickens, that show a conserved authentic genetic pattern. The results have significant importance for designing and improving conservation strategies.

Keywords: Genetic diversity, Population structure, Local poultry breed, SNP marker.

Data, big and small, the way to optimisation in animal production

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In a world of increasing mechanization, reduced available labour in agriculture, rising cost and diminished margins in farming, any production facility (from hatcheries, farms to processing plants and feed mills) needs to be driven ever more by efficiencies. The best and only way to drive optimization is through data. Data must be accurate and relevant. Data can be used not only to, for example, manage flock performance and benchmark them within the company, in the area or even other countries, but also to produce trends that can be very useful to draw conclusions, to know how a hatchery or an abattoir are doing but also connect them with each other. Data must be analysed and presented on a regular basis to all departments within the organisation so the information can be also linked to relevant events that have happened, such as a new procedure introduced, changes in a practice already in place, a new supplier, a novel disinfectant even in different Department within the organisation. But to be able to do this is, it is also necessary to keep records of all these new changes, to be able to accurately pinpoint the event in time and analyse any potential relationship with Key Production Indicators (K.P.I.). Data will help to make decisions when assessing new practices, equipment, etc., not only from a biological point of view but if it also makes financial sense as a whole. Data is essential when investigating a problem. Data provides evidence-based information needed to make changes within the organization at all levels, as the famous American businessman W. Edwards Deming said once: “You can’t manage what you don’t measure”. And most importantly, data is needed to make decisions and be in control of what is happening in the operation at all levels of the business as well as try to make predictions of future potential outcomes and plan accordingly.

Keywords: Data; performance; optimisation.

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[Turkey]

Alternative sustainable broiler feed formulations with local ingredients and Black soldier fly larvae: what do stakeholders think in Turkey?

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The sustainability of poultry meat production is becoming critically important due to the growth in world population, higher demand for animal protein, and the consequent pressure on natural resources. Broiler production is an important source of animal protein, with one of the best feed conversion rates and the smallest environmental footprint among meat-producing animals. However, diet-related environmental effects are high due to fertilizer and pesticide use in the production of feed ingredients and large-scale transport networks. Soybean meal, a major protein source in broiler diets, represents more than 20% of the global CO₂ emission in the chicken meat supply chain. In 2021, approximately 2.5 million tonnes of soybean were imported by Türkiye, mostly from Brazil. More sustainable production can be achieved by replacing the soybean meal completely or partially with local eco-friendly alternative ingredients. The purpose of this study is to evaluate whether a sustainable diet, involving partial replacement of soybean with local feed ingredients, by-products, and black soldier fly larvae, would be acceptable to stakeholders in Turkey. Living Lab activities were carried out in form of online semi-structured interviews with animal scientists, organic and conventional broiler farmers, feed manufacturers, and representatives of the relating NGOs, in September 2021 and February 2022. Market trends, availability of alternative protein sources and local by-products, and the acceptability of alternative diets were discussed. The participants raised a medium level of concern about the environmental impact of diets with high proportions of soybean meal. Although they agree that accessing high-quality protein sources is becoming more valuable than ever in terms of sustainability; they consider that the nutrient content, availability, and price of alternative ingredients are more important than environmental sustainability. It is inferred that the acceptance of alternative sustainable diets by producers will heavily depend on economic factors. However, it is also promising to meet producers and feed providers who currently practice the use of alternative ingredients even if to a minor extent. The results further indicate that attempts to increase the sustainability of broiler diets should consider no more than 10-20 % increase in feed costs which would pass through on meat prices.

Keywords: alternative protein sources; soybean; corn; broiler; feed prices

Local Italian poultry breed for alternative farming systems development

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Poultry biodiversity is essential in promoting sustainable and low input farming systems [1]. The aim of this research was to compare performance and welfare of five different poultry genotypes reared in a free-range housing system and fed a low-input diet (Italian GMO-free ingredients, with partial substitution of soy with beans). A total of 21 d/old 150 male birds of two Local Italian breeds (LIs: Bionda Piemontese (BP) and Robusta Maculata (RM)), two crossbreed (F1s: RMxSasso (RMS), BPxSasso (BPS)) and a commercial hybrid (Ross 308 (C)) were randomly allotted in free-range pens with “natural” environmental conditions (no control over temperature, humidity, and ventilation). Animal density was 21 kg/m² indoor and 1 m²/bird outdoor. Three replicates for each genotype were set for a total of 15 pens. Live weight (LW), mortality, and feed intake (FI) were recorded, and feed conversion ratio (FCR) was calculated. Moreover from 73 to 80 d/old, behavioural patterns such as: feeding, locomotor, resting, comfort, and stretching were registered during 2 periods of 1.5 h each and outdoor use (% of birds outside) was calculated. Slaughtering was performed when birds reached 81 d/old. Differences between groups were assessed by ANOVA test with a Bonferroni multiple t-test ($P < 0.05$). Nonparametric tests were performed on behavioral categories and mortality rate and significance was evaluated by χ^2 and set at $P < 0.05$. Results showed a strong effect of genotype on productive performance ($P < 0.005$). C group showed the highest LW, FI and lowest FCR, while mortality in C birds was significantly higher (4%) than in LIs and F1s (0%) ($P < 0.005$). F1s showed significantly increased performance compared to LIs ($P < 0.005$). In the behavioural analysis, genotype effect was particularly significant for outdoor use, foraging, moving, resting, and comfort ($P < 0.005$), and stretching ($P < 0.05$). C birds presented highest resting, comfort, and stretching and lowest locomotor activities, showing poor outdoor use with just 0-25% of birds observed spending time outside. On the contrary, LIs and F1s performed activities mainly outdoor, moving and foraging were performed by 75-100% of birds in the outdoor area. Combining the analysis of bird's performance and welfare parameters, C birds showed to be poorly adapted to the free-ranging housing system, whereas F1s presented the best welfare conditions with increased growth performance compared with LIs ($P < 0.005$). In conclusion, these results could be useful to improve the economic income of low input and alternative farming systems and consequently their sustainability. Moreover, the use of crossbreeding could improve extensive farming systems considering the significant increase of F1s growth performance and could also help protect local breeds using appropriate mating scheme resulting in the offspring heterozygosity increased and inbreeding decreased. It could also represent a good opportunity for the conservation of poultry biodiversity, through the collaborations between National Research Institutions, Conservation Centres and Local Farmers. [1]FAO, The future of food and agriculture: trends and challenges, vol. 4, no. 4. 2017.

Keywords: Poultry Biodiversity; Crossbreeding; Alternative Farming System

Turkey meat quality traits as affected by gender and muscle type

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Turkey meat is the second most consumed poultry meat worldwide and represents an economic source of high-quality proteins for human consumption. Also in Mediterranean area its production and consumption have been increased during the last decade. Few studies have been conducted in order to characterize meat quality traits in turkeys and most of them only considered meat obtained from P. major muscle. For this purpose, ten females (101 d-old and 9.9 kg at slaughter) and ten males (142 d-old and 21.0 kg at slaughter) Big 6 turkeys were selected and ten muscles representing the main cut-ups were dissected from each carcass: breast (Pectoralis major and Pectoralis minor), wing (triceps humeralis muscle), thigh (sartorius, semimembranosus, ileotibialis and biceps femoris muscles), drumstick (peroneus longus, flexor perforans et perforatus digiti III, gastrocnemius pars interna muscles). Each muscle was used to assess ultimate pH following the iodoacetate method and colour using a Minolta Chromameter CR-400 with illuminant source C and readings expressed using CIE values for lightness (L*), redness (a*) and yellowness (b*). Two-ways ANOVA was performed using a model including gender, muscle type and their interaction term. As expected, both gender and type of muscle affected the most important parameters selected for meat quality assessment. As for gender, male turkeys exhibited lower ($P<0.01$) ultimate pH and higher ($P<0.01$) L* values in the most of muscles considered in the present study. These differences can be likely exacerbated by the large divergence in the slaughter age (14 vs. 20 wks-old) adopted under commercial conditions. Otherwise, redness and yellowness were not modified according to the gender of birds. Concerning the effect of the type of muscle, as expected, significant ($P<0.01$) differences were found in both pH and colour coordinates. Indeed, overall breast and wing muscles showed significantly lower values of ultimate pH, redness and yellowness when compared with thigh and drumstick muscles, which did not differ from each other. These outcomes can be ascribed to the different in vivo metabolism of the examined muscles (glycolytic vs. oxidative). Considering the current different use of turkey meats under commercial conditions, these results can be useful to define the threshold values suitable for establishing quality categories of meat according to gender and muscle of origin.

Keywords: turkeys; gender; muscle; meat quality; pH; colour

Effect of electrical stimulation, deboning time and marination on fresh and frozen broiler meat quality

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It is quite tough to fulfil the demand for broiler meat with the desired quality parameters and processing time. Consumer's perception and awareness about tenderness is the major driver that has urged the processors to produce quality meat products. Post chill deboning time is the determinant factor for ultimate poultry meat toughness. A total of 96 Cobb birds were subjected to eight treatments: electrical stimulation (yes=48 /no=48) along with the post-chill deboning time (0hr and 4hrs) and two marinating methods fresh frozen marination (FFM) and fresh marination frozen (FMF). The pH, colour, marination, water holding capacity, cooking loss, tenderness and sensory attributes of chicken breast were observed against the treatment combinations. Electrical stimulation significantly improved ($p \leq 0.05$) marinade penetration of breast fillet, tenderness, water holding capacity, pH and aroma after cooking while non-significant results for a^* , b^* , L^* , chrome, and hue. Meanwhile, a significantly improved ($p \leq 0.05$) colour was observed in fresh marinated frozen samples compared to fresh frozen marination. Deboning time (4h) significantly ($p \leq 0.05$) reduced the ultimate pH and chrome value while significantly ($p \leq 0.05$) improved water holding capacity and reduced cooking losses were observed for deboning time (0h) with colour attributes a^* , b^* , and L^* remain unaffected. The flavour of cooked broiler meat was non-significantly influenced by electrical stimulation, deboning time and marination methods. Electrical stimulation significantly ($p \geq 0.05$) improved marinade penetration compared to deboning time and marination methods. Overall acceptability remained unaffected by electrical stimulation, deboning time and marination methods. Electrical stimulation can be helpful to accelerate the post-slaughter biochemical changes resulting in reduced processing time by sustaining the meat quality and safety.

Keywords: Breast meat; deboning time; electrical stimulation; meat quality; marination

Effects of including camelina cake in laying hens on physic-chemical and sensory egg quality

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Camelina cake is a by-product from the crop and extraction of *Camelina sativa* oil, which is a potential source of protein, energy and omega-3 fatty acids in poultry feeds. The objective of this work was to evaluate the effect of including increasing levels of camelina cake (0, 5, 10 y 15%) in laying hens' feed on physic-chemical and sensory quality of egg. A total of 240 39-week-old Lohmann Brown-Classic hens were organized in 60 cages with 4 animals each that were homogeneously distributed into 5 treatments: control feed (C), based on corn and soybean meal, and three treatments with 5, 10 and 15% inclusion of camelina cake as a substitute of soybean meal. The composition in nutrients and fatty acids (FA) were determined in camelina cake and feeds. During the experimental phase (12 weeks), feed intake, hens' weight and physicochemical egg quality were recorded periodically. At the end of the trial, the percentage of FA in yolk was determined in all treatments. In addition, the sensory quality of eggs from C and 10% of camelina cake inclusion treatments was evaluated by consumers. The camelina cake had 38,5% crude protein, 10,6% ether extract, 32,4% neutral detergent fibre, 3,6% erucic acid and 27,9% linolenic acid (omega-3 fatty acid). Feed consumption was significantly lower in hens fed with the highest camelina cake inclusion level (15%) during the first 29 days compared to treatment C; however, the differences disappeared thereafter. The thickness and proportion of shell and the intensity of yolk color were reduced with inclusion levels of 10% or higher. Haugh units were lower in C treatment compared with camelina treatments. In parallel, a linear ($P<0.05$) increase in omega-3 FA was observed in the yolk with increasing camelina cake in feeds. However, consumers found no differences in the sensory properties of eggs from C treatment and 10% camelina inclusion, nor in fresh neither after 3 weeks of storage at 4°C. In conclusion, the inclusion of up to 10% of camelina cake replacing soybean meal in layers feed gives rise to acceptable quality traits, with increased proportion of omega-3 in yolk and no effect on sensory properties. However, shell quality could be impaired at this inclusion levels probably due to unexpected imbalances in digestible mineral content in feeds. Acknowledgments: supported by the Spanish Ministry of Economy and Competitiveness (RTC-2015-3265-5) and European Regional Development.

Keywords: Camelina cake, layers, physic-chemical egg quality, sensory egg quality

Effect of eggshell temperature on bone parameters of layers

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Incubation temperature is one of the parameters affecting embryo development. Constant eggshell temperature between 37.5 and 37.8 °C throughout the incubation period promotes hatching performance and chick quality. Slight deviations in incubation temperature have been shown to affect bone mineralization in broilers. High calcium requirement during the eggshell formation have led to bone weakness and increased bone susceptibility to fractures in laying hens. This problem reduces the welfare of layers and results in economic losses. The current study aimed to determine the effect of higher incubation temperatures from d 7 to 21 on bone parameters of laying chicks. Two thousand, one hundred eggs from a white egg-type breeder were incubated for 7 d at 37.5°C. From 7 to 21 d, eggs were incubated at one of two eggshell temperatures of 37.5°C (Control, I-Cont) and 38.5°C (high, I-High). On hatch day, hatching performance and hatch weight of chicks were determined. Weights and dimensions of the tibia, femur, and humerus were obtained and ash content of bones was determined. The chicks from each incubation temperature were reared for 18 weeks. Body weights of hens and bone parameters were measured. Hatching performance was not influenced by incubation temperature, however, I-High resulted in reduced hatch weight, longest tibia, heavier and larger femur were obtained compared to I-Cont. At 18 weeks, I-High pullets had longer tibia than I-Cont pullets. I-High increased tibia ash at 18 weeks, however, the effect of incubation temperature on bone mineral content and bone mineral density was not significant. In conclusion, higher incubation temperature appeared to affect bone parameters up to 18 weeks.

Keywords: Incubation temperature; laying chick; laying hen; bone

Bone mineralization and bone quality in chickens**Alejandro B Rodriguez-Navarro¹, Heather McCormack², Nazaret Domibguez-Gasca¹, Cristina Benavides-Reyes¹, Ana I Garcia-Ruiz³, Ian Dunn²**¹Universidad de Granada, Granada, Spain, ²The Roslin Institute, University of Edinburgh, Roslin, UK, ³Trouw Nutrition R&D, Toledo, Spain*Corresponding author: anava@ugr.es*

Laying hens and broiler (meat-type) chickens have an extreme physiology (highly efficient calcium metabolism or rapid growth rates) that challenges correct bone mineralization. They are an interesting model for studying bone pathologies (i.e. avian osteoporosis, skeletal deformation) commonly observed in these birds and that are caused by high calcium-demanding processes (i.e., for eggshell formation) or by their extreme growth rates. These problems have important economic and animal welfare implications and will become even more prominent as the poultry industry is pushing for increasing egg production, extending the production cycle in laying hens and further increasing the growth rates of broilers. Bone quality in chickens is determined by genetics, age, nutrition and/or physical activity among other factors. To better understand the influence of these factors on bone quality and in the prevalence and severity of bone skeletal problems, we have compared bone characteristics in lines of chickens having extreme bone mechanical properties (i.e., breaking strength), different ages, egg production and that had different diets and nutritional supplements or that were housed in systems, with restricted mobility, and in housing systems that allows increased physical activity. We used an array of complementary analytical techniques (ICP-OES, FTIR, XRD, SEM, TEM, micro-CT) to study in detail changes in bone chemical composition and structure parameters in different experimental groups of chickens.

Keywords: Bone, laying hens, broilers, calcium metabolism, growth rate

[03-06]: *QUALITY OF PRODUCTS* (ID: 130073)
[Spain]

Relationship between bone quality, egg production and eggshell quality in laying hens at the end of an extended production cycle

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Nowadays, there is the need to improve lay persistency and egg production in older hens while maintaining egg quality to achieve a production of more than 500 eggs in an extended laying cycle of 100 weeks. This challenges hen health as intensive egg production deteriorates skeletal integrity and induces severe osteoporosis in laying hens as eggshell formation mobilizes large amounts of calcium from the skeleton (mainly from medullary bone). In this study the relationship between bone quality and egg production, and/or eggshell quality was evaluated at the end of an extended laying cycle of 105 weeks. Hens with a high production and good eggshell quality have poorer bone quality due to a greater skeletal calcium mobilization and as a result have lower calcium reserves in the form of medullary bone. They also have a larger and better developed uterus able to sustain high egg production and transfers calcium more efficiently. Though laying hens with high egg production and good eggshell quality have generally poorer bone quality (lower breaking strength, lesser amount of medullary bone), the relationship between egg production and bone quality is poor so bone and egg traits can be improved separately. Adequate hen nutrition is crucial for optimum hen development and for maintaining overall laying hen health during extended production cycles.

Keywords: laying hens; bone quality; osteoporosis; aging; eggshell quality

[03-07]: *QUALITY OF PRODUCTS* (ID: 130117)
[Spain]

Influence of management on *Salmonella Infantis* shedding and antibiotic resistance evolution during growing period: preliminary results

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Salmonella spp. is a zoonotic pathogen that causes the majority of gastrointestinal outbreaks in industrialized countries. Furthermore, this bacteria gender involves great economic losses in the European poultry sector. In broiler farms, *S. Infantis* is currently the most emergent serovar isolated. In addition, transmission of antimicrobial resistant bacteria from animals to humans is a major threat to public health worldwide. On the other hand, different studies showed that if animals are in good health, their resilience is increased, and their stress levels are lower. As a consequence, an investment on management measures at farm level, could directly affect the control of pathogenic and antibiotic resistant microorganisms as *Salmonella* in the food chain. In this context, the objective of this study was to analyze the evolution of *S. Infantis* shedding and its antibiotic resistance patterns throughout the growing period, in relation to density and ventilation management of the flock. The experiment was performed in two identical poultry houses, and two environmental farm conditions were evaluated: commercial (35kg/m² of density and non-optimal ventilation) and optimal farm conditions (17kg/m² of density and optimal ventilation). At 24 hours of rearing, 20% of animals were orally infected with a *S. Infantis* strain susceptible to all the antibiotics tested. To study *Salmonella* shedding, feces samples of each experimental group were taken weekly and analyzed in accordance with ISO/TS 6579-2:2012. After that, antibiotic susceptibility was assessed according to Decision 2013/653. For both experimental groups, the lowest *Salmonella* count was observed during the first week post-infection, the excretion counts increased until mid-period and then became stable until slaughter day. Isolates from both groups were multi-resistant to antibiotics. In conclusion, the *S. Infantis* shedding increases during the growing period and the isolates become antibiotic resistant, regardless of the management measures. This fact demonstrates the importance of the horizontal dissemination of antibiotic resistances in zoonotic bacteria at farm level. Therefore, it is necessary to have a better knowledge of antibiotic resistance patterns in order to establish better surveillance programs.

Keywords: Antimicrobial resistance; multidrug resistance; broiler; growing period; *Salmonella*

[03-08]: *QUALITY OF PRODUCTS* (ID: 130132)
[Spain]

Bacteriophage prevalence from poultry farms according to the productive orientation: preliminary results.

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Salmonella spp. remains one of the main bacteria involved in foodborne outbreaks, being a worldwide major public health. Furthermore, the emergence of several antibiotic resistance serotypes in poultry derived products underscores a significant food safety hazard. For this reason, it is necessary the study of alternatives to antibiotic treatments at farm level. In this context, the use of bacterial viruses, as bacteriophages, against bacterial infections has been reconsidered. It seems to be a good option due to their minimal environmental impact, self-perpetuating, self-limiting and specificity. In fact, different researchers have demonstrated their success in poultry products. Nevertheless, the knowledge of Salmonella bacteriophages prevalence on the field is quite limited. Therefore, the aim of this study was to assess the Salmonella phages prevalence in poultry commercial farms. To do that, faeces samples obtained from poultry farms (layers and broilers) were incubated together with Salmonella strains, isolated from the Salmonella National Control Program, for bacteriophages isolation. For the strains' characterization, antimicrobial sensibility pattern was performed by MIC method using commercial plates. Then, bacteriophages were isolated and purified by spot test. Results from the study showed a high prevalence of phages in poultry farms, being higher in broiler than in layers. Regarding prevalence per serotype, the main bacteriophages were isolated against *S. Enteritidis* in both livestock productions, followed by *S. Virchow* and *S. Typhimurium* in broiler and layers, respectively. The broad prevalence of Salmonella bacteriophages in the poultry environment suggests that these viruses may play a role in the microbial ecology of the farm. However, genotyping characterization is needed to understand the biology of these bacteriophages more fully.

Keywords: Salmonella; Bacteriophages; prevalence; control

Polyphenols as effective solution to improve meat quality and antioxidant status of broilers

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Intense farming contributes to increased oxidative stress, with harmful implications for health, productivity, carcass dressing and meat quality. The aim of this study was to determine the effect of different doses of a polyphenol blend (ELIFE®) on the antioxidant potential and meat quality of broiler chickens. The experimental design comprised 1440 Cobb® male day-old chicks (4T*9R*40) assigned to 4 dosages: T1 – negative control, T2 – supplementation of 250 mg kg⁻¹, T3 – supplementation of 500 mg kg⁻¹, and T4 – supplementation of 1000 mg kg⁻¹ in finisher phase only. A 3-phase standard corn soybean meal diet (60 ppm vit E) was fed. At the end of the experiment, breast muscle and legs were removed from the carcass and weighed to calculate carcass yield (n=9). Meat quality was determined by the evaluation of thiobarbituric acid reactive substances (TBARS) on breast muscle and oxidative stress was determined by the analysis of glutathione (GSH), glutathione transferase (GST), and lipid peroxidation (LPO) on the liver samples from these same birds. Although not significant, a dose response was found for proportional breast muscle weight. A one percent increase was also found for proportional drumstick weight for the highest inclusion compared to the control. TBARS are formed as a byproduct of lipid peroxidation and indicate damage produced by oxidative stress. TBARS were significantly ($p < 0.0001$) lower for all supplemented groups compared to control. LPO in the liver was also reduced with the inclusion of the polyphenol blend compared to the control, although not significant. GSH content in the liver significantly ($p = 0.0066$) increased with supplementation, indicating less oxidation. GST is an enzyme that interferes in the conversion of reduced glutathione (GSH) into its oxidized form (GSSG). High intracellular concentrations indicate injury to those cells. Its concentration in the liver decreased significantly ($p = 0.019$) with supplementation above 500 mg kg⁻¹ compared to control. In conclusion, supplying polyphenols to fast growing broilers protects them against oxidative stress, with decreased lipid peroxidation and improved meat quality as a consequence.

Keywords: polyphenols; antioxidant; oxidative stress; meat Quality; broilers

[O4-01]: POULTRY HEALTH (ID: 130014)
[Belgium]

Avian Influenza H3N1 outbreak in the western part of Belgium 2019: lessons learned and strategies for the future

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In the spring of 2019, the Belgian poultry industry was affected by an outbreak of LPAI H3N1. This outbreak caused great losses in the western region of the country. The Intra Venous Pathogenicity Index IVPI, that was performed with the virus isolated beginning of April resulted in an IVPI of 0,13, indicating a LPAI. In the field the virus behaved in a very pathogenic way. The disease initially mainly affected older birds, layers and breeders, with high mortality - up to 70% - and a drop in egg production sometimes to 0%. The virus was isolated from different organs, not only from the respiratory tract. Lesions at necropsy also included peritonitis, inflammation of reproductive tract, brain and other organs. No other disease agent, apart from the H3N1 AI- virus was detected in affected flocks. An experimental infection with the H3N1 virus alone was carried out at GD -Netherlands, with layer birds in production at 34 weeks, and confirmed the symptoms seen in the field: high mortality 63%, drop in egg production to 0% and peritonitis. There is an indication of a very strong adaptation of the virus to the chicken as host with very high virus excretion (based on low CT values PCR testing) and rapid spread to neighbouring farms in the region. During the outbreak, younger birds were affected: layers during rearing, turkeys and even broilers. In total more than 120 flocks- breeders, layers, turkeys and broilers- were affected by this outbreak. causing a lot of animal suffering and great economic losses. For this type of LPAI virus, there is no EU regulation, or any legal action taken by the authorities to eradicate the disease by culling and compensation for the farmers. The virus was able to spread rapidly in the area causing a lot of animal suffering and great economic losses. To avoid this kind of threat to animal welfare, food safety and economic damage to the poultry sector, steps should be taken to change the legislation at EU and global level, so similar outbreaks can be handled adequately, by culling and eradication at an early stage.

Keywords: Avian Influenza, low pathogenic, biosecurity

Virucidal effect of a disinfectant based on quaternary ammonium compounds and glutaraldehyde against the avian influenza virus - 3 validation trials

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Avian influenza (AI) is a notifiable disease listed by the OIE. It is a highly contagious viral disease affecting several species of birds. AI outbreaks impact animal and public health, trade and economy in affected countries. Biosecurity measures, including cleaning and disinfection, are key to reducing the risk of disease introduction in the farms and to preventing the subsequent spread of the virus. Disinfection of materials contaminated with AI is an essential aspect in the process of prevention and control of outbreaks. Due to the critical role that proper farm hygiene can play in mitigating the AI risks, a series of independent studies were conducted to validate the virucidal efficacy of Virocid® (broad-spectrum disinfectant based on quaternary ammonium compounds and glutaraldehyde) against AI. Three studies were carried out in independent laboratories and utilized separate methods and procedures to examine the virucidal efficacy of Virocid® against 3 different viruses (H5N1, H5N8 and H9N2). Study 1 was conducted at the Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe), OIE Reference Laboratory for Avian Influenza and Newcastle disease, Italy. The study employed the official AOAC methods and consisted of the laboratory evaluation of the disinfectant Virocid® as a virucidal against High Pathogenic Avian Influenza (HPAI) Virus, H5N1 subtype. Results showed that Virocid® at the recommended concentration (0.25%) is not toxic for developing chicken embryos and is able to fully inactivate a viral suspension of HPAI H5N1 subtype, strain A/duck/Vietnam/12/05 containing 107.5 EID₅₀/ml. Study 2 was conducted at the Wageningen Bioveterinary Research, Netherlands and was performed to test the efficacy of the disinfectant Virocid® against the HPAI virus H5N8 and to examine the effective dilution of the disinfectant. In order to pass the test, a disinfectant should show a minimum of a 4 log₁₀ reduction in titre after 30 min at 10°C (obligatory test conditions NEN EN 14675 norm). The disinfectant Virocid® showed at all dilutions at 3 g/l BSA soiling conditions at 10°C during 5- and 30-minutes incubation, a convincing reduction in HPAI titre being at least 4 log₁₀. Study 3 was conducted at Microbiotest Inc., USA. The efficacy test used embryonated chicken eggs as a host and followed the official AOAC methods. Results showed that Virocid® passed the virucidal efficacy test when the AI virus, Turkey / Wis / 66 strain (H9N2) was exposed to the test agent for 10 minutes at room temperature, viral stock containing at least 5% organic load, 400 ppm hard water, at a dilution 1:400. All the studies showed a high effectiveness of Virocid® versus different strains of AI under a variety of conditions and demonstrate the utility of Virocid® as effective program against AI.

Keywords: avian influenza, disinfection, biosecurity, Virucide, hygiene, viral diseases

Field evaluation of safety and efficacy of a combination of live infectious bronchitis Mass and 793B plus Newcastle disease VG/GA Avinew vaccines sprayed in the hatchery onto day-old free-range (Label Rouge) chicks in France.

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Slow growth traditional free-range chickens in France are traditionally vaccinated with a hatchery vaccination program including a vHVT-IBD vaccine for IBDV control and an association of 2 live attenuated vaccines (Massachusetts + 793B variant IB from Company A – Group A) for the control of infectious Bronchitis (IB). In order to comply with French authorities recommendations regarding Newcastle Disease (ND) prevention, a field trial was performed in order to compare the current program with an alternative program including a combination of IB live vaccines (Massachusetts + 79BB variant from Company B – Group B) and a ND live vaccine. Day-old chicks were vaccinated at the hatchery alternatively every two weeks with program A and program B, for about 6 months. ELISA serologies were performed to monitor the vaccine program, and the overall technical performance of the farms was monitored. Overall, the performance of 292 batches (Program B) and 391 batches (Program A) respectively was evaluated. For this purpose, productivity parameters were recorded and compared: mortality rate, 10 days mortality rate, condemnation rate, average daily weight gain (ADWG), feed conversion ratio (FCR) and net margin (€) per m². IB and ND serologies showed that the vaccine program used was as expected for both diseases, showing seroconversion of more than 80 % of the chickens at 5 weeks for ND virus and 90 % for IB virus at slaughter age. In addition, the average IB antibody titers observed in 20 farms revealed a low prevalence of IB. As expected, antibody titers showed no presence of circulating ND field viruses over the period. No IB related clinical signs were observed in the 292 batches of group B. No significant difference was observed between the two groups for ADWG ($p=0.07$), FCR ($p=0.233$), mortality ($p=0.548$), 10-days mortality ($p=0.727$) nor income/m² ($p=0.118$). In conclusion, this large-scale survey showed that the combination of three live vaccines (IB Massachusetts + variant 793B and ND VG/GA Avinew) was safe and had no impact on the farm performance, especially offering the level of protection expected with the VG/GA Avinew strain. This offers an affordable and convenient option for ND vaccination at day-old, especially for countries officially free from Newcastle Disease.

Keywords: Infectious Bronchitis; Newcastle Disease ; Hatchery Vaccination ; Technical Performance

[04-04]: POULTRY HEALTH (ID: 130083)
[Algeria]

Evolution of infectious bronchitis vaccine viruses reisolated from vaccinated broilers

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Genetic and phenotypic diversity among IBVs (Infectious Bronchitis Virus) is a key element of the epidemiology of infectious bronchitis. This diversity is the result of point mutations and genetic recombination occurring along the entire viral genome with a predilection for the S1 gene, involved in pathogenicity and tissue tropism. Mutant viruses can upset the epidemiology of the infectious bronchitis by changing tissue tropism or affecting a cross-protection with vaccine viruses. Virtually all studies have focused on the evolution of wild viruses. Vaccine strains deserve a special attention. Two strains of IBV, 2T / 2017 and 16T / 2017, detected by qRT-PCR in samples from chickens showing respiratory signs, were genetically analyzed targeting the S1 gene. Both strains were beforehand amplified on embryonated eggs and total RNA was extracted by the classical Trizol method. The S1 gene was amplified in an end-point RT-PCR reaction using a specific primer pair, then sequenced using the Big Dye Terminator v.3.1 kit (Applied Bio-systems). The sequences obtained were aligned and compared to those of reference viruses including vaccine strains, before being subjected to a phylogenetic analysis (MEGA version 6.0.6) The two isolates were shown to be vaccine strains as evidenced by the monophyletic cluster they formed with reference vaccine viruses (100% bootstrap). In addition, the 2 strains were genetically very similar to strain H120 (similarity of 99.60% and 99.47%, respectively for strain 2T/ 2017 and 16T/ 2017). The sequence alignment revealed, for each of the two strains, 1 non-synonymous mutation outside the hypervariable regions (C56T and T39G leading to two aa substitutions: A19V and C13W, respectively for the strain 2T/2017 and 16T/2017). The 2nd hypervariable region of strain 2T/2017 displayed 2 nucleotide substitutions at positions 347 and 345, resulting in a mutation K116T. As for 16T/2017 strain, it harbored two synonymous mutations (T353G and T380G), leading to two aa substitutions: V118G and M127R The formation of viral quasispecies in vaccinated chickens can lead to the selection of mutants with reversion to virulence. This draws attention to the need of monitoring the evolution of IBV vaccine strains.

Keywords: IBV; Vaccines; mutations; S1 gene.

Protection against IBV challenge during the production period

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IBV is considered one of the highly contagious respiratory diseases of chickens. It leads to economic losses in poultry worldwide. Despite of vaccination, it still is a major cause of poor egg production in breeders and layers. In the last few years it was noticed that breeders and layers were facing a production drop problem during laying after the peak. In the Middle East area, as part of the world, the production drop reached up to 15%, in addition to poor egg quality. It reached higher percentage when it is combined with other respiratory diseases. Thus, it was deemed worthwhile to investigate the causative agents behind this problem. Samples were tested by PCR, ELISA and HI. Molecular results showed different IBV variant strains were playing a role during the problem at different farms such as IBV: 274/ Var O2/Q1/ QX and 793, the same was confirmed by HI tests. So, a farm of 60,000 birds was chosen. The flock monitored was given @ day 1 IBV Mass, @ day 14 CHB and @ 13 weeks IBV 793, Then it was given @ 16 weeks inactivated boosting of IB3 vaccine (Mass, 274 and 1466), then monitored monthly from 17 weeks until 42 weeks of age, the titers levels of IBV: 274/Mass and 1466 were monitored by HI test. Additionally, the production curve was monitored. According to Box et al, 1988, the higher level of protection against egg drop after IBV challenge is correlated with higher HI-titer (more is better). The HI results showed high titer of different IBV strains, which indicates IBV challenge, while ELISA showed a challenge in MS starting at 22 weeks of age. There is no vaccine against MS available in the market. It was noticed that the drop in production after the administration of the vaccine is less (2%) compared to before the administration of IB3 vaccine (15%). In addition, the egg quality improved as well, in spite of the fact that the flock was still MS positive. In conclusion, it was noticed that use of the IB3 vaccine increased the protection against several IBV strains even in the presence of MS challenge. This helps in reducing the MS damage compared to previous flock, before starting the treatment. It also provides high level of protection against egg drop. Boosting with inactivated IBV vaccines helps getting higher antibody titers, which is related with higher protection. The presence of more strains in the inactivated vaccine is helpful to induce more antibodies against more strains.

Keywords: IB3, layers, production period

Infectious Bronchitis strains of new appearance in Spain during 2019-2021Alberto Giner¹, Diana Petzoldt²¹Zoetis Spain S.L.U. Calle Quintanavides 13, Edif. 1, 3ra Planta, Parque Empresarial Vía Norte, 28050, Madrid, España,²AniCon Labor GmbH. Muehlenstrasse 13, 49685 Hoeltinghausen, Germany*Corresponding author: alberto.giner@zoetis.com*

Infectious Bronchitis (IB) is a highly contagious and acute disease that causes very important economic losses on the poultry industry worldwide. It is caused by a coronavirus which is known for its ability for antigenic variation that can lead to inefficient vaccination protocol's protection in the field. For some years now Zoetis Spain performs studies for Infectious Bronchitis Virus (IBV) strains in Spanish chicken flocks. The objective of this study is to show the identification of Infectious Bronchitis Virus (IBV) strains that have not been previously detected in Spain. The study is based on samples taken in Spain from January 2019 to December 2021 from outbreaks or routine monitoring in broilers, layer and breeder pullets, commercial layers and broiler breeders. A combination of screening and typing PCRs as well as optional sequencing were used to gain broad information on present IBV strains. In contrast to direct sequencing approaches our technique has the advantage to be able to identify more than one genotype in the same sample if are present. This gives broader information on the IBV situation and allows targeted adaptation of vaccination schedules. The present study is the first to report the presence of strains of IBV lineages GII-1 most related to strain V1397, GII-2 most related to CK/NL/D181/2018 and proposed GVIII-1 most related to CK/DE/IB80/2016 in Spain.

Keywords: infectious bronchitis virus; qPCR; sequencing; novel strains; Spain

Update of IBV variants circulating in Spain in 2018-2022 period

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IBV is one of the major concerns worldwide due to its remarkable impact in poultry industry. This RNA virus shows a high rate of mutation which has constantly caused the rise of new variants which potentially escape from the former flock immunity and the available vaccines on market. Since the epidemiological situation tends to be dynamic, the aim of this work is to update the current Spanish situation through the description of the different genotypes and lineages recently detected in clinical IB cases submitted to our laboratory. For that purpose, 387 clinical samples collected from 2018 to 2022 belonging to 272 different outbreaks were tested for IBV by qPCR. The 272 cases came from at least 65 different farms and included different production systems: laying (n=158), breeding (n=24), broiler (n=5) as well as 85 cases whose information was not available. The outbreaks consisted of diverse clinical signs from which can be highlighted respiratory distress (n=157), drop egg (n=20), digestive problems (n=12) and routinely health check (n=49). IBV was detected in 185 samples (48%) ranging a Cq value from 20.65 to 37.98. Then, samples whose Cq value was lower than 32 were analyzed to determine the variant. The method described by Adzhar et al., 1997 was followed with important modifications in order to allow the detection of the most recently reported genotypes. Partial sequences of S1 gene were obtained and compared with those from reference strains which determine different genotypes and lineages. Six different variants were detected: 793B (GI-13) (47%), D1466/V1397 (GII-1) (24%), IB80 (GVIII) (12.5%), QX (GI-19) (8%), Mass (GI-1) (6%) and Italy02 (GI-21) (2.5%). The co-infection of several genotypes could be demonstrated in five different cases. Nucleotide homology of samples with respective reference strains varied among different genotypes. The homology of samples belonging to GI-19 ranged from 93% to 96% when compared with reference QX strain. Samples identified as GVIII ranged a higher homology with the German strain (CK/DE/IB80/2016) (92%-95%) than that presented for American strain (PA/1220/98) (80%-83%). Moreover, homology of samples diagnosed as GII-1 ranged 91%-95% and 92%-96% referred to respectively D1466 and V1397 reference strains. GI-13 has been clearly the most detected IBV lineage detected in Spain, however, GI-19 and GI-21 showed a minor presence. These results agree with those from previous Spanish and European reports (Blanco et al., 2015). Furthermore, new variant strains barely reported in Spain so far have been significantly detected now: GII-1 and GVIII would represent the third part of all the strains studied in this period. Their S1 sequences hardly reach the 95% of homology compared to their respective reference strains. This genetic drift would indicate a circulation of these virus genotypes among our farms for some time. These findings highlight the need of a constant review of available diagnostic tools to guarantee an early detection of new variants allowing the implementation of control measures of the disease.

Keywords: IBV, variants, Spain

Identification of a novel infectious bursal disease virus genotype circulating in Portugal**Matteo Legnardi¹, Giovanni Franzo¹, Claudia Maria Tucciarone¹, Konstantinos Koutoulis², Isabel Duarte³, Marco Silva³, Bertrand Le Tallec⁴, Mattia Cecchinato¹**

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Infectious bursal disease virus (IBDV) is among the most impactful pathogens affecting the global poultry industry. It causes an immunosuppressive disease that could either result in overt clinical outbreaks or remain subclinical, though leading to secondary infections and vaccine failures. IBDV is a non-enveloped virus of the family Birnaviridae, featuring a bisegmented, double stranded RNA genome. Two serotypes, 1 and 2, are recognized, with only the former being pathogenic. Historically, serotype 1 has been further divided based on antigenicity and pathogenicity into classical, variant and very virulent strains. Nowadays, however, strains are more frequently classified according to genetic features by sequencing portions of viral protein 1 (VP1) and 2 (VP2) genes, allowing for a cost-effective, easily standardized IBDV classification, which is also best suited to describe the growing number of new IBDV subtypes and reassortant strains identified in recent years. This work reports the results of an epidemiological survey performed in Portuguese broiler farms between December 2020 and December 2021. A hundred bursal samples were collected as part of routine diagnostic activities and analyzed by RT-PCR targeting a portion of the VP2 gene, resulting in 70 positive samples. Fifty-three strains were characterized as vaccine strains by Sanger sequencing and phylogenetic analysis. The other 17 field strains were further investigated by sequencing a portion of the VP1 gene. Three of these strains showed features consistent with the reassortant strains that are increasingly detected in several other European countries. Based on all the available classification criteria, the remaining fourteen strains form a novel IBDV genotype, which features multiple amino acid changes in key positions within the VP2, and clusters with classical strains at VP1 level. The newly described genotype seems to have been circulating extensively in Portugal in recent years, prompting an attentive monitoring of the local epidemiological scenario. Nonetheless, further *in vivo* studies are still required to shed light on the pathogenicity of this genotype, and therefore its actual clinical relevance, as well as on the protection conferred by available vaccines.

Keywords: infectious bursal disease virus; molecular epidemiology; broiler; Portugal

Successful Gumboro disease prevention in French « Label Rouge » chickens

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« Label Rouge » [Red Label] chicken production is popular in the French market, since this 81-day old slow growing chicken is regarded as a tasty, free-range, festive and healthy meat by the consumers. It is therefore marketed as a premium price through retailers, or fine restaurants. Disease prevention is of utmost importance in such a high value bird. Efficient, safe but also convenient health programs are requested by the producers. To this aim, a novel Gumboro (IBD) vaccine was used in large scale conditions in almost 500,000 Label Rouge chicks. It is using the immune-complex technology which enables a timely immunization according to the maternal immunity status and a full protection against Gumboro disease through bursa colonization as soon as the vaccine virus is freely released. It can also be conveniently mixed with vector HVT vaccines against other diseases (eg, rHVT-ND or rHVT-ILT) and with Rispens. A total of 89 flocks were included in this trial. After hatchery administration, we monitored the following criteria: production performances, IBD ELISA serology (D0, D28, D42 and D81), and IBDV RT-PCR (D28 and D42). Altogether the collected results showed that this novel immune-complex vaccine is a safe, efficient and presents a convenient option for preventing Gumboro disease in slow growth meat chickens, such as « Label Rouge ».

Keywords: Label Rouge chickens; Gumboro disease; prevention

Live vaccination for Turkey haemorrhagic enteritis proves effectiveness in control virus circulation and related disease

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To improve Turkey Haemorrhagic Enteritis virus (THEV) control in turkey production, live attenuated vaccination was temporary introduced in Italy. To monitor vaccine-take and field virus circulation, longitudinal studies were carried out in four meat turkey flocks, applying a combined PCR and sequencing protocol for vaccine or field strain differentiation. Birds were THEV-vaccinated at four weeks of age with live vaccine (2 flocks) or not vaccinated (2 flocks), then from day 1 to day 63 of life, five turkeys per group were selected and scored in vivo and at post-mortem, to assess and score clinical sign, macroscopic and microscopic lesions (in spleen) referable to THEV infection; cloacal swabs and spleen were collected for THEV PCR detection e differentiation of field and vaccine strains. PCRs analysis were extended weekly up to the end of the production cycle. In live-vaccinated flocks strains of vaccine origin were mainly detected, while in unvaccinated groups field strains were always detected. The clinical, macroscopic and microscopic cumulative scores resulted to be lower in vaccinated animals than in unvaccinated ones. Results show that persistence of the vaccine strain in live-vaccinated flocks is able to reduce field virus circulation and related disease.

Keywords: Turkey; Turkey Haemorrhagic Enteritis; immunosuppressive disease; vaccination

Study of co-infection of chicken infectious anemia virus with fowl adenovirus in commercial poultry

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Commercial poultry can be exposed to a variety of immunosuppressive pathogens, which put heavy impact on health and wellbeing of birds by diminishing both innate as well as acquired immunity. This study was designed to investigate co-infection of chicken infectious anemia virus (CIAV) with fowl adenovirus (FAdV) in commercial poultry. A total of 128 poultry farms were selected for simple random sampling to collect samples with clinical history of CIAV or FAdV infections. The tissue samples from dead and diseased live birds were collected and observed for gross pathology. DNA was extracted from liver samples followed by PCR amplification to confirm the presence of CIAV and FAdV infections. Histopathology of liver, thymus, spleen, and bursa was carried out to examine microscopic changes in PCR positive tissue samples. A total of 640 samples were collected from 128 farms in Faisalabad division Pakistan. The research findings unveiled the presence of CIAV (27.20%), FAdV (21%) and their co-infection (16.9%). This study revealed that disease mostly effects the growing birds with maximum infection of CIAV reported in 2-3 weeks of age (18.5%), for FAdV maximum infection was seen in 1–2-week older birds (17.6%) and co-infection was noted in 2-3 weeks old birds (11.11%). In regard to seasonal distribution, most cases were reported in harsh weather conditions. The results revealed that co-infection exists between CIAV and FAdV which increased the disease severity thus increasing mortality rate in infected birds. There is a need to develop effective preventive measures to avoid the co-occurrence and to develop efficient vaccination program.

Keywords: Immunosuppressive' Co-infection' CIAV" FAdV" PCR" Vaccination

Pathogenicity of fowl adenoviruses serotype 11 isolated from chickens associated with inclusion body hepatitis in Morocco

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Inclusion body hepatitis (IBH) is an acute disease, mainly occurring in young broiler chicken (3-7 weeks old) and caused by several serotypes of fowl adenovirus (FAdV). In Morocco, IBH has been identified and the FAdV has been isolated and characterized from chickens with IBH, but the pathogenicity of the isolated virus has never been investigated. In this study, we used an isolated Moroccan virus from broiler chicken affected with IBH FAdV 11 (MOR111115 strain) to evaluate its pathogenicity by inoculating orally SPF chickens at 3 days of age. The infected chickens showed symptom of depression and decreased weight gain from 3dpi. Necropsy displayed pallor and enlargement in liver, swelling and slight hemorrhage in kidney and spleen at 6 dpi. Histopathological changes were mainly characterized by severe and extensive hepatic necrosis associated with the presence of basophilic intra-nuclear inclusion bodies within hepatocytes. The FAdV was isolated in chicken embryo fibroblast cell culture from liver tissue homogenate of infected chicken from 3 to 6 dpi. Viral DNA was detected by PCR in liver, kidney, spleen and cloacal swabs from 3 to 13 dpi. These results confirmed that the MOR111115 strain is pathogenic in chicken. This study is the first experimental infection of FAdV 11 in chicken in Morocco, which increases our understanding of its pathogenicity in chickens and indicates that preventive measures against FAdV infection in poultry farms should be implemented in Morocco.

Keywords: Inclusion Body Hepatitis, Fowl Adenovirus 11, Pathogenicity

Evaluation protection of ND vaccination regimes against early challenge with Velogenic Newcastle virus-VII.1

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Newcastle disease virus (NDV) is endemic in Egypt since 1960s and vaccination strategy is the main tool to control it. NDV-VII.1 became endemic in Egypt and is associated with mortalities in vaccinated flocks. Therefore, the farmers switched to combined live and inactivated vaccine strategy. The aim of this work was to evaluate the effectiveness of three different vaccination regime (G-1 double inactivated ND vaccine at 1/10 day of age, G-2 single inactivated ND vaccine at 7-day of age and G-3 single inactivated ND at one-day of age) in-combination with three-doses of live ND vaccine against the challenge with velogenic NDV (vNDV). 180,000 one-day old chicks obtained from commercial hatchery were placed in three commercial broiler station "60,000 birds/station" and 40 one-day old chicks were moved to Biosafety level-3 isolators (BSL-3) at MEVAC facility to serve as control groups (non-vaccinated group challenged "G-4" and non-vaccinated non-challenge-G-5). Blood samples, cloacal swabs and oropharyngeal swabs were collected weekly to check the Humoral immune response and exposure to any life-threatening Respiratory virus (Avian influenza" AIV", NDV and infectious Bronchitis "IB" virus). At 24-day of age 25 birds from each station (G1-3) moved to BSL-3 and were kept under observation for 36 hours. Cloacal and oropharyngeal swabs were collected and three birds from each group euthanized, and internal organs examined three times at 12 hours interval to ensure that the birds were free from any live threatening viral respiratory pathogen (AIV, NDV, IB). Birds in G1-4 were challenged with vNDV VII.1 (10⁶ EID₅₀), 0.5 ml/ bird PSB via intranasal route and birds in G-5 received 0.5 ml PBS via intranasal route. Birds in G1-5 were kept in BSL-3 for 10 days under observation and oropharyngeal swabs were collected on days 3,6,9 post challenge (dpc). Protection against mortalities following challenge with vNDV-VII.1; were 100% (12/12), 100% (12/12), 91.7% (11/12), 0% (0/12) and 100% (12/12) in groups 1-5 respectively. Birds in G-1 showed significantly lower amount of virus shedding in comparison to G2/3. In conclusion, using NDV inactivated vaccine in two-dose regime with live vaccines can provide protection to commercial broiler chicken against early challenge with vNDV in endemic areas as early as 26 days of age with significantly lower shedding rate. This vaccination strategy can be an effective tool to control NDV.

Keywords: NDv; Vaccine; Protection; Mortalities

Effect of the replacement of vitamin E by polyphenols in the diet on productive performance of broilers from 0 to 38 days of age.

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Vitamin E is an essential nutrient and an antioxidant used in practical diets in poultry to protect the cell systems in their metabolic processes. The hypothesis of this experiment was that Silvafeed ATX, a source of polyphenols (mainly tannins), may replace vitamin E as an antioxidant but not as a source of vitamin. There were 5 diets with the same ingredient composition that varied only in the level of supplemental vitamin E (0 to 40 ppm with differences of 10 ppm among diets) and Silvafeed ATX (300 to 0 ppm with differences of 75 ppm among diets). The experimental diets, fed as pellets, were based on corn and soybean meal and provided 10 ppm of basal vitamin E. Each diet was replicated 7 times and the experimental unit was a floor pen with 16 straight run Cobb 500 chicks. The feeding program consisted of two phases: starter (from 0 to 21 d) and finisher (from 22 to 38 d). Feed intake, BW, and FCR were determined at 14, 21, and 38 d of age. Data were analysed, by phase and cumulative, as a completely randomized design, using the MIXED procedure of SAS. When significant differences were detected, the Tukey test was used to separate treatment means. In addition, the effects of the supplemental vitamin E and the level of tannins on the different variables studied, were partitioned into their linear and quadratic components. From 0 to 14 d of age, FCR improved linearly ($P < 0.001$) as the tannin content in the diet increased, indicating that, under the conditions of the current experiment, the birds did not need any extra supplementation of the diet with vitamin E. However, from 0 to 38 d of age (end of the experiment), a decrease in vitamin E tended to reduced ADG ($P = 0.078$) without affecting ADFI or FCR. Moreover, most of the differences in ADG observed was detected between the negative control diet that did not include any supplemental vitamin E and the diet supplemented with 10 ppm of vitamin E. It is concluded that, under our experimental conditions, diets supplemented with only 10 ppm of vitamin E (20 ppm in total), provided that tannins are included, can be used to maximize broiler performance.

Keywords: broilers; growth performance; polyphenols; tannins; vitamin E.

[05-02]: POULTRY NUTRITION (ID: 130096)
[Belgium]

Use of chestnut tannins in different broiler diets and its effect on performance and meat quality

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To assess the potential of chestnut tannins as antioxidants, 2160 Ross 308 broilers were fed one of two basal diets: a corn-soy or a wheat-rapeseed-palm oil-based diet. To both diets, chestnut tannins (Tanno-SAN®, Sanluc International NV, Belgium) were added at 0, 0.5 or 2 g/kg feed, combined with two levels of vitamin E (vitE): 25 or 50 mg/kg feed, 12 treatments in total, with 6 repetitions/treatment. Daily gain (ADG), feed intake (FI), feed conversion ratio (FCR) and bodyweight were registered. After 42 days, animals were slaughtered, and breast meat pH and drip loss were determined. Broilers on a corn-soy diet fed 2 g/kg tannins had the lowest body weight, and the highest FCR, while the addition of 0.5 g/kg tannins had little effect. ADG and FI did not differ between treatments. Lowering vitE had no effect on broiler performance. Interactions between tannin and vitE levels were observed for meat quality: meat pH increased with addition of tannins, but only at 25 mg/kg vitE. Drip loss decreased with tannin addition at 50 mg vitE/kg, while the opposite was observed at 25 mg/kg vitE. However, drip loss with 25 mg/kg VitE was always lower than that with 50 mg/kg vitE. On wheat-rapeseed-palm oil diets interactions between tannins and vitE were observed: body weight and ADG did not differ with the addition of tannins at 50 mg/kg vitE but decreased with chestnut tannin addition at 25 mg/kg vitE. FCR of the whole period increased with 0.5 g/kg tannins as in the corn-soy diet but was not affected by vitE levels. Meat pH slightly decreased with 0.5 g/kg tannins, but increased again at 2 g/kg, while vitE had no effect, opposite to the corn-soy diet. Drip loss was decreased for the highest tannin level at 50 mg/kg vitE, while it was lowest for 0.5 g/kg tannins at 25 mg/kg vitE. In conclusion, this study showed non-linear effects of chestnut tannins supplementation to broiler diets, as also seen in practice, with effect size and sense depending on diet composition and vitE concentration.

Keywords: Chestnut tannins; broilers; performance

Eugenol improves productive performance in broilers

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The essential oil of clove (*Syzygium aromaticum* (L.) Merr. & L.M.Perry) is generally recognised as safe (GRAS) for use as food additive by the US FDA (1). It has shown antibacterial (2), antioxidant (3) and immunomodulatory (4) activities, which are due to eugenol, the major constituent (75-88%) of the oil. Eugenol was authorised as zootechnical additive in animal nutrition in May 2019 by the European Commission. The aim of this study was to evaluate the effect of Liderfeed®, additive based on eugenol, on male broiler grow performance. One hundred and forty-four (144) 1-day-old male broilers were weighed individually, identified using numbered wing tags and randomly housed in 24 pens (6 broilers per pen, 12 pens per treatment). One experimental group T2: 100 g of Liderfeed® per ton of feed, that corresponds at 5 ppm of eugenol in feed, were added on basal feeds (starter, phase I & grower, phase II) and a negative control group T1: basal feeds (same phases as T2) were set. Pens were randomly assigned to treatments and chicks reared to 35 days. Eugenol content in feeds was determined by gas chromatography. This study was designed according EFSA guideline for tolerance and efficacy studies in target animals. Data were analysed to determine differences between treatments. Body weight, cumulative and daily feed intake, through a mixed effects model for repeated measures, body weight homogeneity, average daily feed intake and feed conversion ratio, through a General linear model, average daily gain with Mixed effects model, and mortality were calculated. Statistical analysis was done with JMP-12Pro®, tests were two-tailed and carried out with a risk $\alpha = 5\%$. P-value of $p < 0.05$ was considered statistically significant. No significant differences ($p > 0.05$) were found between treatments (T1 and T2) for body weight homogeneity (9 vs. 10 %CV), weekly and overall (3527 vs. 3490 g/bird) cumulative feed intake, average daily feed intake (101 vs. 100 g/bird/day) and mortality (null). Body weight (2324 vs. 2442 g) and average daily gain was higher in group T2 than T1 (69 vs. 65 g/day), in phase II (109 vs. 102 g/day), and between 22-28 days (103 vs. 92 g/day) ($p < 0.05$). Feed conversion ratio of birds in group T2 improved with respect to birds in group T1 (control) in phase II (1.65 vs. 1.51 g/g), and the overall of the study (1.54 vs. 1.46 g/g) ($p < 0.05$). In conclusion, poultry productive performance improved when the feeds were supplemented with Liderfeed® with respect to a non-supplemented feed ($p < 0.05$). Acknowledgement: Lidervet S.L. for financial support (project UdL-LID- S16064). 1. Vijayasteltar et al. Toxicol Rep, 2016; 3, 439. 2. Ordóñez et al. J Appl Poult Res, 2008; 17(3), 376. 3. Pérez-Rosés et al. J Agr Food Chem, 2016; 64, 4716. 4. Pérez-Rosés et al. J Agr Food Chem, 2015; 63, 1496

Keywords: Clove; Eugenol; broiler; zootechnical additive

Exploration of *Zingiber officinale* effects on performance, immunity and gut morphology in broilers

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The objective of this study was to determine the effects of different levels of *Zingiber officinale* as herbal feed additive on performance, carcass characteristic, serum biochemistry, total bacterial count (TBC), gut morphology, and immunological parameters of broilers. A total of 1500, day-old broiler chicks (Hubbard) were equally accredited to five treatment groups, each with six replicates (50 birds/replicate). Five experimental diets were prepared using basal diet with antibiotics positive control (PC); 0%, group A; 0.3%, group B; 0.6%, group C; 0.9% ginger, whereas basal diet without antibiotics was used as negative control (NC). Birds in groups (A&C) had shown significantly ($P<0.05$) higher feed intake (FI) as compared to others. Total bacterial count was found to be significantly ($P<0.05$) lower in group “C” followed by “B” as compared to “NC”. No significant differences were shown among treatments for carcass characteristics. Mean villi length and width were significantly ($P<0.05$) higher in all ginger supplemented groups, as compared to control groups. Blood serum parameters including cholesterol, triglycerides, and low-density lipoproteins (LDL) were significantly lower ($P<0.05$) in groups (B & C) in comparison from control groups. Whereas high-density lipoproteins (HDL) was significantly higher in group (B) as compared to the others. In conclusion, ginger at concentration of 0.6% in diet significantly improved growth performance, gut morphometry of broilers and found best substitute of antibiotic growth promoters. Ginger had positive impact on immune system, cholesterol, triglycerides and gut microbes. This improvement in immunity and cholesterol levels is due to antioxidant activity of ginger.

Keywords: Broiler; Cholesterol; Ginger; Performance; Phytobiotics;

[05-05]: POULTRY NUTRITION (ID: 130051)
[Pakistan]

Effects of dietary organic acids on performance, caecal microbiota and gut morphology in broilers

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Organic acids have exhibited great potential as an alternative to antibiotics and have been used as feed additives. To explore more about organic acids, a total of 900-day-old broiler chicks (Cobb-500) were procured from a local hatchery and distributed into 9 treatment groups having 5 replicates of 20 birds each; duration of the biological trial was of 35 days. Group T1 served as a control group without any dietary supplementation. Other groups T2 and T3 were supplemented with different levels (100g/ton and 250g/ton) of Enramycin (antibiotic), T4, T5 and T6 were supplemented with different levels (2kg/ton, 3kg/ton and 4kg/ton) of ammonium formate and ammonium propionate and T7, T8 and T9 were supplemented with different levels (2kg/ton, 3kg/ton and 4kg/ton) of calcium formate and calcium propionate. The results revealed significant improvement ($P < 0.05$) in body weight gain and FCR in groups T3, T5, T9 while feed intake was not affected. Carcass evaluation resulted in a significant increase ($P < 0.05$) in dressed and eviscerated weight along with carcass yield (T5, T7, T8, T9). Broilers fed organic acid supplemented diet had significantly lower ($P < 0.05$) total bacterial count (T3, T5, T8, T9) and positively improved ($P < 0.05$) villi length (T5, T6, T9) as compared to control group. However, total protein, globulin, HDL and LDL levels were determined to be non-significant ($P > 0.05$) among different organic acids treatments. Organic acids can be utilized as a better replacement for antibiotics. Supplementation of organic acids at a dose rate of 3kg/ton and 4kg/ton is recommended for efficient performance of broilers.

Keywords: Antibiotics; Broilers; Growth performance; Gut health; Organic acids

Effects of a blend of glycerol esters of fatty acids on the performance and intestinal microbiota of broiler chicks in a necrotic enteritis challenge model

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The aim of the present study was to investigate the effect of a blend of glycerol esters of fatty acids (GLY) on the intestinal microbiota and pathogenesis of experimental necrotic enteritis (NE) in broiler chicks. 120 one-day-old broiler chicks were randomly allocated to 4 treatment groups of 6 birds with 5 replicates, as follows: group A, served as negative control, group B, with dietary supplementation of GLY, group C, with challenge of birds with *C. perfringens* and *Eimeria* spp., and group D, with dietary supplementation and challenge of birds. Each bird was wing tagged from the 7th day of age and weighed individually every week until the end of the experiment at 40 days of age. A high protein and energy diet formulation, with high quantities of wheat, fishmeal and animal oil, was used in order to predispose to NE. Crude protein, fat and metabolisable energy for each diet were calculated. Feed and water were provided ad libitum, and the photoperiod was 18:6 hours, according to the breeding company guidelines and EU legislation. The intestine collected and scored for gross lesions from each bird, while caecum was taken for microbiological analysis. The statistical analysis and evaluation of the experimental data revealed that the dietary supplementation increased significantly ($P \leq 0.05$) the body weight, while the challenge reduced it significantly ($P \leq 0.05$). The challenge caused significantly ($P \leq 0.05$) more severe NE lesions, while the dietary supplementation reduced them significantly ($P \leq 0.05$). The dietary supplementation, the challenge as well as their combination increased significantly ($P \leq 0.05$) the *Bifidobacterium* spp. counts in the caecum. In addition, their combination increased significantly ($P \leq 0.05$) the *E. coli* counts in the caecum. The study provides evidence that the dietary supplementation of a blend of glycerol esters of fatty acids can significantly affect the severity of NE lesions and the intestinal microbiota as well as can significantly promote the performance in broiler chicks. "This research has been co-financed by Greece and the European Union (European Regional Development Fund) within the Operational Program "EPIRUS 2014-2020". Project Code: 5033112. MIS: H111AB-0028212. Acronym: EpirORNIS."

Keywords: necrotic enteritis, glycerides, fatty acids, broiler chicks, microbiota

Effect of sodium butyrate protected with sodium salt of medium-chain fatty acids on ileum morphology and serum parameters in broiler chickens

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Butyric acid as a major energy source to enterocytes plays a role in the development of the intestinal epithelium. The combined use of butyric acid and medium-chain fatty acids (MCFA) may widen the spectrum of action to promote gastrointestinal health. This study evaluated the effect of a protected butyrate with sodium salts of MCFA from coconut distillates (BUT+) on ileum morphology and serum parameters. A total of 192 one-day-old female broilers Ross 308 were randomly distributed into 24 cages and 4 dietary treatments. A basal diet (CTR) was supplemented with increasing levels of BUT+ (0.5, 1 and 2 kg/t). Feed intake and live body weight were monitored. One animal per cage was euthanized on days 10 and 39 of age to collect ileum tissue and characterize ileal histomorphometry. Serum glucose, triglycerides and cholesterol concentrations were determined at the end of the trial (39d). There were no significant differences on performance or serum parameters. Besides, the supplementation of BUT+ did not modify villi high and crypt depth at any age. However, the animals receiving 0.5 kg/t of BUT+ at the diet had significantly the highest goblet cells count at 39d ($P = 0.025$). In contrast, the highest dose of BUT+ (2 kg/t) had the lowest number of goblet cells at 10d ($P=0.005$) and reduced the goblet cells in comparison with BUT+ at 0.5 kg/t at 39d ($P=0.025$). Results indicate that the supplementation of 0.5 kg/t of MCFA-protected butyrate could help to reinforce the mucus layer of gut barrier by enhancing goblet cells of intestinal epithelium in broilers at 39d of age.

Keywords: butyric acid; medium-chain fatty acids; gastrointestinal health

Dietary supplementation with a microencapsulated blend of organic acids and essential oils affects gut microbiota and broiler performance under a necrotic enteritis challengeNedra Abdelli¹, José Francisco Pérez¹, Ester Vilarrasa², Diego Melo¹, David Solà-Oriol¹¹Animal Nutrition and Welfare Service. Department of Animal and Food Science. Universitat Autònoma de Barcelona, Bellaterra 08193, Spain, ²Farmafaes- Tecnovit, 43365 Alforja, SPAIN (current address: Kaykun Care, SCCL, 43204 Reus, Tarragona, Spain)*Corresponding author: nedra.abdelli@uab.cat*

The integrity of the gastrointestinal tract and the gut microbial community are keys for nutrients absorption and disease resistance. In poultry, necrotic enteritis (NE) impairs growth performance through affecting gut microbiome equilibrium. An experiment was conducted to evaluate the effect of a microencapsulated blend of calcium butyrate, fumaric acid and essential oils (BUTYTEC-PLUS) on the gut microbiome and its interactions with intestinal histomorphology and growth performance of broilers under a necrotic enteritis challenge using 90 % reused commercial litter and wheat-soybean meal-based diets without xylanases. A total of 162 male Ross chicks were randomly distributed into negative control (NC) and NC supplemented with a dose of 0.5 g BUTYTEC-PLUS/kg, with 9 pens/treatment and 9 chicks /pen. Growth performance was recorded on d 0, 10, 28 and 42. Feces were collected on d 14, 28 and 42 for Enterobacteriaceae and *C. perfringens* count. On d42, ileal tissue samples were taken for histomorphological analysis from one bird/replica. Cecal content were collected for microbiota analysis. Performance and histomorphology data were analyzed with t-test using SAS program. The significance threshold was set at 0.05. Microbiota analysis was performed using RStudio v.3.5.1. BUTYTEC-PLUS supplementation increased the cecum alpha diversity ($p = 0.009$) but did not affect the beta diversity ($p > 0.1$). It also modified the microbiota composition in cecum ($p < 0.05$) by increasing the abundance of some beneficial families, which play an important role in pathogen exclusion and gut barrier maintenance like Bifidobacteriaceae ($p < 0.001$), Ruminococcaceae ($p = 0.05$) and Peptostreptococcaceae ($p < 0.001$) while reduced that of harmful genera such as *Clostridium* sp ($p < 0.01$). This microencapsulated blend reduced fecal Enterobacteriaceae and *C. perfringens* counts ($p < 0.001$). BUTYTEC-PLUS supplementation tended to decrease the crypt depth ($p = 0.09$) suggesting higher energy to be used for productive purposes rather than renewing the intestinal epithelium. These findings may explain the improved global feed conversion ratio (FCR₀₄₂) by BUTYTEC-PLUS supplementation ($p = 0.04$). In summary, BUTYTEC-PLUS supplementation alleviated the negative impact of necrotic enteritis infection on the growth performance through changing the gut microbiota and intestinal histomorphology.

Keywords: organic acids; essential oils; microencapsulation; performance; intestinal histomorphology; microbiota; gut health; broiler

The effects of supplementing monobutyryl on the performance and production efficiency of turkeys fed on a wheat, corn, soybean and rapeseed meal-based diet

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Butyric acid and its derivatives have been well documented to positively impact gastrointestinal health and performance parameters in many different species. The hypothesized beneficial effects of butyric acid and its derivatives are due to the effect on gut integrity and anti-oxidative stress parameters as well as the inhibition of microbial intestinal growth. There is limited published information showing the beneficial effect of monobutyryl in the diets of turkeys. As such, the aim of this trial was to investigate the effect of monobutyryl on the live performance of female growing turkeys. 477 Hybrid Converter turkeys were obtained from a commercial hatchery and allocated to treatment groups. The study consisted of 2 treatments; Control (no monobutyryl added) and Treatment (monobutyryl included at 2kg/ MT feed), each treatment was replicated 9 times with 53 birds per replicate. Birds were fed ad libitum with a diet based on wheat, corn, soybean and rapeseed meal and were formulated to meet the nutritional requirements of the animals according to breed guidelines. Key nutrient levels were analyzed prior to the start of the study. Birds were raised to 112 days and feeding consisted of 4 phases: 1-28, 29-56, 57-84 and 85-112 days. Performance parameters such as, body weight (BW), feed intake (FI) was measured for each feeding phase and feed conversion ratio (FCR: kg feed/ kg weight gain) and European Performance Efficiency Factor (EPEF) were calculated, using the following formula: $((BW \text{ (kg)} * \text{livability (\%)}) / FCR \text{ (kg/kg)} * \text{trial duration (d)}) * 100$. Overall growth rates of the turkeys were high, reaching 11.49 kg and 11.55 kg after 112 days for the Control and Treatment groups, respectively. There were no differences in the BW gain between the groups in any of the feeding phases ($P > 0.05$). Livability was also high throughout the study with 98.5% in the Control and 98.3% in the Treatment group. There was a tendency ($P = 0.06$) for FCR across the 0-112d period to be lower in the Treatment (2.29) group compared to the Control (2.32) group. EPEF was calculated to be 427 for the Control group and 436 for the Treatment group. In conclusion, these findings document the beneficial effects that monobutyryl could have on the feed conversion ratio and performance efficiency of growing turkeys.

Effects of addition of *Saccharomyces cerevisiae boulardii* on multiple parameters on broiler health and productivity

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In this study we implemented field and laboratory investigations that consisted of two trials during the two broilers grow out periods. In the first trial we evaluated the effects of different doses of feed addition of *Saccharomyces cerevisiae boulardii* (SCB) on multiple parameters on broiler health and productivity. In the second trial we chose the most beneficial dose of SCB from the first trial and added it as such in feed or at 50% of it in water. The first trial was done on four groups of 50 chicks per group. Group 1 (G1) was control group, group 2 (G2) - 150 g/1000 kg, group 3 (G3) - 500 g/1000 kg and group 4 (G4) - 1000 g/1000 kg of SCB 1,5x10¹⁰ CFU/g. The second trial was done on three groups of 50 chicks per group. G1 - 500 g/1000 kg in feed, G2 - control group, and G3 - 250 g/1000 l in drinking water. In both trials, each group consisted of 25 chicks per replicate. Productivity data was assessed by weekly measurement of the body weight, and calculation of feed conversion rate (FCR) and European production efficiency factor (EPEF). Blood was collected at day 42 and hematology and biochemistry indices were measured from 20 birds per group. Identification and enumeration of *Salmonella* spp., *Campylobacter* spp., *Clostridium* spp., and Lactic acid bacteria (LAB) was done from the cecal and ileal content from four birds per group. After completion of the second trial, microbiome analysis of the fecal content was performed from four to five samples from each group. Quantitatively, the use of SCB increased the body weight of the broilers by 17% compared to the control group. The FCR and EPEF values indicate a statistically significant difference ($p < 0,05$) between the control group and the SCB treated groups. G3 had the best values for these two parameters. Albumins, total proteins, globulins, cholesterol, triglycerides, urea and calcium were significantly lower ($p < 0,05$) in G4 in comparison with G1 and G2. While ALT and AST were significantly higher ($p < 0,05$) in G3 and G4. Bacteriological analysis revealed absence of *Salmonella* spp. in all groups. There was a declining trend of the *Clostridium* spp. and number of LAB was higher in the G3 and G4 without statistical significance. In the second trial, the G1 had the lowest FCR (1.49) compared to G2 (1.64) and G3 (1.61) and the highest EPEF (448) compared to G2 (386) and G3 (423). The G3 had the highest final body weight (2861 g) compared to other groups. Considering the microbiome profiling data, the predominant fecal populations were Bacillaceae and Thermoactinomyces for G1, Bacillaceae, Thermobacillus and Brevibacillus for G2 and Bacillaceae, Thermoactinomyces and Rickenellaceae for G3. Unlike G1, two of the tested fecal samples revealed clostridial (in G2 and G3) and streptococcal communities (in G2). Feed supplementation with 500 g of SCB 1,5x10¹⁰ CFU/g /1000 kg improves broilers productivity, positively affects several of their metabolic processes and enhances their intestinal microbiota.

Keywords: feed additive; *Saccharomyces cerevisiae boulardii*; blood biochemistry, bacteriology, fecal microbiome

Effects of *Pediococcus acidilactici* and *Saccharomyces cerevisiae* on broiler chickens challenged with *Clostridium perfringens* induced sub-clinical necrotic enteritis

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Necrotic enteritis (NE), caused by *Clostridium perfringens* (*C. perfringens*), is a worldwide disease leading to important economic losses in poultry production. In the present study, we aimed to evaluate the effects of *Pediococcus acidilactici* (*P. acidilactici*) and *Saccharomyces cerevisiae* (*S. cerevisiae*) on growth performance, intestinal lesions and ileal *C. perfringens* count of broiler chickens challenged with *C. perfringens* induced sub-clinical NE. A total of 150 0-day-old broiler chicks were allocated into five treatment groups as follows: T (control group): without treatments; Cp group: without additives but with *C. perfringens* challenge; CpC group: without additives but with *C. perfringens* and coccidiosis vaccine challenge; CpCB group: supplemented with *P. acidilactici* (100 mg/g of basal diet) challenged with *C. perfringens* and coccidiosis vaccine; CpCL group: supplemented with *S. cerevisiae* (100 mg/g of basal diet) challenged with *C. perfringens* and coccidiosis vaccine. The parameters analyzed were body weight gain, feed intake, feed conversion ratio, mortality, intestinal lesion score and ileal *C. perfringens* enumeration by quantitative real-time PCR. The challenge resulted in impairment of growth performance, increased lesion score (≤ 2) and overgrowth of *C. perfringens* population. However, the dietary inclusion of *P. acidilactici* or *S. cerevisiae* caused a significant improvement in feed conversion, net reduction of gut lesions as well as decrease of intestinal *C. perfringens* population. In conclusion, these results suggested that the dietary supplementation with probiotics (*P. acidilactici* or *S. cerevisiae*) could be beneficial to alleviate the negative effects of sub-clinical NE in broiler chickens.

Keywords: Broiler chicken, Necrotic enteritis, *Clostridium perfringens*, *Coccidia*, *Pediococcus acidilactici*, *Saccharomyces cerevisiae*, Growth performance, Intestinal health

Postbiotics of laboratory isolated *Lactobacillus plantarum* improved the growth performance, gut development, and intestinal microbiota in broiler chickens

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The microbial population that inhabits the gastrointestinal tract of birds play an important role in the establishment and maintenance of a healthy gut. Gut health is an important issue when considering how to get the best productivity from a flock. Due to inappropriate use of antibiotics as growth promoters, there is an emergence of antibiotic residue and subsequent resistance issues. Since the ban on antibiotics numerous additives have been tried with varied success in feed of animals/birds. Among the additives the use of probiotics has gained much attention due to its various attributes in gut development, growth performance and safety features. However, few studies have revealed that the use of resistant probiotics could do act as carrier for transmission of antimicrobial resistance. In this background, an alternate additive namely postbiotics have been gaining attention as they do exhibit the activity of probiotics. These postbiotics are either intermediate or final metabolites of probiotic organism. The postbiotics of *Lactobacillus plantarum*, cultured in De Man, Rogosa and Sharpe (MRS) broth were collected and stored at 4°C. The physical attributes of postbiotics were studied, in which there was a significant decrease ($p<0.01$) in postbiotic pH (5.25 vs. 6.62), with increased ($p<0.05$) osmolarity (0.048 vs. 0.045 mOsm/Kg) in comparison to the respective un-inoculated broth. The obtained postbiotics exhibited dose dependent anti-inflammatory activity ($p<0.05$), comparable to drug ibuprofen. Also, the per cent inhibition of DPPH (2,2-diphenyl-1-picrylhydrazyl) and ABTS+ (2,2-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid) radicals by postbiotics were recorded 60.91% and 61.71% respectively, significantly higher ($p<0.01$) than the uninoculated media. In order to study its effect on broilers, a biological experiment was conducted in a total of 300 newly hatched broiler chicken, divided equally into six groups (5 replicates each having 10 chicks) namely: Control (Basal diet); T1 (BD+chlortetracycline @335mg/kg); T2 (BD+uninoculated MRS broth); T3 (BD+0.2% postbiotics); T4 (BD+0.4% postbiotics) and T5 (BD+0.6% postbiotics). The birds were reared in experimental pens and provided ad libitum feed and water throughout the study. The supplementation of postbiotics at 0.6% improved ($p<0.05$) the body weight in broilers than the control birds, whereas it was comparable with the antibiotic supplemented chicken. The microbial population (\log_{10} cfu/g) of caecum was studied at different periods, wherein the concentration of lactic acid bacteria was significantly higher ($p<0.05$) in postbiotic treatments (0.4, 0.6%) throughout the experiment with a subsequent reduction in gram negative bacteria at 21 day of study. Broiler chicken supplemented with antibiotic and postbiotics (0.4%, 0.6%) revealed significantly ($p<0.05$) longer villi and deeper crypts compared to control birds. From the experiment, it could be concluded that postbiotics @0.6% in feed improved the growth and gut development in broiler chicken similar to antibiotic growth promoter.

Keywords: Postbiotics, *Lactobacillus plantarum*, probiotics, broiler, growth performance, gut health

Early feeding and its benefits for the poultry industry

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In 2020, 75.2 million broilers from the same hatchery were followed in several countries in the EU, antibiotic usage and reasons for medication was compared, it was observed a very significant reduction (55%) in antimicrobial prescriptions in the group of the farms where an early feeding system was used versus conventional, the main pathologies with consistent reductions were enteric and locomotory problems, key performance indicators (K.P.I.s) were also improved both at the hatchery and the farm. The egg are placed on the farm at 18 days of incubation and allows the chicks immediate access to feed and water after hatching, the sooner the chicks digestive system starts to learn to process feed, it has also a positive effect on the development and maturity of the gut and its immunity, not only tight junctions are stronger and prevent the leakage of pathogens but the villi and the microvilli or brush border will be taller and thicker so the surface of absorption of nutrients will be much increased, with better gut immunity and a richer and more diverse microbial ecosystem in balance with host mucosal defence barrier. The idea of feeding chicks as soon as they hatch and its benefits is not new, over the years different concepts have been developed to achieve the early feeding of the newly hatched chick, from in-ovo injection of different nutrients to supply feed and water in the hatchers and giving them supplements during transport, to hatching chicks on the farm. The reason for this concept to keep being developed is that even in ideal circumstances with narrow hatch window (24-34 hours), short hatchery processes and holding times and short and well environmentally controlled transportation from the hatchery to the farm, the time in hours from hatching to access to feed and water can be over 48 hours for a percentage of the chicks within the population, if the circumstances are not ideal the time and percentage affected can be considerably higher.

Keywords: Early feeding; performance; optimisation; welfare; development, antibiotics reduction

In ovo administration of selected nucleosides improved the performance and digestive enzymes activity in broiler chickens

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Enhancing the gut health and development is the most essential for the production performance of rapidly growing broiler chickens. Based on our previous experiments with nucleosides in broilers where beneficial effects in terms of performance, the present study was carried out to understand the effect of in ovo administration of nucleosides combination (adenosine, guanosine, cytosine and uridine in equal proportions) on hatchability and activity of digestive secretions. The dose and route of administration was selected based on the preliminary experiment. A total of 600 broiler hatching eggs were collected, fumigated and incubated for 18 days at standard temperature-humidity conditions. At the end of 18 days, the eggs were candled and injected with nucleosides through yolk sac route. The experimental design included 5 groups (100 eggs each) as; control (Con) without in ovo injection, sham control (SCon) injected with sterile PBS, NI, II and III were injected with nucleosides at 50, 100 and 200 mg/egg, respectively. Injected eggs were hatched out and reared under uniform managemental conditions. The hatch weight (0d) was comparable ($P>0.05$) among all the treatment groups. However, at 14d of age the birds injected with 100mg/egg significantly ($P<0.05$) higher body weight when compared to control and sham control. The embryonic administration of combination of nucleosides enhanced both the humoral as well as cell mediated immune response against the NewCastle, infectious bursal disease virus vaccines and intra-digital phytohaemagglutinin-P injection respectively. The administration of nucleosides had favorable effect on amylase and lipase activity in broilers. The amylase activity higher ($P<0.05$) in 100mg/egg group when compared to the sham control, whereas the other three groups exhibited intermediate response at hatch. The similar trend was observed at during 3 and 7d of age but on 14d the sham control exhibited higher ($P<0.05$) activity. The lipase activity did not vary during the hatch but from 3d post-hatch onwards the supplementary groups exhibited higher lipase activity when compared to both the controls. From the study, it is concluded that, the in ovo administration of nucleosides mixture at 18th day of incubation improved the growth performance, immune responses and digestive enzymes activity without affecting the hatchability in broiler chickens.

Keywords: “Nucleosides”, “in ovo”, “hatchability”, “performance”, “digestive enzymes”, “broiler chickens”

Utilization of “diluted splitfeeding system” in adult broiler breeder hens

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Broiler breeders hens are feed restricted diets during all their live to ensure their health and performance. However, it has a negative effect on bird welfare as birds could be chronically hungry. On the other hand, broiler breeders hens are fed once a day mainly during the morning and this approach might not be ideal. The called Splitfeeding system in laying hens provides an optimal supply of nutrient requirements using two different diets throughout the day, according to egg formation phases, improving eggshell quality and sustainability. This study was conducted to assess whether the concept of Splitfeeding combined with a lower quantitative feed restriction might be utilized in broiler breeders as a potential strategy to alleviate hunger feeling and improve performance in the last phase of production cycle. A total of 2560 breeder females 53 weeks aged were allocated in 20 pens for 10 weeks. Ten of these pens received a single control diet (165 g/henxday; 11.4MJ ME/kg, 14% CP, 3.2% Ca, 0.28 %dP) at 6:00 am whereas the other 10 pens followed a diluted splitfeeding program (DSF) which had two meals, one morning diet given at 6:00 am (95 g/henxday) and an afternoon diet supplied at 13:00 pm (95 g/henxday). DSF was formulated with a mixture of fiber sources to provide less AME (-1%), CP (-2%), Ca (-2%) and dP (-11%) than the control diet. Animals who received DSF had a greater egg production, hatching eggs and chicks produced compared to the control diet, without negatively affecting eggshell quality. The higher total feed intake and the lower fasting period with DSF increased time spent eating and reduced stereotypic object pecking, which may indicate a reduced hunger feeling and frustration of feeding motivation. Finally, the use of DSF affected positively to economics, decreasing the production cost per chick hatched by 10.5%.

Keywords: Broiler Breeders; feed restriction; Split-feeding; Animal welfare

Protein value of Spanish camelina meal and cake in broilers: preliminary resultsOlga Piquer¹, Pablo Ferrer², Irene Villalba², Ernesto Gómez², Jose Luís Cano³, Alba Cerisuelo García²¹Departamento de Producción y Sanidad Animal, Salud Pública Veterinaria y Ciencia y Tecnología de los Alimentos, Universidad CEU-Cardenal Herrera, Valencia, ²Centro de Investigación y Tecnología Animal, Instituto Valenciano de Investigaciones Agrarias, Castellón, ³Innovater, Teruel*Corresponding author: cerisuelo_alb@gva.es*

Camelina is an emerging crop in Europe mainly used for oil extraction. Camelina meal and cake are the by-products generated from this oil extraction and are characterized by a high crude protein (CP) and amino acid (AA) content and a moderate oil content in the case of camelina cake. The objective of this work was to determine the standardized ileal digestibility of CP and essential AA of these by-products for broilers. A total of 160 males (Cobb 500) were used in this experiment. Five experimental feeds were formulated, one semisynthetic feed with 20% of cornstarch (C) and four feeds with 10 and 20% inclusion of camelina meal and cake, respectively, in substitution of the same percentage of corn starch. At 20 days of age, animals were housed in pairs in 60 metabolism cages (12 cages/treatment). After 6 days of adaptation to the experimental feeds, animals were slaughtered to obtain the ileal content. Feed intake was registered during the last 24 h before slaughter. Both, ileal content and feeds were analyzed for crude protein, AA and titanium dioxide (TiO₂) to calculate the standardized ileal digestibility (SID) of protein and amino acids in camelina meal and cake by regression between daily intake of crude protein and AA and its digested content at the distal ileum. Camelina meal and cake contained (dry matter basis) 42.8 and 37.2% CP, 2.3 and 10.1% crude fat, 35.8 and 30.4% neutral detergent fibre, 1.78 and 1.73% of lysine and 0.83 and 0.70% of methionine, respectively. Feed intake during the experimental period was lower in the treatments with a higher level of camelina inclusion (20%) compared with the control group. The calculated SID for CP of camelina meal and cake was slightly higher for camelina cake compared with camelina meal (77 and 65%, respectively). In the case of essential AA, the SID was again slightly higher in camelina cake compared with camelina meal. Methionine and lysine were the AA with the highest SID values (more than 78%) in both raw materials. Thus, both, camelina meal and cake can be considered a potential source of CP and AA in broiler feeds. Acknowledgments: supported by the Spanish Ministry of Economy and Competitiveness (RTC-2015-3265-5) and European Regional Development.

Keywords: camelina meal; camelina cake; broilers; protein; amino acids

[06-05]: POULTRY NUTRITION (ID: 130219)
[Germany]

Guanidinoacetic acid secures Arginine supply and enhances Creatine metabolism in broiler chickens fed low crude protein diets

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Guanidinoacetic acid (GAA) is endogenously synthesized from Arginine (Arg) and Glycine. It is the direct precursor to Creatine (Crea). Creatine, together with phosphocreatine, plays a central role in cellular energy metabolism (Wyss and Kaddurah-Daouk, 2000). Dietary supply of Crea to broiler chickens can only occur via feed components of animal origin. However, actual dietary contribution of Crea from these components is limited, since inclusion, if allowed, is generally very low and Crea loss during feed processing conditions is quite substantial (Tossenberger et al., 2018). A unique source of Crea in broiler nutrition is its endogenous precursor GAA, which can be added to the feed. Thereby, reactants of endogenous Crea synthesis, such as Arg, can be spared and therefore, dietary Arg can be replaced (Khajali et al., 2020). This nutritional strategy can come into effect especially in low crude protein (CP) diets, when Arg very likely becomes a limiting amino acid for broilers. Therefore, the objective of this study was to evaluate the extent to which GAA can replace Arg in low CP diets fed to broiler chickens. A total of 480 one-day old male Ross 308 broilers received an adequate starter diet from d0-d10. Birds were then evenly allotted to six dietary treatments with eight replicates of 10 birds each. The treatments, fed during grower (d10-d24) and finisher (d25-d42) phase, comprised a control diet (CON) adequate in CP (21.5 and 19.7% CP, respectively), a diet low in CP (-1.5% in both phases) deficient in Arg, a diet low in CP adequate in Arg (0.2% L-Arg) and three diets low in CP supplemented with GAA. Guanidinoacetic acid replaced 0.1% of L-Arg according to different equivalences (EQ): 50% (0.2% GAA), 100% (0.1% GAA) or 150% (0.067% GAA). Amino acid ratios, except for Arg, were held equal between feeding groups. Reduction in dietary CP and deficiency in Arg led to a reduction in weight gain (2,946 g vs. 3,194 g) and to 10 points higher FCR (1.61 vs. 1.51) as compared to the CON group. Breast meat yield was lower by 7.8% (173.5 g/kg vs. 189.6 g/kg) and Crea concentration was lowered by 27.2% as compared to the CON group. Decrease in performance and Crea concentration loss could be compensated when Arg was added to the low CP diet. When GAA replaced Arg in the diet by EQ 150%, birds showed comparable performance to the low CP diet sufficient in Arg and the CON diet. When GAA replaced Arg by EQ 100%, FCR could be improved by 3 points as compared to the CON diet and low CP diet sufficient in Arg (1.48 vs. 1.51 vs. 1.51, respectively). FCR could be even more improved, when GAA spared Arg by EQ 50% when being compared to the CON diet (1.46 vs. 1.51). Supplementation of GAA with an Arg EQ of 100% led to an increase in breast meat Crea concentration of 27.5% as compared to the low CP diet sufficient in Arg. This effect was even more pronounced when GAA spared Arg by EQ 50% (+42.5% and +37.3% as compared to the CON diet). Dietary GAA supplementation can spare Arg up to 150% in low CP diets while maximizing breast muscle Crea, which enhances cellular energy metabolism.

Keywords: guanidinoacetic acid; arginine; low crude protein; creatine; energy metabolism;

Use of high-oleic oils in broiler diets: effects on abdominal fat depot and carcass yield**Gerard Verge-Mèrida¹, David Solà-Oriol¹, Georgina Farré², Marçal Verdú², Francesc Guardiola³, Ana Cristina Barroeta¹**

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Inclusion of fat sources in broiler diets is an extended practice worldwide due to their high metabolizable energy content and the supply of essential fatty acids. As fats represent an important part of feeding costs, the continuous search for competitive alternatives is needed. The aim of the present study was to introduce high-oleic oils in broiler diets as alternative fat sources and to evaluate the effect on performance, abdominal fat deposition and carcass yield. A total of 3,048 broiler chickens (Ross 308) were randomly allocated to 24 pens (127 chickens/pen) and three dietary treatments (n = 8 pens/treatment). Animals were fed common pre-starter and starter diets until 20 d old. During the experimental period, from 21 to 39 days of age, animals were fed growing and finishing diets based on corn, wheat and soybean meal supplemented at 6% with 3 different fat sources: palm oil (P), olive pomace oil (OP) and olive pomace acid oil [OPA; rich in free fatty acids (FFA): 54%]. Performance parameters, i.e., BW, ADG, ADFI and FCR, were measured at 0, 7, 21, 29 and 39 d of age. Animals were slaughtered at 39 d, and six samples of abdominal fat pad (AFP) from each replicate were collected and weighed. Carcass yield (CY) data for each pen was also measured at the slaughterhouse. FCR was lower ($P < 0.01$) for OP throughout experimental period, showing a higher ($P = 0.020$) ADG from 21 to 29 d, a lower ($P = 0.013$) ADFI from 30 to 39 d and a tendency ($P = 0.071$) to reach the highest BW at 39 d. No differences in performance objectives were found between P and OPA treatments. No differences ($P > 0.10$) in CY were observed among the different supplemented dietary fats. Broilers from OP deposit the highest ($P < 0.001$) quantity of AFP. These results showed that OP included at 6% in growing and finishing diets (from 21 d onwards) improved FCR and led to a larger AFP. Moreover, no differences were observed either on BW, ADG, ADFI, FCR and AFP deposition between animals fed P and those fed OPA rich in FFA.

Keywords: abdominal fat pad; carcass performance; high-oleic oil; broiler

True ileal digestible energy system for poultry: an alternative to metabolisable energy system?

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Apparent metabolisable energy (AME) system has become the cornerstone of poultry feed formulations since its introduction in the 1950's. However, AME is not a perfect system and suffers from several limitations (Mateos et al., 2019; Wu et al., 2020). An alternative energy system could be the apparent ileal digestible energy (AIDE), which is measured at the ileal level and reflects digestibility rather than metabolisability as in the case of the AME. An experiment was conducted to determine the nitrogen corrected AME (AMEn) and AIDE of four cereal grains (maize, sorghum, wheat and barley) for broilers. Four experimental diets with similar inclusion (957 g/kg) of each grain were developed to determine the AMEn, AIDE and true ileal digestible energy (TIDE), using titanium dioxide as an indigestible marker. Male broilers (Ross 308) were allocated to 24 cages (8 birds/cage). Each diet was randomly allocated to 6 replicate cages (8 birds/cage) and fed from 14 to 21 days post-hatch and the ileal digesta were collected on day 21. The AIDE was corrected to TIDE using the previously determined ileal endogenous energy losses in broilers. The TIDE of maize, sorghum, wheat and barley were determined to be 16.40, 15.27, 13.13 and 12.07 MJ/kg DM, respectively, and higher ($P < 0.05$) than the corresponding AMEn values of 14.39, 13.74, 10.78 and 9.92 MJ/kg DM, respectively. The apparent ileal digestibility of DM, nitrogen and starch were positively correlated ($P < 0.001$) with TIDE ($r = 0.990, 0.703$ and 0.705 , respectively) and the AMEn ($r = 0.873, 0.483$ and 0.656 , respectively). The present study provided preliminary data on the TIDE of common cereal grains. However, further research is warranted before TIDE could be adopted as an energy system in poultry feed formulations. In particular, well-planned feeding trials comparing formulations based on metabolisable energy versus ileal digestible energy and, their impact on broiler growth performance and the production economics will be instructive.

Keywords: Apparent metabolisable energy; Apparent ileal digestible energy; Broilers; Cereals

Effects of supplementation of β -galacto-oligosaccharides and methionine on production performance, meat quality, and selected serum hormones in broilers subjected to cyclic heat stress

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Heat stress (HS) is responsible for the production losses in poultry reared under tropical climates. Dietary supplementations of various nutrients and supplements have proved to be helpful in combating the detrimental effects of HS. The information regarding the combined effects of β -galacto-oligosaccharides (β -GOS) and methionine (Met) on heat stress is lacking. Therefore, the present study was designed to investigate the combined effects of β -galacto-oligosaccharides (β -GOS) and methionine (Met) supplementation on growth performance, meat quality parameters, and serum profile of triiodothyronine (T3), and thyroxin (T4) during chronic cyclic heat stress. Day-old broilers (n = 288) were distributed in a 3 \times 2 factorial arrangement (6 replica/group) with 3 levels of β -GOS (0%, 0.2% and 0.5%) and 2 levels of Met (0.5% and 1%). The birds were subjected to cyclic HS (35 \pm 1 °C; RH 65 \pm 5%) daily for 8 hours from day 22 till day 35. The birds were weighed weekly to determine the weight-gain and feed efficiency. On day 35, 2 birds from each replicate were killed to collect the breast meat samples for the determination of meat quality parameters (pH, water holding capacity, and cooking loss) and blood samples for the determination of serum T3 and T4. Data (mean \pm SE) were analyzed using 3 \times 2 factorial ANOVA with SPSS. Duncan multiple range test was employed when means of the treatments were significant at p < 0.05. Results demonstrated that the birds fed the diet containing 0.5% Met were heavier (p < 0.05) during heat stress period compared with the birds that received 1% Met. The β -GOS supplementation did not show any significant effects on production and meat quality parameters. However, feed intake tended (P = 0.063) to be higher in the group supplemented with 0.5% Met and 0.5% β -GOS during day 22 to day 35. The cooking loss was lower (p < 0.05) in the birds fed with the diet containing 0.5% Met without any influence on pH and water holding capacity. Only β -GOS (0.2%) increased (p < 0.05) T3 concentration during heat stress with no effects on thyroxin level. In conclusion, combination of Met and β -GOS supplementation did not show any promising effects during HS in broilers. However, 0.5% Met and β -GOS partially improved the detrimental effects of the HS.

Keywords: Prebiotics, broilers, Heat stress, growth, methionine

Evaluating synbiotic, enhanced organic acid, or combined supplementation for the reduction of *Campylobacter* in broilers

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Campylobacter is a major foodborne pathogen associated with the consumption of poultry meat. In vitro and in vivo experiments were conducted to evaluate the effectiveness of synbiotic, enhanced organic acid (EOA), or combined supplementation for the reduction of *Campylobacter coli*. Supernatants from four probiotic strains were co-cultured with *C. coli* at different dilutions. *Enterococcus faecium*, *Bifidobacterium animalis*, and *Pediococcus acidilactici* probiotic supernatants decreased ($P < 0.05$) the in vitro proliferation of *C. coli* at 1:1 supernatant: pathogen dilution. The inhibitory dilution for *Lactobacillus reuteri* was at 5:1 ($P < 0.05$). Different concentrations of the enhanced organic acid were co-cultured with *C. coli* in vitro. EOA concentration of 0.08% significantly decreased the in vitro proliferation of *C. coli* ($P < 0.05$). For the in vivo experiment, 480 Cobb-500 broiler chicks were randomly assigned to four treatments: control (basal diet), synbiotic (0.5 kg/ton), enhanced organic acid (0.5 kg/ton), or synbiotic + EOA (synbiotic at 0.5 kg/ton from 0 to 28 d of age and EOA 0.5 kg/ton from 28 to 42 d of age). All birds were challenged with 1×10^8 CFU/bird of *C. coli* gentamicin-resistant strain on 14 d of age. At 42 d of age, the combined treatment (Synbiotic + EOA) had a 1.2-log reduction in *Campylobacter coli* load in ceca when compared to the positive control treatment ($P = 0.08$). Enhanced organic acid supplementation increased ($P < 0.05$) TLR4 mRNA levels in cecal tonsils when compared to the basal-fed and challenged control treatment at 28 dpi (42 d of age). There was a significant ($P < 0.05$) increase in TGF- β 4 mRNA contents in the synbiotic-supplemented treatment when compared to EOA-supplemented treatment at 14 dpi. There were no significant treatment effects on FCR, BWG, or IL-10 and IFN- γ mRNA levels. The combined supplementation of synbiotic and enhanced organic acid reduced *Campylobacter* load in ceca ($P = 0.08$). However, none of the treatments altered the load on carcass at 42 d of age.

Keywords: *Campylobacter*, Probiotics, Organic acids

[06-10]: POULTRY NUTRITION (ID: 130143)
[Pakistan]

Effect of symbiotic on intestinal histomorphometry and growth rate in quails, experimentally infected with field strain of *Salmonella gallinarum*

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This study was planned to investigate the effect of synbiotic on intestinal histomorphometry and growth rate of quails experimentally infected with field strain of *Salmonella gallinarum*. Day old Japanese quails (120), average body weight 6.09 ± 1.1 g, were randomly assigned into 4 groups AA, BB, CC and DD and 2 replicates. Group AA was given synbiotic from day one (daily basis) along with challenge + basal diet. Group BB was given synbiotic on weekly basis along with challenge + basal diet. Group CC was the negative control group (challenge + basal diet) and Group DD was the positive control group (just basal diet with synbiotic). Quails of group AA, BB and CC were challenged with *Salmonella gallinarum* and group DD was positive control group. Synbiotic used in this study is the combination of commercially available probiotic and prebiotic. For the formation of Synbiotic, prebiotic and probiotic are mixed together thoroughly in commercially available mash feed in prescribed amount of 2:1. Probiotic used contained patented strain of *Bacillus subtilis*, 1×10^{11} CFU/lb PB6. PB6 is a unique, naturally occurring, spore-forming microorganism and was mixed in mash feed @ 1 lb. per ton or 0.5kg/1000kg of feed. Prebiotic used in this study is a unique Beta-(1, 3)-Glucan products derived from algae, which is used for immune support and modulation to improve general health of the animals and was mixed in mash feed @ 1g/kg of feed along with probiotic. At least five quail chicks were randomly selected to check for salmonella presence or absence in intestine upon arrival and were found negative. A total 60 organ samples of intestine and liver were collected from apparently health and freshly dead quails respectively to isolate the field strain of *Salmonella gallinarum*. Bacterial isolation and molecular identification were performed in accordance with laboratory diagnostic culture techniques and PCR. Results from current study indicate that non antibiotic feed additive such as synbiotic used in this study boosted the gut histo-morphometric parameters including the villus height, villus width and crypts depth under the challenge of *Salmonella gallinarum*. There was significant increase in all these parameters due to synbiotic feeding except the negative control group which showed the lowest values. Group DD (the positive control group) achieved maximum villus height of 636.88 ± 65.93 μ m in duodenal mucosa. Whereas maximum villus width of 182.01 ± 15.40 μ m in duodenal mucosa was achieved by group AA, which was given synbiotic on daily basis along with challenge. Maximum villus height of 276.89 ± 21.16 μ m and crypt depth of 26.66 ± 1.15 μ m in jejunum mucosa were recorded in group AA, given the challenge and synbiotic on daily basis. Hence results illustrate that there is an overall increase in histological parameters of duodenal and jejunum mucosa in the groups fed synbiotic as compared to the negative control group. This study supports the beneficial effects of synbiotic on intestinal health and growth rate of Japanese quails by improving FCR.

Keywords: "Salmonella gallinarum", "Japanese quail", "synbiotic", "intestinal histomorphometry",

Combining Massachusetts vaccine virus with QX or 4/91 vaccine virus induces protection to challenge with IB QX and 4/91 virus

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Infectious Bronchitis (IB) is an important viral disease in chickens. Vaccination schedules in which attenuated live IB vaccines are incorporated are often applied to protect chickens towards the consequences of infection with virulent strains of IB virus. In general, commercially available vaccines offer protection against field viruses homologous to the vaccine strain. Additionally, vaccination schedules may induce protection to IB strains which are heterologous to the vaccine strains. In this study the efficacy of combinations of IB H120 & IB QX and IB Ma5 & IB 4/91 vaccines towards challenge with an IB QX like and IB 793B virus was assessed in SPF laying type chickens using ciliary activity of tracheal explants as read out. The vaccines were applied on the day of hatch by eye-drop. Twenty-one days after vaccination the chickens were challenged. Antibody titers to IB virus were assessed on the day of challenge by means of an ELISA. Both vaccination schedules yielded good protection towards challenge with IB QX (95% and 90% respectively) and IB 793B (both 100%). A low serological response towards vaccination was observed. The results of the present study show the additional value of vaccine schedules containing a Massachusetts type IB virus (IB H120 or IB Ma5) and a QX-like or 4/91 like IB in areas in which IB QX-like or IB 793B viruses is most prevalent

Keywords: infectious bronchitis, vaccines; cross protection; 793B; QX

Foot-pad dermatitis: Potential parameter for poultry welfare

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Special attention to animal welfare and protection of animals is gaining importance during the last decades and severe regulations are implemented especially in Europe. Poultry production is one of the most intensive systems of animal production where the poultry houses are crowded and the animals are confined to reduced areas. Poultry houses crowdedness leads to fast litter deterioration as well as high emission of ammonia and rise of humidity. Foot-pad lesions may range from simple redness and breast feathers detachment to ulcerative and complicated breast blisters. Many poultry houses, in Batna region, were periodically visited. Temperature, humidity and litter quality were recorded as well as the broilers weight. Footpads were carefully observed and the lesions were classified according to our new scoring scale. This later ranged from normal and simple skin discoloration to severe ulceration of more than 50% of the footpads and complicated breast burns. Histological sections were done on foot-pads to confirm the macroscopic observed lesions and to reveal the underlying process. Foot-pad dermatitis prevails on breast lesions in our poultry farms with six scores (from 0 to 5), the foot-pad recorded lesions were as follows: score 0:16%, score 1: 8%, score 2: 29%, score 3: 12%, score 4: 25%, score 5:10%. In one poultry farm and due to extended rearing period, a dramatic situation was observed and 100% of broilers have ulcerative foot-pad dermatitis with score 5 and complicated with hock burns. Foot-pad dermatitis and their percentage look like that observed in some European countries. Foot-pad dermatitis represents a potential parameter and may be used as a good indicator for assessment of poultry welfare. Therefore, drastic measures must be taken to minimize these lesions through shortage of the rearing period, looking for fast growing poultry strains and application of good farming and welfare practices.

Keywords: Food-pad Dermatitis; poultry; welfare, health

[07-02]: *POULTRY HEALTH AND FOOD SECURITY* (ID: 130049)
[Pakistan]

Astragaloside-IV inhibit tibial dyschondroplasia on vascular endothelial cell based PI3K/Akt/HIF-1 α signaling

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Astragaloside IV is extracted from *Astragalus membranaceus* and widely used as anti-cancer, anti-inflammatory and anti-oxidative. AST-IV promotes osteogenesis but its protective effects on tibial dyschondroplasia (TD) have not been studied yet. So, we designed this study to use AST-IV for the treatment of TD through the PI3K/Akt/HIF-1 α pathway. For this purpose, (n=180) chickens were equally divided into control group, TD group and Astr group. The control group offered standard normal diet, while the TD group and Astr group were given thiram @50 mg/kg along with; after 7 days, AST-IV was administered orally @ 50 mg/kg body weight to Astr group. The mortality rate, production parameters, physiological deviations, and tibial parameters along with genes and proteins expression related to PI3K/Akt/HIF-1 α signalling pathway were observed. The results showed GP size was increased significantly, while mortality and lameness were prominent in TD chickens, but difference was not significant. The level of serum and antioxidants contents was regularized by AST-IV. Furthermore, AST-IV administrations reinstated the growth and GP size, whereas reduced the death, tibia lesions and tibial cartilage damage in chickens. The gene and protein expression of VEGF, VEGFR1, HIF-1 α and COX-2 were enhanced in TD group chickens. After addition of AST-IV to chickens, the expression of VEGF, HIF-1 α and COX-2 were decreased. Akt and PI3K were less expressed in TD group as compared to control group. Whereas AST-IV treatment increased the expression of these genes near to control group. Altogether, RT-qPCR, western blotting and immunohistochemistry results reveal that AST-IV regulate the expression of various genes and proteins related to PI3K/Akt/HIF-1 α signalling pathway.

Keywords: Tibial dyschondroplasia; Thiram; Chickens; Growth plate; Tetramethylpyrazine; Astragaloside IV; Chondrocytes

[07-03]: POULTRY HEALTH AND FOOD SECURITY (ID: 130164)
[Pakistan]

Modulation of suppression of HIF1 α /VEGF/VEGFR signaling pathway by Geldanamycin in avian tibial dyschondroplasia

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Tibial dyschondroplasia (TD) is a long bone intractable disorder of fast-growing poultry birds characterized by the appearance of non-vascularized and non-mineralized cartilage masses in tibial growth plates. This economically important disease has been reported to cause devastating effects on poultry industry in recent years. The role of angiogenic signalling pathway; hypoxia-inducible factor-1 α (HIF-1 α), vascular endothelial growth factor (VEGFA), VEGF receptors (VEGF1 & VEGF2) and interleukin-8 (IL-8) in causing this condition has been considered very crucial. Geldanamycin (17-DMAG), a naturally occurring inhibitor of heart shock proteins has been used to regulate the HIF-1 α and its client proteins which modulate the vascular network that allows the growth of tumors and metastasis. A study was designed to investigate the effects of geldanamycin (17-DMAG) in the modulation of suppressed angiogenic signalling pathway in tibial dyschondroplasia in chicken broilers. The birds were divided into two groups; (A) control group (n=100) with normal diet, (B) TD group (n=150) which received a normal diet with 40 mg/kg of tetramethyl thiuram disulphide (thiram) to induce TD. On day 7 post-hatch, half of birds from the TD group were separated and designated as (C) Treatment group which received geldanamycin (600ug) I/V. Slaughtering was done on day 14 post hatch. In this study, we found that, compared to normal, the down regulation of HIF-1 α and its clients VEGFA, VEGFR1, VEGFR2 and IL-8 hindered the tibial vascular distributions leading to the disruption in blood supply in growth plate. However, in contrary, 17-DMAG treatment modulated the activity of HIF-1 α enhancing the tibial angiogenesis due to the pro-angiogenic factor up-regulation (including VEGFA, VEGFR1, VEGFR2, and IL-8). Such changes, as a result, brought the vascular channels to the TD-afflicted area and thus abrogated the lameness of the birds. The occurrence of TD, as described in previous studies, is highly associated with inhibition of tibial angiogenesis through down-regulated expressions of HIF-1 α , VEGFA, VEGF receptors and IL-8, which results in suppression of growth plate development. Our findings reveal that the geldanamycin treatment is suggestive of reverting such condition into the normal vasculature by the up-regulations of the clients of signalling pathway.

Keywords: Tibial Dyschondroplasia, Geldanamycin, HIF-1 α , Broilers

Peritoneal washings in poultry: limitations and proposed solution

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Nowadays, peritoneal washings in poultry are widely used in research laboratories, mainly in immune response control and testing, through collecting heterophils, macrophages and peritoneal exudates for analysis. Usually used after intraperitoneal injection of immunogenic substances followed by peritoneal washing with PBS or normal saline. However, realizing this technique is not simple and needs more time due to anatomic particularities of avian species. In our recent studies, peritoneal washings are complicated and fastidious techniques due to obstructions of syringe tips and tubes, used for peritoneal washings, by intestine, air sacs and even adipose tissue. In order to overcome and minimize occurrence of these obstructions and to collect more liquids in reduced time we used a tube with rounded bottom with many holes. Inserting this tube in abdominal cavity leads to siphonage of peritoneal liquids into the tube through the many small, rounded holes made in its two thirds bottom parts. The peritoneal washes, aspirated in the tube, are readily collected by inserting adapted syringe or cannula. Peritoneal washings in poultry are complicated and fastidious techniques and need more improvements. This new proposed solution represents a potential alternative technique to reduce time and contamination as well as decomposition and deterioration of exudates components for getting best results.

Keywords: poultry; peritoneal; lavage; injection; technique

Synergistic effect of experimentally induced aflatoxin B1 and Ochratoxin A on performance, immunity, livability and serum biochemistry in broiler chickens

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The quality of feed ingredients plays a key role in determining the performance of birds and profit margin to the poultry farmers. Aflatoxin B1 (AFB1) and Ochratoxin A (OTA) are common contaminants in poultry feeds which causes adverse effects in poultry. Number of studies has elaborated the negative effects of both the toxins individually, however their synergistic effects is relative an understudy. A study was conducted to evaluate the combined effects of AFB1 and OTA at four different levels (T1-Control; T2-100 ppb AFB1+100 ppb OTA; T3-100 ppb AFB1+200 ppb OTA; T4-250 ppb AFB1+100 ppb OTA and T5- 250ppb AFB1+200 ppb OTA) on broiler's performance, immunity, mortality and biochemical parameters. 240-day old broiler chicks were distributed into five treatments with six replicates. Ad libitum feed and water was offered, and laboratory generated mycotoxins were added to the diet from the start of the experiment to 42 days. Significant ($P<0.001$) reduction in weight gain and feed efficiency was observed in all mycotoxins affected groups from second week onwards. Dose dependent deterioration in production performance was observed. Combined AFB1 and OTA also affected the cell mediated immunity and humoral immunity. Significantly ($P<0.001$) lower foot web index (CMI) and HA titre against sheep RBC was noticed in T5 group as compared to control. Higher mortality percent (32.5%) was noticed in T5 group and lowest mortality rate was recorded in T2 (7.5 %) among the toxin fed groups. Mycotoxins (AFB1+OTA) also had a negative effect on serum biochemical parameters (14, 21 and 42nd day). From 14th day onwards, reduction in serum protein, albumin, globulin and uric acid was observed in the challenged groups compared to control. Interestingly, higher albumin, triglycerides, calcium and AST levels were recorded in T2 group as compared to other groups including control. Reduction in cholesterol content was observed in T4 group at 14 and 42 days of the experimental period. From the above experiment, it could be concluded that the simultaneous administration of mycotoxins (AFB1+OTA) exhibited synergistic effect in broilers and the effects were dose dependent.

Keywords: Aflatoxins; Broiler chickens; Immunity; Mycotoxins; Ochratoxin A; Performance

[07-06]: *POULTRY HEALTH AND FOOD SECURITY* (ID: 130249)
[Pakistan]

Immunopathological effects of concurrent feeding of ochratoxins and sea buckthorn in commercial broilers

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Mycotoxins are secondary metabolites produced primarily by different genera of toxigenic fungi; *Aspergillus*, *Fusarium*, *Penicillium* etc. Among them Ochratoxin A (OTA) is harmful mycotoxin that is mainly produced by *Aspergillus* and *Penicillium*. It is primarily nephrotoxic and hepatotoxic and has carcinogenic, embryotoxic, genotoxic, immunotoxic and neurotoxic effects. Sea Buckthorn (SBT) is a prickly deciduous shrub having lot of nutritional and medicinal values. Vitamins, trace metals, amino acids, carotene, folic acid, fatty acids are found in abundance in fruits and leaves of Sea buckthorn. The present study was designed to evaluate the immunopathological effects of concurrent feeding of OTA and SBT in commercial broilers. A total of 120, day old broiler birds were evenly distributed in 6 treatment groups. The group A was kept as negative control, Group B was given OTA mixed feed (300 ppb), and Group C and D were supplemented with SBT in graded doses @ 2 & 4 g/kg respectively. In group E and F, SBT with OTA mixed feed was given with dose rate of 2g/kg and 4g/kg respectively. Parameters including immunological, physical, clinical, and histopathological were observed. Birds in groups A, C, D, E, and F were healthy due to SBT but the birds in group B were dull, depressed, pale due to OTA toxicity. Feeding of SBT resulted in higher absolute and relative organ weights of immune organs. Histopathological alterations were more pronounced in OTA treated groups than SBT treated groups. In-vivo mononuclear-carbon-particle phagocytic response, titers of antibodies against (SRBCs) and lymphoproliferative response to avian tuberculin concluded that the use of SBT had a positive immune modulatory effect. This study concluded that OTA has immunosuppressive effect in birds. The use of SBT at higher doses completely ameliorated immunosuppressive response of OTA in commercial birds.

Keywords: Immunopathological' Sea buckthorn (SBT)' Ochratoxin A (OTA).

Combined use of two attenuated *S. Enteritidis* and *S. Typhimurium* vaccines to reduce excretion of challenge strains

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Combined use of two attenuated *S. Enteritidis* and *S. Typhimurium* vaccines to reduce excretion and colonization of challenge strains *Salmonella enterica* serovars Typhimurium and Enteritidis are the predominant causes of food poisoning in humans owing to consumption of contaminated eggs or poultry products. Considering the co-endemicity of *Salmonella* Typhimurium and *Salmonella* Enteritidis, repeated vaccinations with live attenuated vaccines against both serovars need to be applied in pullets for the protection of adult hens during laying. In the present work, we investigated the efficacy of the application of a mixture of two live attenuated vaccines, PRIMUN SALMONELLA E and PRIMUN SALMONELLA T, to reduce excretion and colonization of field strains of both serovars in challenged animals. The assay was performed in laboratory facilities, but the results indicate that the combination of both monovalent vaccines is a valuable strategy that reduces farm operations, as both vaccines can be applied in the same water solution. One-day-old SPF chicks (n=92) were randomized to receive either a mixture of PRIMUN SALMONELLA E and PRIMUN SALMONELLA T vaccines or left unvaccinated as a control group. At 14 days of age, the vaccinated group and control group were divided in two challenge groups which were experimentally infected with *Salmonella* Typhimurium or *Salmonella* Enteritidis field strains. Both vaccinated groups significantly reduced the excretion of *Salmonella* field strain. The non-vaccinated group shed *Salmonella* Typhimurium field strain at a mean rate of 89.3%, with this being reduced by vaccination to 42.1%. The rates achieved after *Salmonella* Enteritidis challenge were 68.5% in the control group and 30.3% in the vaccinated group. Additionally, female hens (n=40) were challenged at the end of the laying period to evaluate the combined vaccine's degree of protection against internal organ colonization. Twenty hens received three vaccine doses at 1 day, 7 weeks and at 18 weeks of age, and the other 20 females remained non- vaccinated as a control group. Two weeks after challenge the colonization in vaccinated was 9% while in control was 37% for *S. Enteritidis* and 15% versus 30% for *S. Typhimurium*.

Keywords: Live attenuated vaccine; *Salmonella Enteritidis*; *Salmonella Typhimurium*, excretion

[07-08]: *POULTRY HEALTH AND FOOD SECURITY* (ID: 130213)
[Spain]

***Salmonella* control in broiler production by microencapsulated bacteriophages feed added**

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Salmonella remains as one of the major causes of foodborne diseases and a considerable problem for the poultry industry [1]. The use of bacteriophages has emerged as a possible intervention by which *Salmonella* colonization could be controlled at field level [2]. The use of *Salmonella* microencapsulated bacteriophage as a feed additive could be an effective practical strategy for its sustainable application at field level [3]. In this context, the objective of this study was to evaluate the implication of microencapsulated bacteriophage as a feed additive in the starter diet to avoid the horizontal transmission of *Salmonella* Enteritidis during the rearing period. *Salmonella* phage used in this experiment was FGS011, which was encapsulated using the anionic polymer Eudragit® L100 by the spray drying technique. For the in vivo trial, 100 one-day-old chicks were randomly divided in two identical poultry houses according to the two experimental groups (control vs L100) simulating field production conditions. In each experimental group, 50% of the birds (n=25) were challenged with 10E5 UFC of *Salmonella* Enteritidis field strain via oral gavage. Animals from the L100 group received the *Salmonella*-bacteriophage FGS011, microencapsulated, as a feed additive (1g/kg, 5.5 UFP/g) with the starter diet (until day 21). Animals from the control group received a basal diet without bacteriophage. During the study, cloacal swabs from 30 animals per group (15 infected and 15 non-infected) were taken twice a week throughout the growing period. *Salmonella* detection was assessed as per ISO/TS 6579-1:2017. Results of the study showed that in non-infected birds, L100 application reduced the incidence of *Salmonella* excretion in the 4th week of rearing compared with the control group (27 ± 8.1 vs $7 \pm 4.1\%$; $P < 0.05$). Moreover, *Salmonella* was not detected in non-infected birds of L100 group at the end of the rearing period (weeks 5th and 6th). These results highlight the use of microencapsulated-L100 phages as an effective approach for reducing the horizontal transmission of *Salmonella* in poultry and to eliminate the *Salmonella* by the end of the rearing period. References: 1.García-Soto S, et al. Front Microbiol. 2020, doi: 10.3389/fmicb.2020.01741. 2. Wernicki A et al. 2017, doi:10.1186/s12985-017-0849-7. 3. Lorenzo-Rebenaque et al. 2021, doi:10.3390/PH14050434.

Keywords: *Salmonella*; Bacteriophages; Zoonosis

[07-09]: *POULTRY HEALTH AND FOOD SECURITY* (ID: 130178)
[Egypt]

Antibacterial activity of silver nanoparticles against *Clostridium perfringens* infection in broilers

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Clostridium perfringens-associated necrotic enteritis is a serious problem affecting broiler chicken farms. In case of outbreaks, antibiotics are applied to minimize the losses. A major challenge is to reduce the application of antibiotics in poultry farms in order to combat the antibiotic resistance. One alternative is the use of nanoparticles (NPs) to overcome bacterial resistance to antibiotics. Nanotechnology has become an extensive field of research due to the unique physical and chemical properties of nanoparticles (NPs), which allow novel applications. NPs show advantages of high surface area, bioavailability with effective delivering to the target tissue in comparison with the bulk form. Nanomaterials show variable forms, sizes, shapes and surface charges. In previous studies in medical research, silver nanoparticles (AgNPs) had showed marked antimicrobial activity against wide array of pathogens. 120 one-day old broiler chicks were divided into 4 groups; each group was subdivided into three replicates (10 birds each). First group (G1) had been experimentally infected with *C. perfringens*, second group (G2), infected and treated with Ag NPs, third group (G3) treated with AgNPs only and last group (G4) as a negative control. AgNPs were synthesized via chemical reduction of silver nitrate with the aid of sodium citrate and sodium borohydride. Chicks in G1 and G2 were infected with *C. perfringens* type A (4×10^8 colony forming unit (CFU)/mL/chick) for 2 successive days. In the treated groups (G2 and G3), Ag NPs (150 μ g/chick) were administered via crop gavage. During the observation period (5 weeks), bird performance was evaluated, and immune organ indexes were recorded. Serum samples were collected for immunological evaluation, tissue samples were collected for histopathology and muscle samples for determination of AgNPs residues. Treatment with AgNPs improved body weights and feed conversion rates, reduced the colonization of *C. perfringens* in the intestine and ceca, decreased the severity of clinical signs and reduced mortalities in comparison with infected non-treated group (G1). Ag NPs treatment alleviated pathological lesions in the intestine and liver, but some Ag residues were found in the muscles. In conclusion, AgNPs have a positive impact on bird weights and gut health integrity in general while leaving some residues in muscles; therefore, further studies are needed on the concentration and size of AgNPs, the method of administration, and withdrawal time to ensure that chicken meat is fit for human consumption.

Keywords: Broiler; *Clostridium perfringens*; Histopathology; Silver nanoparticles; Therapeutic; Tissue residues

Stakeholders' perceptions about the antimicrobial use practices and antimicrobial resistance issues in the Italian poultry sector

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In recent years, the EU and the Member States have undertaken many initiatives supporting a more prudent use of antimicrobials in livestock farming. Consumer demand and production of antibiotic-free broiler meat have consequently been rising. Although, several differences in the practices of AMU among Italian producers and practitioners suggest that perceptions about a prudent AMU and their consequent AMR issues are still remarkable among stakeholders. This study analyses those perceptions to understand the motivating reasons leading stakeholders to adopt more prudent AMU practices. Seven farmers and one veterinarian from five Italian regions were interviewed using a semi-structured questionnaire. All farmers are integrated/dependent to a large processing company and the vet is employed by one of these companies. The poultry production systems comprised both conventional indoor [3] and antibiotic-free indoor [4]. In average interviewees have 18,5 years of experience in poultry farming. Interviews' content was analysed through a qualitative content analysis. They covered different themes that were classified in twelve categories namely: Becoming a Poultry-producer; Systems and supply chains; Dimensions of intensive livestock farming; Diseases; AMU/Medicalisation/Treatment; Changes processes (triggers and barriers); Emergent themes; Caring for chickens; Demographics and spatial issues; AMR concern; A good farmer; Chickens as agents. Among these, the most mentioned were Changes processes (triggers and barriers) [259 mentions], followed by Caring for chickens [236] and Systems and supply chains [235]. The results reveal that farmers are not independent in the decision-making about the AMU treatments, according to [farmer 7] "it is the company veterinarian who tells us what treatment to do and for how long". Both conventional and antibiotic-free farmers are aware and concerned with the problems of AMR, noticing that antibiotics are becoming less effective along the years, but the AMR is not attributed to the animal, but to the specific environment where the animals are raised having differences even between sheds of the same farm. Concerning the AMU and its practices, there is a consensus that a massive reduction of antibiotics occurred in the past years in poultry farming, even in conventional systems, as a result of different technologies and strategies, as reported by the [vet]: "From when I started to today, the use has dropped considerably thanks to vaccines, biosecurity and probiotics". The ban on growth promoters, the higher requirements of biosecurity, the application of precision farming tools for the control of environmental parameters, the enhancement of genetic breeds, individualisation of treatments by flock instead of the whole farm and the use of feed electronic dispensers and probiotics also contributed to further reductions. Sectoral organization and supply chain coordination are key aspects to the national success in AMU reduction in Italy. In conclusion, the study results indicate that different pieces of a coordinated effort at sectoral level, led stakeholders to change their perceptions and behaviour towards a more prudent AMU in the Italian poultry sector.

Keywords: Stakeholders' perceptions; prudent AMU; AMR concern; poultry producers

[07-11]: *POULTRY HEALTH AND FOOD SECURITY* (ID: 130221)
[Spain]

Safety of a modified live *Escherichia coli* vaccine, when administered to chickens during lay

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Avian colibacillosis in domestic poultry is a significant issue globally. Infection commonly occurs via the respiratory tract after a primary bacterial or viral infection or as a result of poor husbandry practices. The disease is associated with high morbidity and mortality. An *E.coli* modified *aroA* gene deleted-live vaccine (Poulvac *E.coli*) was developed and is already registered in the European Union for spray vaccination of chickens and turkeys and for use in drinking water for chickens. However, the original claim contra-indicated the use of the product in chickens during lay because the necessary data had not been generated. This paper will describe several studies which were performed to demonstrate the product's safety when administered to chickens during lay. Firstly, reproductive safety was evaluated in a laboratory study where animals were vaccinated with a single commercial dose at day of age and revaccinated with an overdose (10X) at 21 weeks of age. Egg production was followed from start of lay until 4 weeks after revaccination. Vaccinated animals showed standard mean egg production and egg weight and no abnormal eggs were observed. Secondly, dissemination of the vaccine into the tissues of the reproductive system was assessed in hens vaccinated with the commercial dose at 5 days of age, 14 weeks of age and 30 weeks of age during in a field safety study. Dissemination was also evaluated in a preliminary laboratory safety study where 42 weeks old SPF chickens were vaccinated with a 10X overdose. Microbiological testing of swabs was performed on days 3-4, 7 and 14 (only in the lab study) after vaccination, and no residual bacteria from the *E. coli* vaccine were observed neither on the eggs' surface nor in the eggs' content. Moreover, testimonials of three farms dealing with colibacillosis during egg production and therefore vaccinating with Poulvac *E.coli* showed no safety concerns. On the contrary, a reduction of mortality after vaccination was noted in all three farms. Based on these results, it can be concluded that Poulvac *E.coli* vaccine administration to chickens during lay is safe and according to field use experience during production there was observed a decrease in mortality after this use.

Keywords: *Escherichia coli*; colibacillosis; layers; safety.

[07-12]: POULTRY HEALTH AND FOOD SECURITY (ID: 130237)
[Germany]

Concomitant monitoring of *Clostridium perfringens* and *Eimeria* species in fecal samples of conventional and slow-growing broiler flocks by multiplex qPCR

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Necrotic enteritis infection by *Clostridium perfringens* (Cp) alone is well characterized, but the co-infection with *Eimeria* spp. is not fully elucidated. Herein, a survey to evaluate the prevalence of Cp by detection of toxin A and *Eimeria* spp. in pooled samples from conventional and slow-growing broiler flocks across 45 farms was conducted. The prevalence of Cp was significantly higher (79/88; 90%) for samples from slow-growing flocks than for conventional flocks (61/155; 39%). The most prevalent *Eimeria* spp. in conventional and slow-growing broilers were *E. acervulina* (98/155; 63%) and *E. maxima* (49/88; 56%) respectively. In contrast, *E. tenella* was the least prevalent in samples from the conventional (39/155; 25%) and the slow-growing flocks (9/88; 10%). Interestingly, the prevalence of Cp and *Eimeria* spp. increased between 7 and 28 days-of-age for both flocks. These findings further underline a potential interaction of Cp and *Eimeria* in the pathogenesis of enteric diseases in broilers.

Keywords: Necrotic Enteritis, *E. maxima*, *E. acervulina*, *E. tenella*, cpa

Plasma and muscle metabolomics profiling of modern broiler chickens exposed to chronic heat stress

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Heat stress represents a major concern for the poultry industry causing huge economic losses, low productive efficiency and poor animal welfare. In particular, continuous heat waves tend to prolong the exposure time of chickens towards these adverse environmental conditions. Therefore, the aim of this study was to investigate the effects of chronic heat stress conditions on plasma and muscle metabolomics profile of fast-growing broiler chickens. A total of 300 Ross 308 male chicks were raised either in thermoneutral conditions for the whole rearing cycle (TN group; 6 replicates of 25 birds/each) or exposed to chronic heat stress conditions (30°C for 24 h) from 35 to 41 d (HS group; 6 replicates of 25 birds/each). Both the groups received the same commercial diet throughout the study. At processing (41 d), plasma and breast muscle samples were obtained from 12 birds/experimental group and analyzed applying an ¹H-NMR-based metabolomics approach. As expected, heat stress conditions negatively affected productive performance (HS birds: -14% and -33% of body weight and daily feed intake compared to TN ones, respectively; P<0.05) and slaughter yields. Plasma and muscle metabolomics profile revealed remarkable alterations in response to the different environmental conditions. In particular, a total of 19 and 23 metabolites, mainly involved in important metabolic pathways such as protein and energy metabolism, exhibited significantly different concentration in plasma and breast muscle of TN and HS birds, respectively. Taken together, these results add important information regarding the complex physiological and metabolic response of broiler chickens toward chronic heat stress conditions, opening the way for potential interventions able to counteract the negative effects induced by such condition.

Keywords: broiler chicken; heat stress; metabolomics; plasma; muscle tissue

Thermal stress in day-old chicks: risk factors and effects on mortality

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The aim of this study was to identify risk factors for thermal stress in the hatchery under commercial conditions, and to determine their relationship with chick mortality during the first week of life. Risk factors were classified as biotic and abiotic factors. Cloacal temperatures of day-old chicks were sampled at three points in the hatchery: immediately after hatching, before their placement in the expedition room and in the expedition room. Chicks' cloacal temperature was significantly affected by breeder age, chick gender, incubation process, waiting time until the start of sampling, sampling time and whether the ventilation system was on or off at sampling. It was observed that, as time passed since hatching, biotic factors had less influence on cloacal temperature, whereas abiotic factors became more significant. Furthermore, cloacal temperatures below the optimum range (<39.7°C) could increase first-week mortality by up to three times. These results suggest that it is important to consider abiotic factors and to avoid cold stress in commercial conditions, as these may decrease chick welfare and increase first week mortality.

Keywords: animal welfare; broiler chicks; cloacal temperature; thermal stress; mortality

The effect of monochromatic, combined, and mixed light-emitting diode light regimes on growth traits in broiler chickens

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The aim of this study is to determine the effects of different lighting programs on growth traits of broilers reared in an extensive indoor system. A total of 300 broiler chickens (Cobb500) were used in the study. Experimental groups were formed as follows; 1-conventional lighting (incandescent white bulb), 2-blue monochromatic lighting (480 nm), 3-green monochromatic lighting (560 nm), 4-blue-green combined monochromatic lighting (blue for the first ten days, then green), 5-green-blue combined monochromatic lighting (green for the first ten days, then blue), and 6-blue-green mixed lighting (alternating every 5 minutes). To obtain the estimates of individual growth curve parameters, all birds were weighed weekly from hatching to 8 weeks of age. The Gompertz nonlinear regression model was used to estimate the growth curve of each bird. At the end of the experiment, the highest body weight average (3522 g) was obtained in the green-blue group ($P<0.05$). It was determined that the broilers in the green and green-blue groups had higher mean values (respectively 7174 g and 7150 g) of mature weight parameter of Gompertz growth model, and similarly mean values (respectively 2644 g and 2634 g) of the weight of inflection point of the growth curve in the green and green-blue groups were higher than those of other groups ($P<0.05$). There were no differences between the experimental groups for the parameter of instantaneous growth rate and shape parameter of the Gompertz growth function. As a result, it was determined that the application of green monochromatic lighting in the first ten days of the fattening period and blue monochromatic lighting in the following period positively affected growth characteristics. (Dear reviewer, broiler strain information (Cobb500) has been added to the abstract section. In "the extensive indoor rearing system", the earliest slaughter age is 56 days (SCAHAW 2000). Therefore, earlier slaughter is not possible in such studies. In addition, information about basic applications such as the content of the diets used in study and the vaccination program are usually presented in the "Materials and Methods" section of a scientific paper. All this information is included in the full-text version of our study.)

Keywords: Lighting; Monochromatic; Tonic immobility; Fear; Poultry behavior

Comparison of performance and developmental stability characteristics of broilers reared in conventional and extensive indoor systems

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The aim of this study is to compare the performance and development stability characteristics of broilers reared in two different systems. For this purpose, a total of 400 broilers were raised in conventional and extensive indoor systems until 56 days of age. The mean values (respectively 2592 g and 3684 g) of live weight of broilers reared in conventional system at both 42 days and 56 days of age were higher than those of broiler (respectively 2298 g and 3195 g) grown in extensive indoor system. In terms of feed efficiency, better results were obtained from chickens reared in the conventional system. However, in terms of feed consumption, the average value of chickens reared in extensive indoor system was found to be higher. In the study, the carcass yields of broilers varied between 72.88% and 72.63%. There was no difference between the experimental groups in terms of carcass yield and carcass part percentages. In terms of abdominal fat ratio, the mean value (3.23%) of broilers reared in the conventional system was higher than the averages (2.82%) of the birds reared in the extensive indoor system ($P < 0.05$). Similarly, the average value (3.18%) of male chickens was higher than the mean value (2.87%) of females. Length measurements were made for face, wing, and shank trait, which are bilateral characteristics of broilers reared in different systems. There were no differences between the experimental groups in terms of mean values of relative asymmetry determined for face length, wing length, shank length, and shank diameter. The symmetry types detected in both trial groups for these four bilateral traits were two fluctuating asymmetries, one directional asymmetry, and one anti-symmetry. As a result, better results were obtained in terms of performance characteristics of broilers reared in conventional system than those grown in extensive indoor system. In addition, there was no difference between the two groups in terms of developmental stability characteristics. Although 8/16 lighting programs were applied in the intensive indoor system, the feed consumption was higher. At the same time, the slaughter weight obtained per square meter has exceeded the standards. A suitable and attenuated diet is recommended for broilers reared in extensive indoor system.

Keywords: Broiler; Extensive indoor; Relative asymmetry; Fluctuation asymmetry; Carcass

Best Practice Hens: tools and strategies to support egg production during transition to non-cage egg production systems in the EU

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Supported by 170 NGOs and 1,6 million European citizens, the ‘End the Cage Age’ initiative demands legislative action to end the use of cages in all livestock production in Europe. The European Commission committed to revise the EU animal welfare legislation by the end of 2023, and to develop supporting measures for farmers in their transition to non-cage systems. This measure will have far more impact in those countries with large egg production in cage systems, such as those in the Mediterranean region. Portugal has 52% of production in enriched cages. In Spain, this is even higher (77%), and the cost of transition to cage-free farming is estimated to be around 1000 million euros. The EU tender project Best Practice Hens (<https://bestpracticehens.eu>), launched in May 2021, involves 7 EU countries and has the goal of supporting farmers in the transition toward non-cage egg production. To achieve this goal, the project has compiled and assessed scientific, technical and practical information about non-cage egg farming systems in selected EU countries, from which a guide with best practices has been synthesised. A welfare assessment toolbox has been developed, facilitating tool selection to farmers and other end-users according to their needs. The eventual transition to egg production in non-cage systems will, in practice, be conditioned by the particular context of each country. Therefore, a socio-economic overview for each target country participating in the project (Belgium, Poland, Portugal and Spain) has been done with the support of national stakeholders. A survey was also launched to capture farmers’ perspectives. Results of this survey for Spain indicate that most respondents considered animal welfare as an important aspect of production. Farmers keeping laying hens in cages and in aviaries were the ones with more animal welfare certifications. All producers agree that an eventual transition would be positive for hen welfare and the image of the egg sector. Still, they are concerned about the cost of the transition and the sector’s competitiveness and viability. Producers indicated that the recovery of the investment, the cost of the investments, the resolution of problems derived from the transition, manpower requirements, government economic support and time without production will have a negative or very negative impact during the transition period.

Keywords: animal welfare; best practice; laying hen; non-cage system

Animal welfare assessment: quantifying differences among commercial medium and fast growth broiler flocks

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European broiler production is shifting towards the use of slower growth strains, and lower stocking densities to overcome animal welfare issues associated to fast growth. However, few studies have quantified the differences in animal welfare outcomes among broiler strains differing in growth rates under commercial conditions. To cover the Five Freedoms' principles that define animal welfare, in addition to the need for precision and objectivity, broiler welfare assessment in commercial flocks should combine animal- and resource-based indicators. In this study we used a combined welfare assessment protocol resulting from protocols developed in the frame of the AWIN® and Welfare Quality® EU research projects, to determine the differences regarding animal welfare assessment of medium and fast growth flocks (growth to 56 and 42 days of age, respectively). Ten commercial medium growth (Hubbard×Ross) and 10 fast growth (Ross 308, Cobb 500, or a mix of both) flocks were respectively assessed at 48 and 32 days of age, respectively. Two observers simultaneously collected data on each flock. Observations included transect walks on central and wall areas to assess the AWIN® welfare indicators, bedding quality, environmental parameters and positive behaviours, all of them collected with the i-WatchBroiler app. Novel object tests, carried out according to the WQ® methodology, and human avoidance tests were performed to assess fear. Both tests were performed in the house areas that resulted from the house division into transects. Lameness, assessed through gait score, body weight and hock burns were also measured on each flock. Medium growth flocks had lower percentages of immobile (0.015±0.019%), lame (0.125±0.026%), sick (0.003±0.005%), featherless (0.000±0.005%), and tail wounded broilers (0.000±0.021%; P<0.05 in all cases), and thus less welfare issues. Play fighting (1.65±0.56%; P=0.002), wing flapping (5.73±0.85%; P=0.014) and running (3.55±0.8%; P=0.002) were more frequently observed when medium growth broilers were assessed on central locations, while fast growth flocks were overall more limited in the expression of positive behaviours. Medium growth flocks also had lower gait scores (0.7±0.1; P<0.001). Fast growth broiler fear response was likely affected by mobility problems and the higher stocking density associated to their management. In comparison, better mobility and welfare, and also smaller stocking densities of medium growth flocks allowed for a differential response to behavioural tests depending on the proximity to the house wall. The transect sampling method and i-WatchBroiler app proved their usefulness in detecting strain differences in welfare issues and positive behaviours, which adds new arguments in favour of the use of method and technology to monitor broiler welfare. Clearly, the strain and rearing conditions of medium growth result in better outcomes during animal welfare assessments, including flocks' response in terms of positive welfare indicators. The reasons for this are the combination of the better leg conditions and higher mobility of slow growth birds, although the lower rearing density may also be affecting these improved outcomes.

Keywords: animal welfare; broiler; genetics; house location; transect method

Effect of peat and wood shaving bedding on the NH₃ level during the broiler fattening period.

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The aim of the study was to evaluate the NH₃ level during broiler fattening period using wood shavings and peat bedding and mix of these materials with calx and special bedding premix. The study was organized in a commercial poultry farm, which is located in central part of Latvia. Experiment was organised in 5 treatments with 3-4 replications or broiler rearing periods per treatment from December 2021 till June 2022. Boilers were rearing in 5 pens (each pen 41 m²) using 2 beddings types' of wood-shavings and peat and using 3 combinations of bedding material mix with calx (wood+calx; peat+calx) and special bedding premix "Comfort" (peat+Comfort). Calx was applied to the wood shavings and peat bedding one day before using. 'Comfort' was added according to manufacturers' recommendations. The bedding was spread manually before each rearing period approximately 5-10 cm deep and added during rearing period 3-4 times or every week. The amount of bedding material was recorded. Stoking density at the beginning of the fattening periods was around 10-12 chicks/m² or 10.2 – 10.5 kg/m² and was increased at the end of experimental period till 22.3 - 25 kg/m² at d 42. The results showed that the interaction effect of bedding type and fattening period on survival/mortality rate of broiler chickens was significant ($p < 0.05$). The mortality rate was observed from 7 to 15%. Broiler body weight was lower at d 42 for the wood shaving treatment compared to the peat treatment. NH₃ concentrations in an all treatments were in acceptable range (not higher than 20 ppm), with no significant differences between treatments. The results showed that the highest level of NH₃ was during the first month of the intensity of fattening period, when the broiler growing intensity is high. Experiment is still in progress and the next step of the research is to evaluate the cost-effectiveness of different materials. Funding: This research was funded by EAFRD (European Agricultural Fund for Rural Development) Ministry of Agriculture Republic of Latvia, project No18-00-A01620-000038 "Reduction of ammonia emissions in poultry farms".

Keywords: broiler, bedding material, ammonia

Behaviour of Romagnola geese reared in different agroforestry systems

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Orchards and olive groves in Italy are often located on marginal land where the agricultural mechanisation is quite impossible. For this reason, much of the marginal land are at risk of abandonment. Agroforestry system, in particular the combining of vegetable and livestock production in the same area, could represent a powerful tool to promote the safeguard of territory. The aim of this study was to evaluate the behaviour of Romagnola geese reared in two different agroforestry systems: orchards and vineyard. Two different methods for the behavioural analysis were compared: behavioural sheets and computerized video recording system. Fifty geese for each agroforestry system were reared from 1 to 160 days of age (outdoor space availability 300 m²/bird). One week before slaughtering, 10 geese per system were identified in order to facilitate the behavioural observations. Two experts in two observation periods (morning and afternoon), of 30 minutes each, filled the behavioural sheets and at the same time, a video was realized. Moreover, the foraging behaviour has been investigated using exclusion pens placed at 10 and 20 m of distance from the shelters. Results showed that geese exhibited various behaviour pattern related to the different time of day (morning and afternoon) in terms of category and frequency. In both agroforestry systems, during the morning, geese exhibited higher frequencies of grass intake and walking behaviour, whereas in the afternoon, they increased the comfort behaviours. Geese reared in the vineyard showed a higher grass intake with respect to those of orchard system (223 vs 106 g/d); probably due to the greater forage availability in the first system. In conclusion, Romagnola geese showed a high frequency of grass intake and comfort behaviours, and they seem to be adapted to agroforestry system. Both methods (sheet filling and video analysis) can be considered as valid tools in behaviour assessment; in particular, the computerized system allows a better discrimination of the behaviour categories whereas the behavioural sheet provides a more general overview of the animal adaptability.

Keywords: Agroforestry; geese; behaviour;

Comparative effect of light emitting diode versus traditional light sources on performance, slaughter characteristics, immunity and gland's weight of broiler.

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Light is an important factor of chicken environment. Concern over lighting source is increasing from few last decades but still there is a lot of variability in this regard for profitable chicken farming. Recent studies have shown an impact of light sources on performance, immune response, slaughter profile and endocrines. Now a days LED (light emitting diodes) are considered well reputed efficient light and are gaining functional validity over traditional light sources. Previous studies suggested that light emitting diode may decrease the waste production at broiler farm. In the present study we addressed effect of different light sources on performance of chicken. Two hundred fifty day-old chicks were purchased and one hundred sixty chicks of middle weight range were selected and distributed randomly in to different light treatment groups: A, Fluorescent (FC); B, Light Emitting Diode (LED); C, Incandescent (INC) and D, Compact Fluorescent (CF). Each treatment received four replicates having ten chicks per replicate. All birds were provided homogeneous environmental conditions except light environment. Complete record of weekly feed consumed, body weight of birds and mortality were maintained. Antibodies against Newcastle disease (ND) & infectious bursa disease (IBD) were measured by analyzing serum samples of bird. At the end of experiment two birds from each replicate were picked up randomly and data regarding slaughter characteristics were recorded. The data so obtained were statistically analyzed using Completely Randomized Design (Steel et al., 1997). Feed intake, weight gain, feed conversion ratio (FCR), dressed meat weight, thigh weight, liver weight, gizzard weight, heart weight, intestinal weight, bursa weight, thymus weight and immunity against ND and IBD were affected ($P < 0.05$) by light sources whereas shank length, shank weight and keel length were not affected ($P > 0.05$). Chicken received incandescent light showed higher mortality (13%) whilst those of received LED light showed only 3% mortality. These results indicated that LED has beneficial effect on welfare of broiler and helpful in minimizing the production cost therefore must be used in the modern broiler husbandry

Keywords: Broiler chicken, light, Newcastle disease, infectious bursa disease

Characterization of feed and litter for the estimation of metals contamination in the air of broiler houses

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The poultry sector is flourishing all over the world to fulfill a gap between supply and demand of protein for a rapidly growing population. However, due to enlargement in the poultry business, concerns are being raised about emissions like PM, gases, and bio-aerosols from this sector. The present study was conducted for the chemical characterization of particulate matter in feed, litter and both indoor and outdoor air of broiler houses. Feed, litter, and air samples were collected from 14 randomly selected controlled environment broiler houses and categorized into three groups differing in an age: Group I (1-20 days), Group-II (21-30 days), Group III (31-40 days). All collected samples were digested with 3:1 (nitric acid and perchloric acid), diluted with de-ionized water and stored in borosil glass tubes before analysis. Fourteen metals were analyzed by Inductively Coupled Plasma Atomic Mass Spectrometry (ICPA-MS). The detected metals were categorized as essential (Ca, K, Mg, Na, P) and the trace metals (Cu, Fe, Mn, Zn, Mo, V, As, Ni, Se). The mean metal concentrations for feed and litter samples were reported in mg/kg while for indoor and outdoor air samples in $\mu\text{g}/\text{m}^3$. The results showed that feed has higher concentrations of these metals as compared to litter and indoor air. Moreover, ANOVA was applied, and a non-significant difference was noticed in the feed for the metal concentrations in different age groups of the birds fed with varying feeds (starter, grower, and finisher). It was concluded that feed can act as an indicator about the contamination of litter and indoor air. However, in the outdoor air samples, no particular trend was noticed for the increase and decrease of the metals. This showed that outdoor air has some other sources of metal contamination and did not depend on indoor emissions.

Keywords: Poultry facilities; ICP-MS; metals; feed; litter; indoor; outdoor

Endocrinological gender identification in the hatching egg as solution to end chick culling.

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Every year in Europe alone about 330 million one-day-old male chicks are killed directly after hatching during egg production. This is because they do not have the capacity to lay eggs and because fattening them is not economically profitable in comparison to specialized broiler races. This practice has not been welcomed by different social movements and activists in Germany, those who have fought to abolish it. Thus, since 1 January 2022, the slaughter of one-day-old male chicks the species *Gallus gallus* in German hatcheries is prohibited. France, Switzerland and Italy are also taking measures to end this practice, which poses a major challenge to the European poultry sector. The most cost-effective, marketable and ethical way, not only in terms of animal welfare but also in terms of sustainability, to end this practice is being sought. The alternatives currently available in Germany are therefore the use of “dual-purpose” breeds, the fattening of the male chicks and the gender identification in hatching egg. Gender identification in hatching egg has the advantage that the one-day-old male chicks do not even hatch, resources are not wasted on feeding male chicks with low carcass performance of the cockerels and scandals about the fate of the chicks are avoided. The SELEGGT sexing method, which it is offered by the company Respeggt GmbH, is the earliest (detection at day nine of incubation) most widely used gender identification method. It is currently the most versatile procedure, as it determines the gender of embryos in all genetics (brown and white hens). The determination speed of the SELEGGT machines is one egg per second with an accuracy of 98%. Furthermore, it provides a circular approach to nutrient utilization by using the male embryos to produce high protein quality feed. Respeggt GmbH, in addition to gender identification, provides the verification of the “free of chick culling” egg supply chains, not only of fresh eggs, but also in the egg product production chains, to provide transparency and security to all parts of the supply chain and to consumers. By using modern blockchain technologies that transmit data sets transparently and in a tamper-proof manner, Respeggt GmbH can ensure that all the principles of the respeggt promise are respected throughout the supply chain. Consumers can easily detect Respeggt eggs that bear the heart shaped Respeggt label, and additionally they can verify the Respeggt eggs by themselves by entering the producer code in the Respeggt website (www.respeggt.com).

Keywords: laying hens, gender identification, free of chick culling, SELEGGT, Respeggt.



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Poultry science education in Algeria

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Poultry farming occupies an important place in the Algerian economy. It is the most important animal production among farmers. Therefore, poultry science education should be a priority in the pedagogical system of animal sectors in the different training centers. Currently, this teaching is carried out in 20 universities and 2 graduate schools. In the universities, teaching is done in the animal production departments and veterinary institutes. In graduate schools (Higher National Veterinary School and Higher National Agronomy School of Algiers), the teaching of poultry farming is also important and integrates with other animal sectors (cattle, sheep, goats, camelina ...) The number of students taking part in animal production courses is estimated at 2800 in 2019. In these universities and graduate schools, in addition of teaching domestic animals breeding techniques and veterinary medicine, research projects are developed each year to enable masters and PhD students to acquire more knowledge in different topics chosen by the scientific council of the universities. Each year, a competition is scheduled to select the best students to be enrolled into PhD program. The number of positions in animal production is estimated at 200 in universities and 40 in both graduate schools. The development of poultry farming has motivated many students to choose research topics related to poultry science. Every year, the Algerian WPSA branch is organizing a conference to allow participants, among them students and researchers to present their scientific work.

Keywords: education; teaching; poultry sciences; Algeria

[P1-02]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130103)
[Romania]

A nutritional perspective regarding the productive performances of the broiler chicken

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The use of natural feed additives could be a beneficial approach to maintain the health of chickens but also a way to improve food digestion. The aim of the study was to evaluate the effects generated by the presence of linseeds, as a source of antioxidants, in the conventional diet for the productive performance of the Cobb 500 breed. A total of 80 Cobb 500 broilers were housed in an experimental hall under controlled environmental conditions. The chickens were divided into two groups: control group (fed with conventional diet) and experimental one (fed with conventional diet supplemented with 4% linseed), consisting of 40 individuals per groups. After 42 days of feeding, the chickens were sacrificed and samples of intestinal content and tissue were taken from duodenum and jejunum for biochemical determinations. The experiment was repeated twice. The specific enzymatic activities of α -amylase, trypsin, lipase and endo- β -1,4-glucanase were analyzed from the intestinal contents while, activities of maltase and invertase were determined from the intestinal mucosa. All assays were performed by classical methods. Enzymatic specific activity (U /mg protein) of maltase, invertase, α -amylase, trypsin, lipase and endo- β -1,4-glucanase of Cobb 500 broilers were performed in triplicate. Each data point was plotted as mean value (\pm standard deviation, SD), and are presented relative to control. The experimental results showed a slight increase of the specific activity of α -amylase in both intestinal segments from the experimental group. The specific activities of invertase and maltase were almost twice higher in jejunum compared to duodenum. The level of lipase was slightly increased compared to control, which suggested that the use of linseeds in basal diet stimulates the hydrolysis of triacylglycerols in food. Also, the activity of trypsin was lower in the duodenum and higher in the jejunum, compared to the control group. Furthermore, the enzymatic activity of endo- β -1,4-glucanase activity was significant increase in the experimental group, by about five-fold in duodenum respectively three-fold in jejunum compared to control group. In conclusion, our study indicated that supplementation with linseeds of the basal diet for broiler chickens, lead to an increase in the activities of α -amylase, disaccharidases and endo- β -1,4-glucanase, in duodenum as well as in jejunum, the latter being correlated with a decrease in trypsin activity, which showed that linseeds represent a good additive that improve digestive health, and performance of the broiler chickens. Acknowledgments: This work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0473, within the PNCDI III program.

Keywords: Cobb 500, broiler chicken, linseed, enzymatic activities, nutrition

[P1-03]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130018)
[Bangladesh]

Effects of different dietary energy and protein levels on the production performance and carcass characteristics of native hilly chicken during growing phase in confinement

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Two hundred and sixteen 10 weeks of age hilly chickens were used to determine the effects of dietary energy and protein level on growth performance, carcass characteristics and meat quality. The chicks were randomly allocated into 3×3 factorial in a completely randomized design. Three levels of energy (2600, 2700 and 2800 ME kcal/kg) and three levels of dietary proteins (16, 17 and 18% CP) were offered ad libitum to the chicks from 10-16 weeks of age. There was no significant interaction effect between dietary protein and energy levels in the diets. At 10-16 weeks of age hilly chickens fed with the medium protein diet (17% CP) showed shortened feed intake ($p < 0.001$) but FCR found better in 16% CP diet. Dietary protein levels higher than 16% CP did not show any significant effect on growth performance. However hilly chicken fed with lower protein diet converted protein to body weight and body weight gain more efficiently than those fed higher protein diets. Dietary energy contents of 2600, 2700 and 2800 ME kcal/kg did not affect the growth performance of hilly chicken except ME, CP intake and protein conversion ratio. ME and CP intake was increased with increasing dietary ME and CP levels ($p < 0.001$). Protein utilization was better ($p < 0.05$) in higher (2800 ME kcal/kg) and medium (2700 ME kcal/kg) ME level diet. Abdominal fat percentage was significantly ($p < 0.05$) lower in birds fed the low energy (2600 ME kcal/kg) diets. Colour (L^* , a^* and b^*) of breast meat was not affected by dietary ME and CP ($p > 0.05$). Dietary energy and protein level did not significantly ($p > 0.05$) affect the drip loss and cooking loss of breast meat between the treatments. In the present study there was no effect of dietary CP and ME ($p > 0.05$) on pH in breast meat of hilly chicken. The ranges of pH value of all treatments are 5.78-5.83 and these ranges indicate that the pH value of breast meat of hilly chicken is higher quality. Based on the data of growth performance, carcass characteristics and meat quality, the optimal dietary ME requirement of hilly chickens from 10-16 weeks of age is 2700-2800 ME kcal/kg and the CP requirement is 16%.

Keywords: nutrient; energy; protein; native

[P1-04]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130093)
[Spain]

Effects of a short-term fasting period challenge to young broiler chickens on splenic immune gene expression.

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Recent studies in broiler chickens have shown that fasting of up to 24h increase intestinal permeability. An increase in intestinal permeability leads to an increase of food and bacterial antigens that might trigger a gut inflammatory response. Also, nutrient depletion during short-term fasting might influence immune responses. On the other hand, little information is available regarding the impact of a short-term fasting on systemic immune response. The avian spleen is the main peripheral lymphoid organ with important roles on lymphocyte generation and storage (primarily B-cells) and chemotactic and inflammatory factors production. Gene expression in the spleen has been used as an indicator of systemic immune response. The present study aimed to investigate the effects of a 15.5 h short-term fasting period on splenic gene expression associated with the immune response. To this end, 264 one-day-old male broiler chickens housed in floor pens were randomly assigned to 2 experimental groups (6 pen/treatment, with 22 birds/pen), fasted (F) and non-fasted (NF). From 1 to 14 d of age, animals were fed a basal diet with no medication based on maize and soybean meal (CP = 23.0%, AME = 2,974 kcal/kg). At 14 d of age birds allocated to F treatment were submitted to a 15.5 h short-term fasting period. After this, two birds per pen (n = 12) from F and NF groups were sacrificed and the spleen sampled for gene expression analysis. Selected immune function related genes were: B cell marker (Bu-1), Cluster of differentiation 3 (CD3 γ D) as T cell marker, Interleukin 8 (IL-8), Interleukin 2 (IL-2) and Interleukin 6 (IL-6). Results were analyzed by one-way ANOVA and Student's t-test for means separation with animals as the experimental unit and fasting period as fixed effect. Results showed that CD3 γ D and IL-8 gene expression was significantly up-regulated (P < 0.01) in F animals compared to NF. It is concluded that a short-term fasting of 15.5 h significantly alters spleen T cell gene expression dynamics. The biological significance of this alteration on immune cell dynamics deserves future investigations.

KEYWORDS: Broiler chicken, fasting period, spleen, B cell, T cell..

[P1-05]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130086)
[Romania]

Comparative study on using a dietary vegetable by-product (sea buckthorn meal) in broiler reared under thermoneutral conditions vs. high heat stress on the balance of intestinal microflora

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The aim of the present study was to evaluate the influence of dietary sea buckthorn meal (SB) as by-product on intestinal microflora balance of broiler reared under thermoneutral conditions (TN) vs. high heat stress (HS). The first experiment was conducted on 60 Cobb 500 broiler chicks assigned in two groups (C-TN, SB-TN) with 30 chickens/group and kept in thermoneutral conditions. In the second experiment, other two groups (C-HS and SB-HS) with 30 chickens/group were kept in high heat stress (32°C). In both experiments, the light regimen was 23 hours light / 1 hour of darkness. The structure of control groups diet (C-TN and C-HS) was the same. Compared with the control diets (C-TN; C-HS), the experimental diets included the addition of 1% of sea buckthorn meal (SB-TN; SB-HS). The performance parameters were recorded during the experimental trials (0-42 days). At the age of 42 days, 6 broilers/ group were slaughtered, and samples of intestinal content were collected for bacteriological assessment (*Enterobacteriaceae*, *E. coli*, staphylococci, *Lactobacilli*, *Salmonella* spp.). Dietary sea buckthorn meal (1%) did not affect ($p>0.05$) the daily feed intake, feed conversion rate neither under thermoneutral condition nor under heat stress condition. Both in thermoneutral conditions and under heat stress, the lowest count ($p<0.05$) of *E. coli* and staphylococci colony forming units was recorded in the intestinal content of SB-TN and SB-HS broilers vs. C-TN and C-HS broilers. If under heat stress, the addition of 1% SB did not significantly influence ($p> 0.05$) the number of *Lactobacilli* spp in the broiler intestine, under thermoneutral conditions, they were found at a higher number ($P <0.05$) in the intestine content of SB-TN fed broilers than those fed C-TN diet. Under heat stress conditions (32°C), the addition of 1% SB in broiler diets exerted a positive effect on the intestinal microflora, reducing the proliferation of tested Gram-negative and Gram-positive bacteria. Only under thermoneutral temperature conditions, SB led to the growth of probiotic bacteria in the intestine.

Keywords: Broiler, intestinal balance microflora, sea buckthorn meal, heat stress, thermoneutral condition.

[P1-06]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130187)
[Spain]

Environmental impact of laying hen feeds using low impact alternative ingredients and insect inclusion

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It is well known that the feeding of laying hens accounts for more than 80% of the environmental impact of its production. The reduction of soybean meal use, and the incorporation of alternative ingredients could be a strategy to achieve diets with lower impact. In addition, Insects could be an alternative ingredient, due to their protein and energy content. Thus, the objective of the present work was to determine the effect of the introduction of alternative ingredients and the inclusion of *Hermetia illucens* in the formulation of layer hen feeds. To carry out the evaluation, two feeds for layer hens were formulated according to their requirements. Control formula with the usual ingredients, and Alternative formula with the inclusion of ingredients with less environmental impact: peas (+10 % percentage units), rapeseed meal (+2 in percentage units), bakery meal (+7% percentage units), and dried larvae at 5%, using lower soybean meal (-10.43 percentage units) and higher non-imported cereals (+15.81 percentage units). The impact of each feed was determined using the Sima Pro 9.2.0.1 software, implementing the ReCiPe 2016 Endpoint and Europe ILCD 2011 Midpoint methods. The impact of feed ingredients was evaluated using the Agri-Footprint database, assuming the loads of production and transport to the feed mill. To estimate the impact of the larvae, the inputs and outputs applied for their production and transport were analysed. According to ReCiPe method, the Control formula reached a total impact of 116 points (variant coefficient (VC)=3.53%), and the Alternative with insects of 101 points (VC=3.98%), which represented a decrease of 12.93% in total impact assessment. According to ILCD method, the estimation of CO₂ emissions could decrease by 16.02% (from 2560 (VC=4.32%) to 2150 (VC=4.23%) kgCO₂-eq/t, for the Control and Alternative formula, respectively). In conclusion, the use of alternative ingredients and dried insect larvae can reduce the estimation of the environmental impact of laying hen feeds, although the consequences of their use on productions “in vivo” conditions must be studied. This project (grant Number 2015), is part of the PRIMA programme, supported by the European Union.

Keywords: Laying hens; feed; *Hermetia illucens*; environmental impact.

[P1-07]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130019)
[Australia]

Solid-state fermentation improves the nutrient composition of lupin flour for inclusion in broiler diets

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The cost of raising poultry birds to market weight accounts for about 70-80% of the total production cost. The persistent increase in the price of the conventional protein feed ingredients such as soybean meal has geared poultry producers to explore alternatives so as to maximize broiler production. In the present study, solid-state fermentation (SSF) of lupin flour (LF) using *Aspergillus ficuum* was conducted under aerobic conditions for 7 days prior to inclusion in broiler diets. Raw and solid-state fermented LF samples were analyzed for nutrient composition (dry matter, crude protein, metabolisable energy, crude fat, crude fibre, ash, total sugar (sucrose), starch, calcium, and phosphorus) as well as for pH, phytic acid and total phenolic contents. Crude protein content increased from 35.8% in the raw LF to 39.3% in the solid-state fermented lupin flour (SSFLF). The amount of total sugar (sucrose) and starch were remarkably decreased by 84.48% and 85.16%, respectively. Phytic acid content reduced by 73.17% and total phenolic contents increased by 37.31% in SSFLF. The pH also reduced at the end of the SSF process. This study revealed that SSF could improve the nutritional value of lupin flour. The results of this study will potentially contribute to the currently limited knowledge on the dietary use of SSFLF at optimal inclusion levels in broiler diets.

Keywords: broiler chickens, solid-state fermentation, sweet lupins, *Aspergillus ficuum*

[P1-08]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130118)
[Greece]

Investigation of the in vitro antimicrobial activity of phytogetic feed additives against common poultry pathogens

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Phytogetic feed additives are widely discussed as promising alternatives for antibiotic growth promoters, due to their high content of blends of essential oils (EOs), the pharmacologically active compounds. Additional studies demonstrate that the use of EOs as additives in animal nutrition improves their performance and control pathogens due to the antimicrobial properties they have. Researchers indicated that blends of EOs have a greater effect than administering each component separately, due to their synergic activity. The objective of this study was to investigate the Minimum Inhibitory Concentration (MIC) of five commercial phytogetic feed additives products (A-E) against *Staphylococcus aureus*, *Salmonella typhimurium*, *Escherichia coli*, *Campylobacter jejuni* and *Listeria monocytogens*. The antibacterial activity of the products was tested by the micro-MIC method and expressed as the lower concentration of the products which inhibits bacterial growth. The majority of the tested phytogetic feed additives exhibited antimicrobial activity against tested bacteria, except for product D. The low MICs values of products A and B, which were 0.07% v/v respectively, against most of the tested bacteria was remarkable. Product B was effective against all the strains of bacteria tested, a result which could be explained due to the high carvacrol concentration in the product. Product C, a blend of oregano, cinnamon, and aniseed oil, exhibited promising MIC values varying from 0.28 to 0.57% v/v against *Staphylococcus aureus*, *Salmonella typhimurium*, *Escherichia coli* and *Listeria monocytogens*. This could be derived from the synergistic action of its compounds, which separately have been proven effective against a large number of bacteria. Products E and D exhibited almost equal activity among tested bacteria strains. Higher concentrations (4.54% v/v) were needed against strains of *Staphylococcus aureus*, *Salmonella typhimurium* and *Escherichia coli*. On the other hand, these products exhibited strong anti-*Campylobacter* activities due to low concentrations (0.14% v/v). The results of this study indicate antimicrobial activity of the phytogetic feed additives against common poultry pathogens. Further in vivo studies are needed because a systematic approach toward the efficacy and safety of phytogetic feed additives in animal nutrition have not been tested. "This research has been co-financed by Greece and the European Union (European Regional Development Fund) within the Operational Program "EPIRUS 2014-2020". Project Code: 5033112. MIS: H111AB-0028212. Acronym: EpirORNIS."

Keywords: phytogetic feed additives, essential oils, MIC, antimicrobial activity, poultry pathogens

[P1-09]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130119)
[Greece]

In vitro investigation of commercial poultry acidifiers against potential poultry pathogens

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Poultry are vulnerable against potentially pathogenic microorganisms such as *Escherichia coli*, *Salmonella* spp., *Staphylococcus* spp. and *Campylobacter* spp. Organic and inorganic acids have been used widely in poultry production as acidifiers in feed or drinking systems, enhancing animal performance and water quality. The aim of this study was the in vitro investigation of the antimicrobial activities of five commercial poultry acidifiers (A-E) against *Staphylococcus aureus*, *Salmonella typhimurium*, *Escherichia coli*, *Campylobacter jejuni* and *Listeria monocytogens*. The antibacterial activity of the products was tested by the micro-MIC method and expressed as the lower concentration of the products which inhibits bacterial growth. All the tested products exhibited significant antibacterial activity against the pathogens used in the study. Product A, a blend of hydrogen peroxide, paracetic and acetic acid exhibited the lowest MIC values in this study (0.004% v/v) against *C. jejuni* and two strains of *S. aureus*. Formic, propionic, acetic and sorbic acids are the main components of Products B and C. Both products showed almost equal antimicrobial activity among the tested microorganisms recording significant MIC's scores (0.07% v/v) against *E. coli*, *S. typhimurium* and *C. jejuni*. Product D, a disinfectant, blend of inorganic peroxygen compounds, inorganic acid, and inorganic salts was effective against the tested pathogens on MIC's values varying from 0.01%-0.41% v/v. Product E, a commercial mixture of organic acids, with the addition of essential oils and glycerol esters, was effective on the MIC of 0.14% v/v against *C. jejuni*, *S. typhimurium*, *L. monocytogens*, and *S. aureus*. The MIC's scores indicate that all the tested products exhibited significant antimicrobial effects. Further in vivo investigation is required in order to understand in depth their impact on health, immunity and performance in poultry. "This research has been co-financed by Greece and the European Union (European Regional Development Fund) within the Operational Program "EPIRUS 2014-2020". Project Code: 5033112. MIS: H111AB-0028212. Acronym: EpirORNIS."

Keywords: poultry, acidifiers, disinfectants, organic and inorganic acids, antimicrobial activity, MIC

[P1-10]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130235)
[Spain]

Efficacy of an attenuated coccidiosis vaccine in combination with different additives on production performance and intestinal lesions in broilers challenged with necrotic enteritis. 2 studies.

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Necrotic enteritis (NE) is a poultry enteric disease caused by *Clostridium perfringens*. Several factors predisposing to the disease have been identified, including diet and *Eimeria* spp. Reduced sensitivity of *Eimeria* parasites to coccidiostats can generate subclinical and even clinical coccidiosis that can favour NE. The combination of vaccination against coccidiosis and the supplementation of the diet with feed additives could be a composite approach to the control of NE problems triggered by *Eimeria* spp. infestation. The objective of the two studies was to evaluate the efficacy of an attenuated coccidiosis vaccine (EVANT®) in combination with different in-feed additives on broilers challenged with NE. In the two studies, healthy day-old broilers were randomly allocated to different groups (8 cages of 20 birds/group). In both studies, two groups were left unvaccinated against coccidiosis. The rest of the groups were vaccinated. Moreover, the diets of some vaccinated groups were supplemented with feed additives. In the first study, medium chain fatty acids (MCFA), butyric acid or phytogetic feed additives (PFA) were added in the diet. In the second study, probiotics or PFA were added in the diet. A NE infection model was used to challenge all groups except negative control group; chickens were orally infected with *Eimeria maxima* (4,500 oocysts) and then *C. perfringens* (108 CFU) at 15 and 20 days, respectively. The diet of all groups was formulated to provide predisposing factors for NE development. Birds were monitored and productive parameters recorded until 42 days in the first study and until 35 days in the second study; intestinal lesions were scored in both studies. The oocyst excretion results after *E. maxima* challenge showed a higher level of parasite replication in the first study. In this study, coccidiosis was the main trigger factor of NE, while other factors were more important in the second. In both studies, results showed that the vaccination, with or without the addition of feed additives, decreased intestinal lesions associated with NE and improved the performance of the birds. Besides, the supplementation with feed additives provided additional benefits in some of the treatments. Therefore, vaccination with EVANT® together with the in-feed inclusion of certain feed additives might be a solution to reduce NE in broilers raised antimicrobial- and coccidiostat-free, both in high and low replication rate of an *E. maxima* challenge.

Keywords: Broilers; Necrotic enteritis; Vaccine; *Eimeria*; Feed Additives

[P1-11]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130099)
[Romania]

The effects of some antioxidant feed additives on digestive enzymes activity in Tetra-SL laying hens

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The Tetra-SL is a brown egg laying hen hybrid which is widely used for its excellent internal and external egg quality. A method to improve animal performance is the use of herbal feed additives, which have beneficial effects in livestock production, health and nutrition of animals, which might arise from activation of feed intake and digestive secretions. Therefore, the purpose of this study was to evaluate the effects of herbal additives on the digestive and metabolic performance of the Tetra-SL laying hens. 32 weeks Tetra-SL laying hens were assigned into five experimental groups and one control group (C) (four hens per group), housed in an experimental hall under a 16 hours light – 8 hours dark schedule and controlled environmental conditions. Feed and water were offered ad libitum during the experiment. The basal diet was served as control and different levels of herbal feed additives were supplemented to basal diet as follows: 0.5% cranberry leaves (E1), 1% walnut leaves (E2), 2% sea buckthorn (E3), 1% mixture of cranberry leaves, walnut leaves and sea buckthorn (E4), as well as 1% watermelon shell (E5). The experiment was repeated twice. After four weeks, the hens were sacrificed and samples of intestinal content and tissue (~5 cm) were taken from the duodenum and jejunum in order to perform enzymatic determinations. Likewise, activities of alpha-amylase, maltase, trypsin invertase were determined by spectrophotometric assays in triplicate. The experimental data revealed a decrease in the activity of alpha-amylase in all five experimental groups, for both duodenum and jejunum, compared to control group. Feeding the hens with a basal diet supplemented with 1% walnut leaves (E2) or with a 1% mixture of cranberry leaves, walnut leaves and sea buckthorn (E4) resulted in an increased enzyme activity of the duodenal invertase, in E2 by 20% and in E4 by 50%. Moreover, a significant increased maltase activity by 70% was observed in E5 group which might be promoted by an increase in the gastric retention time of the ingested feed, thus resulting in improvement of its digestibility and the availability of nutrients. In contrast, for the jejunum samples an increase in maltase activity was observed only in groups E2 and E3 by 50% and 40% respectively, and a decreased invertase activity in E2 by 30% and in E3 by 25% compared to control. Furthermore, the enzymatic activity of trypsin from both intestinal segments was insignificantly decreased and below control group level in all five experimental groups, possibly due to covalent attachment of phenolic compounds from feed additives to reactive nucleophilic sites of the enzyme, affecting its three-dimensional conformation and probably the active site. As a result, rate of the catalysed reaction could decrease. These results indicated that changes in some digestive enzymes activities were relevant, which suggest that supplementing basal feed with herbal feed additives could lead to improved nutrition performance. **ACKNOWLEDGMENTS** This work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0473, within the PNCDI III program.

Keywords: Tetra-SL; laying hens farming; additives; digestion; nutrition

[P1-12]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130186)
[Belgium]

The use of Xylanase in laying hen production: can it also modulate the microbiome?

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In the modern laying hen industry, the intensification of production invariably entails a continuous search to optimize the diet recipe for maximizing bird performance while keeping the cost of the feed as low as possible. Recent scientific research with a newly developed xylanase demonstrates also its beneficial impact in promoting gut health, suggesting the strategy of applying a xylanase can be also a suitable way to help laying hen producers to manage gut disorders, especially considering the increasing pressure to reduce their use of antibiotics. Anti-nutritional factors such as non-starch polysaccharides (NSP) are present in viscous cereals used in feed for poultry. Exogenous carbohydrases are commonly added to monogastric feed to degrade these NSP. Our hypothesis is that xylanase not only supports laying hen performance via increasing feed digestibility, but also by inducing a significant shift in microbial composition within the intestinal tract and thereby possibly exerting a prebiotic effect. Therefore, it was necessary to get a better understanding of whether and how the chicken gut microbial population can be modulated by xylanase. To assess this added value, the present study was set up to evaluate the effects of dietary supplementation of an intrinsically heatstable xylanase (Xygest™ HT; Kemin Europa NV, Herentals, Belgium) on performance, apparent total tract digestibility (ATTD) and cecal microbiome in laying hens. A total of 96 HiSex laying hens were used in this experiment (3 diets and 16 replicates of 2 hens). The xylanase, a new beta 1-4, endo-xylanase enzyme produced by *Thermopolyspora flexuosa* expressed in *Pichia pastoris*, was added to the diets at concentrations of 0, 45,000 (15 g/t Xygest™ HT) and 90,000 U/kg (30 g/t Xygest™ HT). All diets were based on wheat (~55 %), soybean and sunflower meal. At the lowest dose of xylanase, 45,000 U/kg, average egg weight and feed efficiency was already significantly improved compared to the control treatment ($P < 0.05$). Egg quality also significantly improved in the experiment in response to the xylanase addition. For example, during the last 28 days of the trial, the eggs of hens receiving the 45,000 U/kg and the 90,000 U/kg supplemented diets, exhibited an increase in Haugh units and albumin heights ($P < 0.05$), correlated with fresher and higher quality eggs. Compared with the control, the ATTD of organic matter and crude protein were drastically improved in the 45,000 U/kg treatment group ($P < 0.05$). Furthermore, gross energy and the ATTD of crude fat were improved significantly for birds fed 90,000 U/kg group compared to the non-supplemented hens. Importantly, 16S rRNA gene analysis revealed that adding the xylanase at a dose of 45,000 U/kg induced a change in the cecal microbiome as seen in a significant increase in beneficial gut flora (Bacilli class; Enterococcaceae and Lactobacillales orders; *Merdibacter*, *Enterococcus* and *Nocardiopsis* genera; *Enterococcus casseliflavus* species). In conclusion, dietary supplementation of xylanase at 45,000 U/kg significantly improved digestibility supporting a better laying hen performance. However, microbiome analysis suggests that xylanase may also favourably modulate the bacterial population of the laying hen, potentially exerting an additional prebiotic effect. This is an important discovery in the mode of action of this enzyme which contributes to its added value in a sustainable laying hen production.

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[P1-14]: POSTER SESSION 1: NUTRITION AND EDUCATION (ID: 130166)
[Belgium]

Investigating the combined effect of medium-chain fatty acids and phytogetic extracts on broiler growth efficiency

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Improving growth efficiency is an important subject for the sustainable development of broiler production. This can be achieved when animal resilience and growth efficiency go hand in hand, where energy is diverted as less as possible away from growth. Medium-chain fatty acids (MCFAs) are known for their strong antibacterial activities and positive impact on intestinal morphology, while phytogetic extracts have been shown to possess antioxidant, anti-inflammatory, and enzyme-stimulating properties. Therefore, MCFAs and phytogetic extracts could contribute to growth efficiency by improving the resilience of animals. Besides being the main site of nutrient absorption, the gastrointestinal tract is a chemosensory system with specialized receptors. MCFA can bind with certain G-protein coupled receptors on intestinal L cells leading to the secretion of amongst others glucagon-like peptide-1 (GLP-1) and peptide YY (PYY), which are hormones involved in energy homeostasis and as such may play a role in improving growth efficiency. To evaluate the individual and combined effect of MCFAs and phytogetic extracts on broiler growth efficiency, an experiment was performed with 2944 male day-old broiler chicks (Ross 308). Birds were fed a standard wheat-rye-soybean pelleted diet ad libitum for the entire duration of the experiment, divided into nine dietary treatments (11 replicates for the each two control groups and 10 replicates for the each of 7 treatment groups, 32 birds per replicate): one control diet (C) and eight experimental diets consisting of C supplemented with MCFAs (combination of pure C6, C8, C10 & C12), phytogetic extracts (PE 1 to 3), or a combination of both. On day 15, 29, and 37 (end of experiment), average body weight (ABW), average daily weight gain, feed intake and feed conversion ratio were calculated. On day 29, segments of the pancreas and duodenum were collected of two birds per pen for GLP-1 analysis and PYY mRNA expression. All parameters were analyzed by a General Linear Model followed by a Tukey post hoc test. The results showed that combining PE1 with MCFA had a negative effect ($p < 0.001$) on ABW on day 15 and 29, while combining PE3 with MCFA improved ABW on day 37 ($p = 0.001$). None of the groups resulted in a significant difference compared to the negative control.

Keywords: broiler; fatty acids; phytogetic; hormonal secretion; growth efficiency

Muscovy duck fed black soldier fly larvae meal: effects on blood parameters and antioxidant status

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The black soldier fly (*Hermetia illucens*, HI) represents a promising alternative protein source for poultry. The aim of the study is the evaluation of dietary partially defatted HI larvae meal inclusion on blood parameters and antioxidant status of female Muscovy ducks. A total of 192 3-day-old female Muscovy ducks were assigned to 4 experimental treatments (6 replicate/treatment; 8 birds/pen) with increasing dietary HI levels (0, 3, 6, 9%, HI0, HI3, HI6, HI9, respectively) in substitution of corn gluten meal. At 51 days of age, after 12h of feed withdrawal, 12 ducks/treatment (2 birds/pen) were slaughtered, blood samples were collected and prepared for further analysis. The total red and white blood cell counts, serum protein, lipid and minerals, liver and renal function serum enzymes were then evaluated. Plasmatic concentration of glutathione peroxidase, total antioxidant status, methylglyoxal, malondialdehyde, 3-nitrotyrosine were evaluated. The collected data were tested by one-way ANOVA using polynomial contrasts to test the linear and quadratic responses to increased levels of HI inclusion in the diet (significance at $P < 0.05$). Red and white blood cell, as well as the serum proteins were not affected by dietary treatments ($P > 0.05$). Serum lipids were affected by dietary treatment, showing a linear response (minimum for HI9) for triglycerides and cholesterol levels ($P < 0.05$). Among serum minerals, Ca and P were not affected by treatments, while Mg and Fe showed a linear response to increasing dietary HI levels ($P < 0.05$). Regarding liver serum enzymes, only alkaline phosphatase showed a linear decrease with a minimum for HI9 ($P < 0.05$). Renal serum enzymes were partially affected by dietary treatment. Uric acid serum levels were similar among groups, while creatinine showed a linear decrease (minimum for HI9; $P < 0.05$). Finally, the antioxidant status results showed a linear decrease with a minimum for HI9 for malondialdehyde and 3-nitrotyrosine ($P < 0.05$). The obtained results showed that the dietary inclusion of a partially defatted HI larvae meal could be suitable in Muscovy duck nutrition, with unaffected haematological traits and liver and renal functions. Moreover, a reduction of serum cholesterol and triglycerides was observed, with an improvement of the antioxidant and health status of birds.

Keywords: duck; blood; antioxidant status; black soldier fly

Blood chemistry of medium-growing male and female chickens supplemented black soldier fly live larvae

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Effects of live larvae provision on poultry chemical blood parameters have been poorly investigated. This study aims to evaluate the changes in blood chemistry parameters in medium-growing chickens supplemented black soldier fly (BSF) live larvae. Two hundred and forty 21d old sexed Label Naked Neck birds were divided into 4 experimental groups: females fed basal organic feed (BOF), males fed BOF, females fed BOF + 10% BSF live larvae supplementation based on the expected daily feed intake (DFI) and males fed BOF + 10% BSF live larvae supplementation based on the DFI (6 replicates/diet, 10 birds/replicate). Blood samples were collected at slaughter (82d old) from 2 birds/pen (12 birds/treatment). Serum samples were used for biochemical analysis. A compact liquid chemistry analyzer system (BT 1500 vet–Futurlab) was used to determine the concentrations of alanine aminotransferase (U/I), aspartate aminotransferase (U/I), creatinine total proteins (mg/dl), uric acid (mg/dl), cholesterol (mg/dl), triglycerides (mg/dl), gamma glutamyltransferase (GGT, U/I), phosphorus (mg/dl) and magnesium (mg/dl). Data were analyzed by GLMM (SPSS software, $P < 0.05$). Overall, the blood parameters were not affected by the live larvae supplementation ($P > 0.05$) in both sexes, thus being indicative of a good health status of the birds. Moreover, the GGT was detected in lower concentrations in the supplemented groups than in the control groups ($P < 0.05$), suggesting a positive effect on the hepatic function. In conclusion, the live BSF larvae provision did not negatively affect the blood parameters of medium-growing chickens and could be beneficial for bird hepatic activity.

Keywords: poultry nutrition; medium-growing chickens; live larvae; blood chemistry.

[P2-03]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130233)
[United Kingdom]

Growth performance and jejunal cytokine expression in broiler chickens fed graded levels of Sea-Buckthorn (*Hippophaes rhamnoides*) berries

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This study aimed to assess the effect of graded levels of dietary sea buckthorn (SB) at 0, 3, 6, 9 and 12 g/kg diet on the modulation of immune biomarkers of broiler chickens and their growth performance. Eighty 7 d old female Ross 308 chickens were assigned to one of five dietary treatments. The basal diet was formulated to meet breeder's recommendations (Aviagen Ltd., Edinburgh, UK). The basal diet was then split into five batches, and one of the batches was used as a control diet (C). The remaining four diets were the C supplemented with dry and milled SB berries at 3, 6, 9 and 12 g/kg on the expense of the basal diet. Each diet was offered ad libitum in a meal form to birds in eight pens following randomization. Growth performance variables including feed intake (FI), weight gain (WG), and feed conversion ratio (FCR) were recorded from 7 to 21d age. Genes of interest (GOI) were determined in jejunal intestine tissue from 21 d old birds. Samples from the middle part of the jejunum, between the point of bile duct entry and Meckel's diverticulum, were collected and stored in RNAlater at minus 80°C prior to analysis on the relative expression of the GOI. The GOI included cytokine/immune related (CD40LG, IFNG, IL2, IL4, IL6, IL10, IL18), mucin (MUC2) and tight junction related (CLDN4, OCLN). Comparisons among studied variables were performed by ANOVA and testing the orthogonal polynomials for linear (L) and quadratic (Q) responses to graded levels of SB in diets. In all instances, differences were reported as significant at $P < 0.05$. Feeding SB did not change ($P > 0.05$) any of the growth performance variables and there were no ($P > 0.05$) interactions. Genes for IL2, IL4, IL6, IL10 and CLDN4 either failed to amplify or were below the detection limit and are not included in the results. CD40LG gene expression (copies per reaction) responded quadratically ($P < 0.05$), peaking at 9 g/kg SB inclusion. Similarly, IFNG gene expression also responded quadratically ($P < 0.05$), peaking at 6 g/kg. There were no effects of SB dietary inclusion on cytokine gene (IL18), mucin (MUC2) or tight junction (OCLN) expression. In conclusion, dietary inclusion of SB did not have an impact on overall growth performance variables and intestinal cytokine expression.

Keywords: "broilers", "sea-buckthorn", "cytokine expression"

[P2-04]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130234)
[United Kingdom]

Feeding black pepper (*Piper nigrum* L) and xylanase to broiler chickens

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Black pepper (*Piper nigrum* L) (BP) has been shown to improve antioxidant status of animals. Exogenous xylanase (XYL) is routinely used in monogastric animal nutrition to improve performance. However, information on the interaction between BP and XYL is limited. The aim of this study was to determine feed intake (FI), weight gain (WG), feed conversion ratio (FCR), N-corrected apparent metabolisable energy (AMEn), total tract dry matter (DMD), nitrogen (ND), fat (FD) and neutral detergent fibre (NDFD) digestibility coefficients when supplementing broilers with BP and XYL alone or in combination. The experiment was conducted at the National Institute of Poultry Husbandry and approved by the Harper Adams University (HAU) Research Ethics Committee. A wheat-soy-based basal feed containing 650 g/kg wheat and 220 g/kg soybean meal as main ingredients (12.67 MJ/kg AME and 206 g/kg CP) was mixed. The basal feed was then split into four batches; one batch was fed as is; second batch was supplemented with *Aspergillus oryzae* commercial preparation of endo-1,4-beta XYL at 200 FXU/kg (Ronozyme WX, DSM, Switzerland); third batch was supplemented with 10g/ kg diet of milled BP (determined 4.2% piperine); the fourth batch was supplemented with both, XYL and BP, at the same level as in the previous two batches. Xylanase and BP in each diet were added on the top of the basal feed. Sixty-four male Ross 308 chicks were used in the study. At 7 d age the birds were allocated to 32 pens, 2 birds in a pen, following randomisation. Standard rearing conditions for broilers were used (Aviagen Ltd., Edinburgh, UK). Each diet was fed to 8 pens and information on FI, WG and FCR was obtained from 7 d old to 21 days of age. For the last three days of the study, from 18 to 21 d age, the solid floor in each pen was replaced with wire mesh, excreta were collected each day, pooled, oven dried and used for further analysis. Growth performance and dietary AMEn, DMR, ND and FD were determined. Data were analysed by two-way ANOVA following 2 x 2 factorial arrangement (Genstat 19th edition). Feeding BP reduced FI, WG and feed efficiency ($P < 0.001$) and also DMD, ND and NDFD ($P < 0.05$). Xylanase improved WG ($P = 0.050$), AMEn, DMR, ND and NDFD ($P < 0.05$). There were no BP by XYL interactions ($P > 0.05$). Supplementing XYL to poultry diets can be used to improve growth performance and availability of dietary energy and nutrients. Research to optimise inclusion rates of BP is warranted to provide more information to poultry nutritionists.

Keywords: "black pepper", "xylanase", "broilers", "metabolisable energy", "performance"

[P2-05]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130120)
[Spain]

Influence of dietary fat source on biochemical blood profile in laying hens

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The increase in feed costs and the concern for the environment lead to re-evaluate the use of food by-products in animal nutrition. The use of supplemental fats, with different ratio unsaturated:saturated (U:S) fatty acids (FA) to meet the energy requirements is a common practice in poultry nutrition as acid oils could be economical and sustainable feedstuffs. Acid oils are fat by-products from the edible oil refining industry with similar FA composition to their respective crude oils but richer in FFA. A trial was conducted in order to study the influence of the dietary FFA content and fat saturation on biochemical blood profile in laying hens. 72 Lohmann Brown hens from 20 to 35 weeks of age, housed in groups of 3 birds per cage (experimental unit), were used. Four experimental diets were tested (6 replicates per treatment). Diets contained 6% vegetable fat added to a basal diet: Soybean Oil, as control group (SO; high U:S, 5% FFA), Soybean Acid oil (SA ; high U:S, 50% FFA), Palm Oil (PO; low U:S, 5% FFA) and Palm Fatty Acid Distillate (PFAD; low U:S, 50% FFA). At 35 weeks of age, blood samples were collected in heparinized tubes from one bird per cage (3 ml per bird) by puncturing the metatarsal vein. Samples were centrifuged at 2060 × g for 5 min and the plasma obtained was stored at -80 °C until analysis. Individual plasma samples were analyzed by photometry to evaluate alpha-amylase, cholinesterase, bile acids, aspartate aminotransferase (AST), creatine kinase (CK), lactate dehydrogenase (LDH), total proteins, albumin, globulin, uric acid, inorganic phosphate, calcium, and triglycerides. Sodium and potassium were determined by direct potentiometric measurement. For statistical analysis, GLM procedures have been performed for all dependent variables with Tukey multiple comparisons between treatments. Significant differences were considered for $P < 0.05$. Results show that all the biochemical parameters analyzed were within the normal range for healthy hens. Dietary fat source did not have a significant effect on alpha-amylase, cholinesterase, bile acids, AST, CK, LDH, uric acid, inorganic phosphate, sodium and potassium. In contrast, plasma concentration of triglyceride in the SO group (10.98 mmol/L) was significantly lower than those of the other treatments (SA: 16.27; PO: 16.05; PFAD: 15.36 mmol/L). Differences in total proteins and globulin were significant between SO and PO group: hens fed SO had lower levels than hens fed PO (total proteins: 46.07 and 55.77 g/L; globulin: 27.50 and 33.63 g/L, respectively). Albumin and calcium levels were also significantly lower in SO group than in PFAD group (albumin: 18.57 and 22.93 g/L; calcium: 5.63 and 7.33 mmol/L, respectively). Even though some fat sources tested in this study showed differences in blood biochemical profile with SO, all of them could be considered as an interesting alternative in layer nutrition because. The results show that they are not harmful to hen's health. Financed by Generalitat Valenciana and the European Social Fund (Project GV/2018/188 and ACIF/2019/204).

Keywords: Laying hen; nutrition; fat; acid oil; biochemical blood profile

[P2-06]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130238)
[Spain]

Effect of free fatty acid content and degree of fat saturation on bone calcium reserves and eggshell quality

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The scarcity and price instability have led to the search for agro-industrial by-products as unconventional ingredients for animal nutrition. Some fat by-products, such as acid oils (AO) and fatty acid distillates (FAD), may be of interest to the poultry industry. They are characterized by having a high proportion of free fatty acids (FFA), which have been reported to form insoluble calcium soaps in the intestine, especially when they come from fats rich in saturated fatty acids. A trial was conducted to evaluate the effect of the degree of fat saturation and dietary FFA content on calcium digestibility, bone calcium reserves and eggshell quality. For a 15-week period, 144 laying hens (19-weeks-old) were randomly assigned to 8 dietary treatments (6 replicas each), which were obtained by gradually replacing crude soybean oil with soybean AO, or crude palm oil with palm FAD. Thus, there were 4 soybean (S) and 4 palm (P) diets with 6% added fat varying in their FFA% (10, 20, 30, and 45%), following a 2×4 factorial design. At the end of the trial, excreta were collected to determine the apparent total tract digestibility coefficients of calcium, eggs were subjected to quality assessment, and one tibia per replica was collected for analysis of bone calcium content. Calcium was determined using ICP-OES (Optima 3200 RL, Perkin Elmer, Waltham, USA). For statistical analysis, two-way ANOVA using the GLM procedure has been performed. Orthogonal polynomial contrasts were used to determine the linear effect of increasing inclusion levels of FFA. Significant differences were considered for $P < 0.05$. Highest calcium digestibility coefficients were recorded in S diets ($P < 0.001$). Moreover, increasing the FFA content also reduced calcium digestibility in both fat sources (S and P), showing a significant linear effect ($P < 0.01$). The bone calcium reserves were also affected by the degree of fat saturation, being lower in P diets ($P < 0.001$). No effect of FFA was observed at this point. Regarding eggshell quality, no influence by the dietary treatments was found for calcium content and shell thickness. However, resistance to breakage was higher in P diets ($P < 0.05$). Biologically, as observed, hens prioritize allocating dietary calcium to shell formation. Furthermore, varying dietary FFA did not affect calcium metabolism as much as the degree of saturation did, supporting the use of FFA-rich by-products as alternative feed ingredients. Financed by the Generalitat Valenciana and the European Social Fund (GV/2018/188 and ACIF/2019/201).

Keywords: Laying hen; fat; calcium; egg quality; shell; bone

[P2-07]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130116)
[Spain]

Combination of palm fatty acid distillate with soybean oil in broiler chicken diets: fat digestibility along the gastrointestinal tract

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Fats are usually used in poultry diets as they satisfy an important fraction of their energy requirements. Based on circular economy, the use of fat industry by-products in animal fed would be worthwhile. Palm fatty acid distillate (PFAD) is an important fat by-product from physical refining process of palm crude oil. It is characterised by having high proportions of free fatty acids (FFA: 85-95%), and has similar fatty acid (FA) composition than its respective crude oil. Recent studies have been suggested that FA digestibility is more influenced by the FA profile than the FFA content. Therefore, it has been hypothesized that the combination of saturated and unsaturated oil might be a suitable energy source for poultry diets. The present study aimed to evaluate the effect of the combination of soybean oil (S) with PFAD on the apparent digestibility coefficients (ADC) of FA along the gastrointestinal tract (GIT) in 35-day-old broiler chickens. A total of 384 broiler chickens (Ross 308) were distributed in cages (6 cages/treatment, 16 birds/cage). Animals were fed 4 experimental diets obtained from a basal diet supplemented at 6% with: S, PFAD, or combinations of 33%S-66%PFAD and 66%S-33%PFAD. At 35d, digestive content from upper and lower jejunum, upper and lower ileum and excreta were collected. TiO₂ (5g/kg) was used as indigestible marker to calculate the ADC. In general, higher dietary saturation and FFA%, lower FA absorption rate, being the contribution of the upper jejunum from 51.8% (S) to 30.9% (PFAD). The regression analysis showed that the replacement of S by increasing levels of PFAD promoted a significant linear decrease of ADC of Saturated FA (slope = -0.0113; R² = 0.85), Monounsaturated FA (slope = -0.0024; R² = 0.66), and Polyunsaturated FA (slope = -0.0034; R² = 0.67), in lower ileum. However, along the GIT no differences were observed in the ADC of TFA between S and the combination of 66%S-33%PFAD. The results suggest that the use of palm fatty acid distillate in growing-finishing diets as a replacement for 33% soybean oil leads to similar apparent digestibility coefficients of fatty acid.

Keywords: free fatty acid; acid oil; fatty acid digestibility; broiler

Effect of a new 3-phytase on egg production and quality and bone mineralisation traits in laying hens

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Exogenous microbial phytase is commonly used in poultry diets to ameliorate the deleterious effect of phytate on bird performance and the environment, as well as to reduce feeding costs. Although there are some evidences of the effectiveness of phytase in improving P digestibility in laying hens, information on the extent to which phytase dose can affect laying hen performance, egg quality and bone mineralisation traits is still scarce. The objective of this work was to evaluate the efficacy of a new 3-phytase, added at different doses, on laying, egg quality and mineralisation level in hens. A total of 288 laying hens (Lohmann brown) of 16 weeks of age were used. The study lasted 106 days in total. The animals were randomly housed into 72 cages (4 animals/cage; experimental unit). At 22 weeks of age, hens were weighed, and each cage was assigned to one of the five dietary treatments: PC, positive control with no added phytase, Ca at 3.69% and P at 0.60%; NC, negative control with no added phytase, Ca at 3.69% and P at 0.38%; and other three diets where NC diet was supplemented with the new 3-phytase at 250, 500 and 1000 FTU/kg feed. Experimental feeds were provided until 31 weeks of age. Body weight (BW) was recorded at 16, 22, 25 and 31 weeks of age. The number of eggs produced, and their weight was monitored daily. Average egg production, egg weight and egg mass were calculated. Average daily feed intake (ADFI) and feed conversion rate (FCR; feed/egg) were controlled during the experimental period. Height of the inner thick albumens, yolk color and shell thickness was measured on days 42, 43 and 59 of the experimental periods, in all the eggs produced in the last 24 hours (150 eggs/treatment approximately). At the end of the trial (31 weeks of age), one bird randomly selected from each cage (12 animals per treatment) was euthanized. The left tibia from each animal was obtained, weighted, and analyzed for ashes, Ca and P content. Dietary inclusion of the new 3-phytase at 1000 FTU increased laying performance compared with PC diet (+0.02; $P < 0.05$), but no significance differences were observed with respect to the NC diet. In addition, hens fed with 1000 FTU of phytase had the lowest ADFI values ($P < 0.05$) that, together with their higher laying performance, led to a better FCR respect to PC diet (-0.09 ; $P < 0.05$). Shell thickness of eggs from hens fed with NC diet was lower than those with PC (-0.011 mm; $P < 0.05$), but when the phytase was added at 250 FTU, PC values of shell thickness were recovered. In a similar way, yolk color values of eggs from hens fed with NC diet was higher to those with PC (+0.31 points in the Roche scale), but when the phytase was added at 1000 FTU, PC values of yolk color were recovered. With respect to bone mineralization, hens fed with the NC diet showed lower ash and P content in their tibias compared with PC diet (-1.9% and -0.3% in dry matter basis, respectively; $P < 0.05$), while hens fed with phytase supplemented diets had intermediate values. In conclusion, our results indicate that phytase addition could contribute to improving egg production and quality, as well as to reducing the mineral supplementation to achieve adequate bone mineralization.

Keywords: phytase, hens, laying, egg, mineralisation

[P2-09]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130139)
[Spain]

Validation of the nutritional matrix of a multienzyme complex through performance and digestibility improvement

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When evaluating nutritional matrices for feed enzymes we should pay attention not only to figures but mostly to how these figures were obtained. Aiming to further validate an existing nutritional matrix of a commercial multi-enzyme complex (MEC) the following investigation was proposed. 320 one-day-old male Ross 308 chickens were randomly assigned to 4 treatments that were replicated 8 times: T0: positive control (PC) without enzymes; T1: negative control (NC), PC reformulated to reduce apparent metabolizable energy, digestible amino acids and crude protein by 65 kcal/kg and 2% respectively; T2: NC + MEC (xylanase + betaglucanase + cellulase + amylase + protease) at 250 g/ton; T3: NC + a commercial xylanase + betaglucanase complex (XBC) at 50 g/ton. The total treatment duration was 35 days with a 3-phase feeding system (starter 1-11d), grower (12-24d) and finisher (25-35d). Performance parameters were recorded per feeding phase and for the overall trial. Digestibility was determined during the grower period from 18th to 21st day. For the whole experimental period, no statistical difference was found between PC (T0) and NC + MEC (T2) birds for the feed conversion ratio, whereas that of NC (T1) and NC + XBC birds was significantly worse ($P < 0.001$) compared to PC (T0) and NC + MEC birds (T2). Birds fed NC diets supplemented with MEC (T2) were characterized by the highest starch total tract digestibility ($P < 0.0001$) while birds fed NC diets (T1) were characterized by the lowest. Total tract digestibility of GE was significantly better ($P < 0.0001$) in birds from PC (T0) and NC + MEC (T2) compared to the NC (T1). The same effect was observed for AME/GE ratio. AMEn of diets fed to PC (T0) and NC + MEC birds (T2) was not significantly different despite of the gap created by MEC nutritional matrix. AMEn of the diet fed to NC (T1) and NC + XBC birds (T3) was not different, and it was lower compared to PC (T0) and NC + MEC birds (T2), which is also consistent with the FCR results. The MEC when added at 250 g/ton of feed in reformulation (reducing apparent metabolizable energy, digestible amino acids and crude protein by 65 kcal/kg and 2% respectively) reduced the feed cost by 12 €/ton of feed (on average) compared to the PC diet, without compromising broiler performance. The XBC did not show the ability to recover the nutritional gap following reformulation.

Keywords: Multi-enzyme complex; nutritional matrix; broiler performance; digestibility

[P2-10]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130140)
[Spain]

Effects of lysolecithin supplementation on ileal digestibility of energy, fatty acids, and amino acids in broilers

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Lysolecithin supplementation of broiler diets is known to improve AME and growth performance, though there is little published data on the impact on other nutrients. Therefore, the effect of lysolecithin supplementation at 500 g/t, on the ileal digestibility of energy, fatty acids, and amino acids in broilers was investigated. Basal diets were based on corn/soy, with tallow as the fat source, and included TiO₂ as an indigestible marker. Birds were allocated at 21 days to 6 cages per replicate, with 2 birds per cage; ileal digesta samples were collected at 28 days old for analysis. Significant responses to lysolecithin were seen for dry matter (67.90 control vs 71.92% 500 g/t, P=0.003), N (78.21 control vs 81.39% 500 g/t, P=0.047) and crude fat (76.34 control v 81.52% 500 g/t, P=0.026) digestibility. For individual amino acids, positive trends were seen for improved digestibility of ASP, CYS, GLU, GLY, HIS, ILE, LEU, LYS, PHE, THR and VAL (P<0.1). A significant response to lysolecithin was seen in PRO (Proline) digestibility (P=0.040). For fatty acids, significant improvements were seen in the digestibility of C16:0, C16:1n7, and C18:0. These results give an initial indication of a digestibility response to lysolecithin supplementation beyond emulsification; further work is required to confirm and elucidate mode of action.

Keywords: Lysolecithin, digestibility, amino acids, fatty acids, nutrient absorption

Effects of a combination of lysolecithins, a synthetic emulsifier, and glycerol monooleate on growth performance, intestinal morphology, and selected carcass traits in broilers, fed low-energy diets without added oil.

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Lysolecithins have been shown to improve bird performance when added to nutritionally adequate diets or when diets are reformulated to provide lower levels of energy. However, there is a scarcity of data on the effect of lysolecithins when added to low-energy diets containing only intact fat from raw feed ingredients (e.g. with no added fat). Therefore, two studies (study 1 and study 2) aimed to evaluate the effect of supplementing a combination of lysolecithins, a synthetic emulsifier, and glycerol monooleate (LEX) on growth performance of broilers fed low-energy diets without added oil. Basal diets were based on corn, soybean meal and extruded full fat soya and were formulated to low-energy content with 100, 150 and 200 kcal/kg lower for starter, grower and finisher feeding phases respectively, compared to Arbor Acres broiler nutrition specifications. In each study, three hundred one-day-old Arbor Acres broilers were assigned to two dietary treatments with six replicates of 25 birds each and fed either a control low-energy diet without added oil supplemented with 0 or 250 g/t of LEX for 28 days. Growth performance was measured and recorded throughout the study. In study 2, intestinal morphology, and selected carcass traits were also evaluated. At slaughter, 60 birds per treatment were used to assess the effect of LEX on carcass traits, and the jejunum of 6 birds per treatment were collected to measure villus height and crypt depth. In both studies, final average body weight and feed conversion ratio were improved ($p < 0.05$) in the birds fed diets including LEX compared to control. In study 2, LEX supplementation resulted in a higher ($p < 0.05$) carcass weight and yield and reduced ($p < 0.05$) abdominal fat and liver weight. Moisture content was higher ($p < 0.05$) in ground deboned broilers fed LEX treatment. Lastly, villus height was increased ($p < 0.05$), and crypt depth reduced ($p < 0.05$) in the jejunum of birds treated with LEX. Hence, both studies demonstrate that supplementation of LEX to low-energy diets without added oil, supports a better performance in broilers chickens. In addition, as seen in study 2, LEX improved carcass traits and positively influenced intestinal morphology, suggesting more absorptive surface area for optimizing nutrient absorption in the gut.

Keywords: Broiler, carcass trait, gut morphology, lysolecithin, performance

[P2-12]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130248)
[Spain]

Influence of lysophospholipid content and metabolizable energy level in laying hen diets on performance and egg quality

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The useful life of laying hens on farms is being extended thanks to many factors. However, some problems such as a poorer feed digestion, lower egg quality or poorer hen health still appear in layers during the productive period. Lysophospholipids can improve the digestion in laying hens, and improve the metabolism of lipids, including cholesterol. Lipidol Ultra® (Pathway Intermediates, Limited, Shrewsbury, UK) is a dietary lysophospholipid product (LPL) based on enzymatic hydrolysed soya lecithin. An experiment was conducted to test the effect of LPL on performance parameters and egg quality during the early laying cycle. 144 Hy-line brown laying hens (aged 21-week-old at the beginning) were randomly housed in 48 experimental 3-hen cages (being each cage replicate). Cages were distributed in a 2x3 factorial design (6 different treatments with 8 replicates per treatment), including two levels of Metabolizable Energy (ME; 2650 kcal/kg or 2750 kcal/kg) and three levels of LPL (0, 0.25 and 0.5 g/kg of feed). The trial lasted 15 weeks. During the comparative study, individual egg weight was recorded daily. Hen-day eggs, feed intake and feed conversion ratio (FCR) were measured and calculated weekly, and the individual hen live weight every 5 weeks. Moreover, 864 eggs (18 eggs/replicate) were analysed in two different moments (at 8 and 12 weeks of the trial) to determine egg quality: egg proportions (yolk, albumen, shell), yolk colour, albumen consistency (Haugh units), eggshell thickness (μm), eggshell broken strength (N), broken eggs (%), dirty eggs (%), abnormal eggs (%). Data were statistically analysed by the General Linear Model, with the ME and LPL levels as the main effects and the cage as random effect. Significant differences were considered when $P \leq 0.05$. Statistical analysis was carried out with the program IBM® SPSS® Statistics 27.0. During 10 weeks, standard ME diets showed heavier egg weight than low ME diets ($P=0.022$). Also, the higher the level of LPL, the higher the egg weight, in both low and standard ME levels ($P<0.01$). So, the proportion of XL eggs were higher ($P < 0.05$) in treatments with the highest level of LPL (0.5 g/kg) regardless of ME level. No differences in hen-day eggs, FCR or in hen live weight were found by ME and LPL levels ($P > 0.05$) during 10 weeks. Regarding the quality of albumen, 0.5 g/kg of LPL improved Haugh Units at week 8, whilst no effect at week 12. Yolk colour was not affected by LPL dose. Eggshell quality was decreased at week 8 in treatments while no effect was found at 0.5g/kg LPL at week 12. LPL had no effect on dirty, broken, white-banded or pale-shelled egg proportion. The results of this experiment suggest that LPL can be used to improve egg size in laying hens at 0.5 g/kg, regardless the ME level, with no negative effect on egg quality.

Keywords: lysophospholipids; laying hen; egg quality; feed

Influence of different concentrations of artificial pigments on the egg yolk color and content of carotenoids

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Egg consumer's expectations with regard to egg yolk color tend to be towards a more intense yellow or orange color. In order to achieve this, the egg producers use the feed with artificial pigments. The aim of this investigation was to determine the influence of addition of artificial pigment Canthaxanthin on egg yolk color and carotenoid content. In this research, we used 36 Tetra hybrid layers which were divided into 4 groups. Each group was administered different concentrations of artificial pigment Canthaxanthin (A-80 mg; B-60 mg; C-40 mg and D-0 mg) in the feed mixture. The study lasted for 6 weeks. Based on the results obtained during this research, it can be concluded that the nutrition treatment did not have an effect on the body mass of hens during the study. The nutrition treatment had no effect on the average daily consumption of the feed. The coloration of the egg yolk was highest in group A (13.71), group B (11.75) and C (11.14) were acceptable, while in group D the coloration was the weakest (6.14). Carotenoid content in egg yolk was highest in group A (20.43 µg/g), then group B (16.38 µg/g) and group C (14.57) and the lowest in group D (12.54 µg/g). Based on these results, we recommend the reduction in the proportion of artificial pigment in feed for laying hens as in groups B and C if it is to achieve the desired egg yolk color that will appeal to consumers.

Keywords: egg yolk color, content, carotenoids

Effect of yeast cell wall supplementation on broiler chickens performances under chronic heat stress

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The objective of this study was to investigate the effects of dietary supplementation of a commercial yeast cell wall product (YCW) on performance of broilers exposed to chronic heat stress (overall temperature +32°C) in presence of an Avian pathogenic *Escherichia coli* (APEC) challenge. 440 one-day old male Cobb broiler chickens were divided into 4 groups which were fed with Control diets (NC and CC) or diets with YCW at the rate of 1000 mg/kg diet for starter and 500 mg/kg for grower and finisher periods (NYCW and CYCW). Two groups (CC and CYCW) were exposed to an intestinal challenge with APEC at day 14. Feed (3-phase pelleted diet) and drinking water were supplied ad libitum. Body weight (BW) of the birds was recorded weekly pen-wise. The cumulative feed intake (FI) was per feeding phase. Average daily gain (ADG) and average daily feed intake (ADFI) were calculated. Data were analyzed using a General Linear Model with two fixed factors (diet and challenge) and their interaction (SPSS v24.0). APEC challenge significantly reduced growth performances (BW: No Challenge: 2679 vs APEC: 2565 g) as well as the ADFI (-2.7%) resulting in a significant degradation of the Feed Conversion Ratio (FCR) by +0.03 units for challenged birds. Mortality was significantly higher for the birds challenged with APEC (1.8 times higher). The European Efficiency Factor (EEF) was significantly lower for challenged birds (EEF=367.4) compared to the non-challenged ones (EEF=401.7). Birds in YCW groups had a significantly higher final BW compared to Control (Control: 2585g vs YCW:2659g). Interaction between diet and challenge tended to be significant for the ADFI, with the CC group having a lower ADFI than the three other groups (NC: 95.4 g/day; CC: 90.7 g/day; NYCW: 97.4 g/day and CYCW: 97.0 g/day). Groups receiving YCW had the lowest mortality rate (1.82% vs. 7.27% for animals not receiving YCW). EEF was significantly improved by 27 units for the YCW birds. The results from this study, conducted under chronic heat stress conditions, demonstrate that supplementation of broiler diets with YCW improves their performances and survival. It can also alleviate negative effects of APEC challenge on ADFI.

Keywords: broiler; yeast cell wall; chronic heat stress; APEC

The effect of in-ovo exposition to ethanol upon osteogenesis of the chicken embryo**Khenenou Tarek¹, Benzaoui Hassina¹**¹agroveterinary institute of Souk Ahras, Algeria*Corresponding author: tarekhenenou@yahoo.fr*

Excessive alcohol consumption by a pregnant woman may delay foetal development and may cause malformations. In this study, we have used the model of the chicken embryo to demonstrate the teratogenic effect of ethanol (33%) on the chicken osteogenesis on the 10th day of embryonic development. In our experimental investigation, 49 fertilized eggs were used. Hence, different doses of ethanol were injected into the chicken embryos at 33% (20, 40, 80µl) in the air space at gastrulation and, on the other hand, an equivalent amount of the mentioned doses of distilled water were injected into the control-group eggs. We did this once every two days in order to maintain a high concentration in the blood. Experiments were repeatedly and independently carried out three times. The eggs were incubated in a humid incubator at the temperature of 37.7° C and at 60-65% of humidity. On the 10th day of incubation, the embryos were taken out and fixed in formalin at 10%. After that, the eggs were sectioned at 5µm of thickness with a Leica microtome and then, stained with the Hematoxylin and eosin. Histological examination revealed that the exposition of chicken embryos to ethanol (33%) delays the skeletal development in a dose-dependent manner by reducing the length of the cartilaginous proliferation zone and hypertrophic zone during the bone formation period. Furthermore, under the effect of ethanol, the cell proliferation activities were repressed. In conclusion, our results show that using ethanol to treat chicken embryos at early stages causes considerable malformations and a decrease in the embryo survival rate. The exposition to alcohol affects the chicken osteogenesis in a dose-dependent manner.

Keywords: Chicken embryo, Ethanol, Malformations, Osteogenesis, Teratogenic effect

Morpho- histological study of the spleen of broiler chickens during post-hatching age**Khenenou Tarek¹, Benzaoui Hassina¹**¹agroveterinary institute of souk ahraas ,algeria*Corresponding author: tarekchenenou@yahoo.fr*

The development of the spleen during the 10 weeks of rearing period was studied on 88 broiler chickens (Hubbard F15). This allowed us to collect information about the morphometric and histologic aspects of this organ according to the post-hatching age. The spleen's average weight increased up to the 7th week of age and entered in a stationary phase characterized by keeping its weight to 3.7g until 8th weeks of post-hatching age. The spleen's histological variations are not in close relationship with the sexual maturity of the broilers like the thymus and the bursa of Fabricius. The white pulp and red pulp are intermingled and there is no limit between the two. These results can be used in the diagnosis of different diseases such as Gumboro and Marek disease.

Keywords: Morpho histological study, spleen, post-hatching age, broiler chicken

External and internal characteristics of eggs of different varieties of Utrerana avian breed compared to commercial laying lineages

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The development of new commercial lineages of laying hens has promoted the regression of native breeds to a second place. Therefore, it is essential to develop new lines of research that enable the development of production models adapted to these breeds and look for new markets in which their products are valued which may guarantee the conservation and biodiversity of this endangered native breed. The objective of the present study was to characterize the egg of the Utrerana avian breed and make a comparison of the relationships between the parameters that determine the internal and external quality of the egg, through a canonical correlation analysis. For this, a batch of 68 Utreranas hens, with individuals from each of their four varieties (Partridge, Franciscan, Black and White) and a control flock of 17 Leghorn hens were housed in individual cages. The purpose is of achieve total traceability of the egg and make a correct evaluation of its quality. The parameters measured were: egg weight, major diameter, minor diameter and shell color (by portable spectrophotometer) to assess the external characteristics of the egg, and white height, yolk color (by DSM® fan and portable spectrophotometer), yolk diameter, shell weight, yolk weight and white weight, to evaluate the internal characteristics of the egg. All the statistical analyses were performed on a sample of 194 eggs, collected between the months of March to June 2018. Significant differences were reported for almost all variables when both breeds were compared, except for white height, yolk diameter and L* coordinate for yolk color ($p > 0.05$). Significant differences were also detected in egg quality between the different varieties of the Utrerana avian breed. This study provides consistent results that allow predicting the internal quality of the product from the external characteristics of the product, thus enabling the implementation of an effective non-invasive method to determine the internal quality of the egg and allowing a better classification to meet the needs of consumers.

Keywords: Native breed; egg quality; color coordinate decomposition; internal quality traits; external quality traits

Preliminary results of reproductive traits of the Andalusian turkey

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The Andalusian turkey is a native breed originating in Andalusia, which has been subjected to great genetic erosion, as a result of the development of new and more productive lines. The reproductive characterization is essential for breed recognition and its conservation. Therefore, the objective of this work was to perform a preliminary evaluation of the reproductive rates of the Andalusian turkey that guarantee the multiplication of the individuals of the population. For this, a total of 15 females and 3 males turkeys from different families were assessed. The animals were divided in 3 flocks (5 females for each male) depending on the feather colour that they presented (black (B), black roan (BR) and copper roan (CR)). A total of 151 eggs were incubated in six incubation batches in 2019 spring. The eggs were incubated in electric incubator at an interval less than 7 days after oviposition. All eggs were checked by ovoscope at 12 days, to verify the embryo viability and reject the non-fertilized eggs. Fertility, embryonic mortality, perinatal mortality, and hatchability rates were calculated, while the birth weight of the animals was estimated. Feather colour was considered as an independent factor in statistical analyses. The results obtained did not show significant differences ($p > 0.05$) depending on feather colour for any of the variables, with 90% fertility for CR individuals, 96% for B and 91.6% BR. Embryonic death was 3% (CR), 6.66% (B) and 12.73% (BR), while perinatal mortality was 20%, 7.14% and 11.76% respectively. Regarding the percentage of hatchability, this was 90.90 (RC), 93.33 (N) and 70.83 (RN), respectively. Finally, birth weight was 53.54 ± 3.63 (RC); 56.20 ± 4.64 (N) and 55.62 ± 6.2 (RN), respectively. Despite the low number of animals used in this study, these results show some valuable information for the breeder. However, further studies are needed to optimize this characterization. The reproductive indexes obtained during the present study ensure the future viability of the conservation process. Taking these fertility results into account, it would be feasible to carry out an emergency incubation in case of a severe problem that causes a decrease in the Andalusian turkey population. However, perinatal mortality reported indicates the high sensitivity of individuals during their first days of life, an aspect to be considered for future incubations seeking the multiplication of specimens.

Keywords: Native breeds; fertility; embryonic death; perinatal mortality; hatchability; birth weight

Genome-wide scan for selection signatures in Italian local chicken breeds

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Genetic makeup of chicken populations is the result of a long-term process of selection and adaptation to specific environments. Identifying genomic regions that are or have been under selection pressure (selection signatures) is essential for sustainable chicken production because it could help to elucidate molecular mechanisms governing robustness and environmental responses in local populations. In this study, we used single nucleotide polymorphism (SNP) data from 600K Affymetrix Chicken array to detect signatures of selection in 23 Italian local chicken breeds and 4 commercial hybrid lines. The breeds were categorized into 6 groups for comparative analysis based on classification (local vs commercial), live weight (heavy vs light) and geographic origin (Northern vs Southern Italy). Putative selection signatures were investigated by combining three Extended Haplotype Homozygosity (EHH) tests either within (iHS) or among groups (Rsb and XP-EHH). After genotype quality control, 582 animals and 313,508 SNPs were available for statistical analysis. Eleven candidate regions were detected within groups while 12 regions putatively under divergent selection were jointly identified by Rsb and XP-EHH approaches in the three group comparisons. Within these genomic regions, we identified genes involved in chicken adipogenesis, growth-related processes and feed efficiency which are basically under strong selection in commercial chicken as they are of great economic importance. Other identified regions contained candidate genes with biological functions in response to environmental stress, immune responses, and disease resistance, which underline local adaptation. Indeed, local breeds are reared as backyard chickens and thus they have developed resistance to environmental challenges than commercial chickens. Results highlight that selection and environmental adaptation have played an important role in shaping the genome of local chicken populations. Our study can be considered as a starting point to identify gene mutations that can have a central role in coping with climate change.

Keywords: indigenous breeds, local breeds, genomic, selection signature

[P2-20]: POSTER SESSION 2: NUTRITION AND REPRODUCTION (ID: 130244)
[Spain]

The origin of the domestic turkey and early distribution in Europe

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The ancestors of wild turkeys are known to have occupied North and Center America since the last Ice Age. Wild turkey subspecies differ in size, plumage and geographic distribution. Seven subspecies of wild turkeys were already described long time before settlers reached America for the first time. Among them, the Mexican subspecies (*M. g. gallopavo*) has been addressed to be the most presumable founder of current domestic turkeys, without discarding the contributions of other subspecies. Contextually, even if their expansion across Europe was widely documented since the early XVI century, the specific moment and cradle of turkey domestication still remains uncertain. Despite scientific efforts, this knowledge gap about the origins of domestic turkeys could be ascribed to the lack of skeletal differences between domestic and feral individuals, along with recurrent crosses with the wild population. Despite the wide variability of scientific hypotheses and the controversial nature of the subject, the present report briefly gathers all documented pieces of evidence and descriptions of turkey domestication. Conclusively, according to literature, two likely origins are determined. On the one hand, Mesoamerica (± 700 b. C – 400 a. C), which is the most widely accepted. On the other hand, the South-West of the United States (± 300 b. C.), as a direct consequence of agricultural features' migration.

Effects of an Allium derivate on productive parameters in turkey farms.

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The use of antibiotics as growth promoters has been restricted due to the appearance of resistant bacteria that constitute a serious public health problem. Faced with this situation, farmers demand alternative methods that allow moderating the use of antibiotics without reducing the profitability of their production. In this sense, organosulfur compounds derived from alliaceous (garlic and onion), have shown to exert numerous functional properties that place them among the most relevant candidates to promote animal health and improve production rates (1). In the present study, the efficacy of GARLICON, a product rich in propyl-propane thiosulfonate (PTSO) from Allium was evaluated in a fattening turkey farm. For this aim, a total of 72,000 turkeys divided into 3 different treatments with three replicates each (n=8,000) were used. Each treatment consisted in a control group (CON) whose water did not contain Allium derivate, a group that began to consume water with Allium derivate from day 30 of life (GAR 1) and another group from day 15 of the cycle onwards (GAR 2). In both groups, the product was added to the drinking water at a dose equivalent to 30 ppm of PTSO. The results indicate that birds that consumed PTSO in drinking water obtained better FCR values (2.25 ± 0.04 and 2.28 ± 0.02 , respectively) than the control group (2.40 ± 0.05), being significantly lower when consumption began at earlier stages of the cycle. In the same way, the mortality rate was reduced in those birds that consumed water with PTSO, obtaining similar ratios in both treatments. This improvement in the productive parameters could be due to a modulation of the intestinal microbiota that allows an improvement in the health of the animals. Similarly, studies in chickens showed an improvement in FCR fed PTSO, related to a decrease in enteropathogens and an increase in intestinal absorption surface and nutrient digestibility (2). These results show the effectiveness of PTSO to be used to improve production parameters in antibiotic-free farms, being an optimal candidate as substitute for growth promoters. (1). Abad et al.(2021) *Animals* 11(1):1-14. (2). Peinado et al. (2012). *Poult Sci.* 91(9):2148-2157.

Keywords: FCR; mortality; turkeys; Alliaceae; PTSO; onion; garlic.

Supplementation of DL-methionine at 65% of MHA-FA support similar performance in broilers

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DL-methionine (DL-Met) and liquid methionine hydroxy analogue-free acid (MHA-FA) have been widely used by poultry industry, and both Met sources have shown to support proper broiler performance, whether their nutritional value is correctly considered in feeds. Misconceptions about such values could decrease revenue of broiler enterprise. The current research was designed to investigate broiler responses to concentrations of Met + Cys provided by feeds containing DL-Met or MHA-FA, in which relative bioavailability (RBA) of MHA-FA was considered 65% compared with DL-Met, in a product-basis. In total, 720 one-d-old male Ross 308® chicks were randomly assigned into 5 treatments, 9 replicates of 16 chicks throughout 35 days. A basal diet (BD) was formulated to meet Ross 308® recommendations for broilers in the starter (1 to 10d), grower (11 to 24d), and finisher (25 to 35d of age) phases, except for Met + Cys whose dietary concentration was supplied solely by the wheat, soybean meal and peas. In all the phases, BD was supplemented with DL-Met (99%) or MHA-FA (88%) to provide 75% and 100% Met + Cys Ross 308® recommendations. The RBA of MHA-FA was assumed to be 65% of DL-Met. Data were analyzed as one-way ANOVA and treatment means compared by Tukey's multiple comparison test. Regardless of the source, Met supplementation increased body weight (BW), average daily gain (ADG), and average daily feed intake (ADFI), and improved feed conversion ratio (FCR) of broilers compared with Met deficient feeds ($p < 0.05$) throughout 35 days period. In such period, both Met sources supported similar performance in birds fed either 75 or 100% Met + Cys ($p > 0.05$), but regardless of the source assessed, birds fed 100% recommendations exhibited a better performance ($p < 0.05$) compared with 75% Met + Cys. On a product basis, DL-Met (99%) can be supplemented at 65% of MHA-FA (88%) without compromising performance traits.

Keywords: poultry; relative bioequivalence; sulphur amino acids

Effect of feeder space and stocking density on broiler breeders' performance up to 50 wk of age

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The effects of feeder space and stocking density on Cobb 500 pullet' growth and breeder hens' productivity were studied from 0 to 50 wk of age. The trial was divided in phases: rearing from 0 to 17 wk, pre-laying period from 18 to 23 wk and production from 24 to 50 wk of age. There were 2 trials with two experiments each. In the first trial, one experiment was conducted with low feeder space (LFS): 12 cm per bird and two stocking densities: high density (HD) and low density (LD), and the other experiment was conducted with high feeder space (HFS): 15 cm per birds and the same stocking density HD and LD. In the second trial, one experiment was conducted with LD and two feeder space LFS and HFS, and the other experiment with HD and the same two feeder space. The density of birds in the HD and LD treatments was 10,4 and 8,2 birds/m² from 0 to 23 wk and 7 and 5,5 birds/m² from 24 to 50 wk of life, respectively. A common standard feed as Cobb 500 Broiler breeder guide was used in all the experiments. Data were analyzed by general linear model of SPSS (v.28.0) for each of the fourth experiments. Each treatment was replicated 6-8 times and the experimental unit consisted of a department (5,37 × 2,42m) with 106 chicks at LD and 135 chicks at HD chicks from 0 to 23 wk of age and 72-91 hens from 24 to 50 wk of age. Live body weight (BW) of the birds was determined individually per replicate at 21, 24 and 50 wk of age and BW uniformity was calculated. In laying period, the laying index, age at peak production and the number of eggs laid were determined. Pullets BW and BW uniformity were not affected at any age studied (21, 24 and 50 wk) by any of the treatments used in the four experiments. In the first trial, from 24 to 50 wk of life, pullets with LD and HD treatment showed the same peak production when housed in LFS and HFS (LFS: 88,3 vs. 87,9%; P > 0,10 and HFS: 88,3 vs. 88,6%; P > 0,10). Also, pullets with LD and HD treatment reached the peak production at the same age when they were housed in LFS and HFS (LFS: 30,4 vs. 30,3 wk; P > 0,10 and HFS: 30,8 vs. 30,3 wk; P > 0,10). Total eggs produced per hen housed at 50 wk tended to be higher for LD than for HD when LFS was applied (126,6 vs. 123,1 eggs; P = 0,10). However, stocking density did not affect total eggs produced per hen housed at 50 wk by when pullets were housed with HFS (125,6 vs. 127,0 eggs; P > 0,10). In the second trial, from 24 to 50 wk of life, pullets with LFS and HFS treatment showed the same peak production when housed in LD and HD (LD: 88,3 vs. 86,8%; P > 0,10 and HD: 87,2 vs. 88,6%; P > 0,10). Also, pullets with LFS and HFS treatment reached the peak production at the same age when they were housed LD and HD (LD: 30,4 vs. 30,9 wk; P > 0,10 and HD: 30,8 vs. 30,3 wk; P > 0,10). In our experimental conditions, we concluded that neither feeder space nor stoking density have affected broiler breeder laying index, age at peak production and total egg produced per breeder hen housed. Data for each experiment were analyzed by GLM of SPSS (v.28.0) with experimental treatment as main effect.

Keywords: Broiler breeder hens; feeder space; stoking density; egg production.

Effect of early age heat treatment on chronic heat stress resistance of broilers

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This study was performed to evaluate the effects of early heat conditioning on growth performance, liver-specific enzymes (GOT and GPT), neuro (dopamine and serotonin) and stress (corticosterone) hormones, and the expression of HSPs, HSFs and pro-inflammatory cytokines in broiler chickens under chronic high temperature. A total of 144 one-day-old chicks were divided into three groups followed; the control group (C) was raised at optimum temperature without any heat stress, the chronic heat stressed group (CH) was exposed to high temperature (40°C for 24 h/day) at 21-35 days of age, the early heat exposed group (HH) was exposed to high temperature for both 40°C/24 h/day at 5 day and 21-35 days of age. Broilers were fed commercial diets, and the feed and water were supplied ad libitum at normal temperature. Groups exposed to high temperature (CH and HH) showed significantly lower body weight and feed intake and diminished the expression of GOT and GPT compared with the control groups without early heat exposure. In addition, the expression of HSPs were decreased by chronic heat stress (HS) in both groups exposed to early heat and late heat treated groups (CH and HH). The expression of HSP60 and HSF3 genes was significantly lower in the heat-treated groups (CH and HH), while HSP70 and HSP27 genes were higher in the HH group compared with the control group. The expression of pro-inflammatory cytokine genes was significantly higher in the HH group compared with the control and CH groups. Therefore, exposure of broilers to early HS may improve the inflammatory reactions, but chronic HS did not change the early heat exposure effect on liver enzymes and heat shock protein expression.

Keywords: chronic heat stress, heat shock protein, broiler, resistance

Effect of different levels of light intensity on behavior and blood profile of broilerAsad Aslam^{1,3}, Ghulam Abbas^{2,4}¹Department of Pathobiology, RCVetS, Lahore, ²Department of Animal Production, RCVetS, Lahore, ³Department of Pathology, University of veterinary and animal sciences, Lahore, Pakistan, ⁴Department of Poultry Science, University of agriculture, Faisalabad, Pakistan*Corresponding author: asadaslamkhan@hotmail.com*

Commercial birds at farms in Pakistan are often reared at too much higher light intensities than the actual need thus negatively affect the welfare of birds as well as profit margin of farmers in terms of extravagant use of energy. So we designed this project to explore most responsive light intensity for chicken. One hundred fifty broiler chicks were randomly divided into 15 experimental units comprising 10 chicks each, to be designated as replicates, three replicates were randomly assigned to each of the five experimental treatment groups. All birds were provided 20 lux light during first week after that treatment distribution was as follow. Light treatment T1 i.e. (5 lux from 2-6week) was given to group A, T2 i.e. (10 lux from 2-6week) was given to group B, T3 i.e. (20 lux from 2-6week) was given to group C, T4 i.e. (30 lux from 2-6week) was given to group D, T5 i.e. (40 lux from 2-6week) was given to group E. Chicks were vaccinated according to recommended schedule. All birds were provided homogeneous environmental conditions except light intensity. The data collected for behavioral profile, blood profile, rectal temperature and respiration rate were statistically analyzed using Completely Randomized Design. Results revealed non-significant ($P > 0.05$) effect of light intensity on: eating behavior at Week (W) 2, W4, W5, W6., drinking behavior at W2, W5, W6., standing behavior at W2, W5., Preening behavior at W2, W3, W5, W6 and aggressive behavior at W3, W4, W5. whereas Eating behavior at W3, drinking behavior at W3, W4, standing behavior at W3, W4, W6, Preening behavior at W4 and aggressive behavior at W2, W6 were affected ($P < 0.05$) by light intensity. Light intensity affected cholesterol and T4 hormone level ($P < 0.05$) whilst it did not affect cortisol, urea, creatinine, T3 level, respiratory rate and rectal temperature ($P > 0.05$). The present research will cause a significant impact on poultry industry of Pakistan. The research has provided an important clue about the obligatory light intensity for best production performance in the ecological conditions of Pakistan. It is recommended that light intensity at broiler shed should not exceed than 5 lux.

Keywords: Broiler chicken, Blood Profile, Light Intensity

[P3-04]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130220)
[Spain]

Differences in productive parameters from fast-growing and alternative slow-growing chickens fed with a conventional and a slow-growing diet

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Selective pressure for productive efficiency in current broiler production has triggered alterations in the development of animals that compromise their welfare. Intermediate genetics with slower growth are proposed as an alternative breeding that improves these conditions. The aim of this study was to evaluate if these alternative strains can equal the current productive results without increasing the final production cost. Farm productive parameters were compared from a conventional fast-growing and a slower-growing strains until 42 days. A total of 696 one-day-old chicks from each of the following treatments were housed in 36 boxes (58 birds/pen): Ross 308 males (RM), Ross 308 females (RF), and mixed Ranger Classic (RC) males and females. Two diets were defined in the three groups, a fast-growing diet (FG) and slow-growing diet (SG). Body weight, feed intake, average daily gain and feed conversion ratio were registered weekly and mortality daily for each pen. Genetic and diet effects and their interactions were analyzed with a General Lineal Model (SPSS 26.0). Sex effect was evaluated only in Ross genetics. Body weight, feed intake and average daily gain were lower in RC animals than Ross 308 throughout the lifecycle ($p \leq 0.001$). RM were always heavier, with the greatest weight at 42 days (3.39kg in RM vs 2.88 in RF and 2.27kg in RC; $p \leq 0.001$) and the highest average daily gain (80 g/d vs 68 in RF and 53 g/d in RC; $p \leq 0.001$). In addition, Ross animals that received a fast-growing diet grew more than animals fed with a slow-growing diet (3.47 vs 3.31kg in RM and 2.92 vs 2.84kg in RF; $p \leq 0.001$) without differences for the Ranger Classic strain (2.29 vs 2.24kg). These animals were less efficient with a lower feed conversion ratio (1.66 in RC vs 1.57 in RF and 1.54 in RM; $p \leq 0.001$). There was less mortality percentage in Ross 308 females followed by the Ranger Classic's group and Ross 308 males (4.60 vs 5.75 vs 8.76% respectively; $p \leq 0.05$). It is necessary to continue with a genetic selection for this type of strains to achieve current productive results, offering a quality product and assuring animal welfare.

Keywords: Broiler; Ranger; body weight; feed intake; average daily gain; mortality

[P3-05]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130241)
[Spain]

Welfare indicators evaluation from fast-growing and slow-growing chickens in a conventional and slow-growing cycle

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Lesions associated with litter quality is one of the main problems derived from intensive genetic selection for fast growth. As an improvement action due to the emergent awareness of consumers about animal welfare, alternative genetic strains appear on the market with slower growth that allow reducing the incidence of these problems. Farm welfare indicators were compared between conventional and slower-growing strains. A total of 696 one-day-old chicks from each of the following treatments were housed in 36 boxes (58 birds/pen) with wood shavings as litter: Ross 308 males (RM), Ross 308 females (RF), and mixed Ranger Classic (RC) males and females. Two diets were defined, according to a daily gain rate of 65 g/d (fast growing diet) and with a 4% reduction in energy and 17% in lysine content (slower growing diet). Footpad dermatitis, hock burns, and plumage soiling were evaluated in 30 animals per treatment (5 birds/pen) weekly until 56 days with a five points scale (absence to severe). Effects of genetics, diet and week were analyzed with an Ordinal Logistic Regression (ORL) Model with R software. Footpad dermatitis incidence estimation was higher in RM than RF and RC (0.29 and 0.76 logistic units worse $p \leq 0.05$ and $p \leq 0.001$, respectively) whereas RF were 0.46 units worse than RC and fast-growing diet was 0.50 units better than slow-growing diet ($p \leq 0.001$), independently of the week. The output of the ORL model suggested that the probability of finding this lesion with any severity degree was 36.1% in RM, 29.5% in RF and 21.0% in RC. Hock burns were more evident in RM and RF than in RC. In this case, RM were 0.71 units worse than RF and 1.66 worse than RC whereas RF were 0.95 units worse than RC ($p \leq 0.001$). Diet did not have any effect, but each week on the trial increased the incidence in 0.90 units. The probability of suffering this lesion at some degree was 23.0% in RC, 43.6% in RF and 61.2% in RM. Finally, plumage soiling was not affected by diet or gender in the case of Ross animals but increased in 0.71 units in RF and 0.87 units in RM compared to RC ($p \leq 0.001$). The most influential factor was week since each week in trial increased the estimation in 1.59 units ($p \leq 0.001$). In this case, a severity of 3 would have a probability of 19.3% for RM, 16.9% for RF and 9.1% for RC. The development of these new genetic strains allows to reduce fast growth selection consequences, ensuring a profitable production committed to animal welfare.

Keywords: Broiler, Ranger, footpad dermatitis, hock burns, soiling of plumage, litter quality

Behavioural reactivity of slow-growing chickens fed live black soldier fly larvae: preliminary results

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The aim of this preliminary research was to investigate the effects of access to black soldier fly (*Hermetia illucens*; HI) live larvae on fearfulness in slow-growing chickens. We hypothesized a positive effect of early experience and environmental enrichment on fear reduction. Eighty-four Naked Neck (Red JA Naked Neck – Hubbard®) slow-growing chickens were randomly allotted to 12 pens (1m×3m) at 14 days of age. Each pen was assigned to a dietary treatment (TRT; 4 pens/treatment, 7 chickens/pen) as follows: i) control diet (CO): commercial feed; ii) CO + 10% of the expected daily feed intake (DFI) of HI live larvae (g) (C10); iii) CO + 20% DFI of HI live larvae (g) (C20). The commercial diet was distributed ad libitum in all the treatments. The behavioural reactivity (fear response) was tested using the Novel Object Test (NOT). The novel object – a XXL RED KONG® Classic dog toy – was placed at about 1.5 m from the front wall of the rearing pen between the feeding and drinking areas. The number of birds close (10 cm max distance) to the object was recorded every 30 sec for 2 min. The total number of birds close to the novel object in the observational time lapse was calculated (TOT). The birds were weighed after the test (WEI). NOT was repeated 1 h before (BEF) and 1 h after (AFT) larvae dietary supplementation at 4, 8, 12 weeks of age. Statistical analysis was carried out using the GLM procedure (SAS 9.4®); WEI and TOT were the dependent variables, while dietary treatments (C0, C10, C20), age of birds (4, 8, 12 wks.), testing moment (BEF, AFT) and their interactions were the sources of variation. WEI was significantly affected by TRT and age (physiological growth), TOT was affected only by ACC. In the overall period, C10 and C20 birds were slightly heavier than C0 birds, whereas body weight was similar in C10 and C20 birds ($P \geq 0.05$). TOT was significantly affected by larvae supplementation, but no significant differences between C10 and C20 were recorded. The present results show how access to HI live larvae can reduce birds' fearfulness improving their coping ability and welfare. Further studies are needed to confirm the positive effects of live larvae supplementation on birds' behaviour and welfare in broiler rearing systems.

Keywords: Chicken; Welfare; *Hermetia illucens*; Novel Object Test; Live Larvae

Application of a visual scoring system for the assessment of litter quality as an on farm welfare indicator in commercial broiler production

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Footpad dermatitis (FPD) scored at slaughter is considered the most reliable indicator of broiler welfare on farm. This is due to the fact that footpad health correlates directly to litter quality, in particular wetness. The assessment of litter quality therefore could be used as an outcome-based indicator to foresee the incidence of FPD lesions, but it requires the development of a tool for this purpose. The aim of this study was to identify a practical and reliable method to assess litter quality and to understand if a visual assessment of litter characteristics (wetness and friability, evaluated on a ten-point scale) could be a reliable tool to foresee the incidence of FPD lesions scored at slaughter. Comparisons were made between visual scoring, performed during 54 visits in 27 different farms, and litter moisture content (deep and superficial). Litter assessment was performed dividing each inspected shed in half lengthwise, then considering three longitudinal strips down the left part (one strip in the middle of the shed, one near the drinker line and one near the feeder line), and identifying three points along each line (near the entrance, in the middle and near the end of the shed). Litter evaluation was performed by measuring deep and superficial wetness with a portable instrument (SM150) and through visual Friability and Wetness scoring (according to Vinco et al., 2018), in each of the identified 9 points. Furthermore, one hundred birds of each inspected barn were scored for FPD at the slaughter plant, and the Swedish Score (Berg, 1998) calculated. A significant correlation was found between both deep and superficial litter moisture and Wetness (SM150 deep: -0,66, p-value<0,0001 – SM150 superficial: -0,64, p-value<0,0001) and Friability (SM150 deep: -0,62, p-value<0,0001 – SM150 superficial: -0,66, p-value<0,0001) visual scores. Instrumental litter moisture was significantly correlated with an increase in the Swedish Score (SM150 deep: 0,59, p-value<0,0001 – SM150 superficial: 0,51, p-value<0,0001). Friability and Wetness visual scores were also significantly correlated with an increase in the Swedish Score (Friability score: -0,52, p-value<0,0001 – Wetness score: -0,53, p-value<0,0001). Results suggest that visual assessment of litter quality seems a reliable tool and could be used in animal welfare assessment schemes for broilers on farm.

Keywords: "Footpad Dermatitis", "litter quality", "visual score", "welfare indicator", "broiler"

[P3-08]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130084)
[Slovakia]

Humic acids and their effect on ammonia concentrations, final live weight and mortality of broilers

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In this study, we investigated the effect of humic acids on ammonia concentrations, final live weight and mortality of broilers. We applied a preparation containing humic acids into the litter (140 g per m²) in the experimental section of broiler housing with 14,100 broilers. The second section, with 14,100 broilers also, was control. Every 10 minutes for 35 days, we measured ammonia concentration (mg.m⁻³), temperature (°C) and humidity (%) in three or two (humidity) locations of both sections. For measuring of NH₃ concentrations, we used gas detectors Dräger X-am 7000 and Oldham Ibrid MX 6. To measure temperature and humidity, we used devices Kestrel 4000, Testo 435 and Oldham Ibrid MX 6 (only temperature). We found very high significant (P<0.001) differences in the values of ammonia concentration, temperature and relative humidity between the individual sections. The average value of ammonia concentration (expressed as mean ± SE) was lower in the experimental section (0.95± 0.01) vs. the control section (1.01± 0.01). Conversely, the average values of temperature and humidity were higher in the experimental section (25.84± 0.03; 42.08± 0.10) vs. the control section (25.57± 0.04; 37.55± 0.13). 946 and 869 broilers died in the experimental and the control sections, respectively, but the difference in broiler mortality was not significant (P=0.0616). The average final live weights of broilers were 2.05 and 1.94 kg in the experimental and the control sections, respectively. The application of humic acids significantly decreased the ammonia concentrations in the housing area and increased the final live weight of broilers by 110 g on average but did not reduce their mortality. This article was possible through project APVV 15-0060 of the Slovak Research and Development Agency Bratislava.

Keywords: broilers; humic acids; ammonia concentrations; final live weight; mortality

[P3-09]: *POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS* (ID: 130121)
[Croatia (Hrvatska)]

Greenhouse gas emissions from the Croatian poultry production over the last decade (2010 - 2020)

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In recent years, people become more aware of the impact of food production on the environment and increasingly want to change their food to minimize the impact of their diet on the planet Earth. To make this possible it is necessary to know the exact impact of certain types of food of animal origin on the environment. This paper presents greenhouse gas (GHG) emissions as well as the intensity of greenhouse gas emissions associated with the production of different poultry species in Croatia over the last decade (2010 - 2020). Greenhouse gas emissions were calculated using the Intergovernmental Panel on Climate Change (IPCC) methodology for conditions in Croatia. As the birds do not have the highest GHG emission within animals, emissions from enteric fermentation, only CH₄ and N₂O emissions from manure management in poultry production were considered. Between the years 2010 and 2020, total emissions of CH₄ from poultry production were increased by about 12%, at the same time N₂O emissions increased by 53%. The changes, that is, an increase in GHG emissions can be attributed to the total number of poultry in Croatia, which increased by 38%. According to the Central Bureau of Statistics, apart from the total number of poultry in the last ten years, there has been a significant change in the proportion of certain poultry species. This primarily refers to broilers and laying hens, which have changed their annual population average from 3.4 to 9.2 million broilers or 5.0 to 2.9, million laying hens. Emissions in other poultry species have been declining significantly, as the number of animals has also been declining. Poultry production in the Mediterranean and continental parts of the Republic of Croatia did not significantly affect the total GHG emission in Croatia. Poultry production in the Mediterranean part represents only 7% of total poultry production in Croatia.

Keywords: greenhouse gas; emissions; poultry; Croatia

[P3-10]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130065)
[Spain]

Influence of supplementation with saccharose and fasting on broiler meat quality

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Meat colour is the first quality attribute that affects consumer purchasing decision. Several factors influence the colour of poultry meat, but pH has a direct relationship with meat quality attributes such as tenderness, water-holding capacity (WHC), colour and shelf life. After death, pre-slaughter without enough time to replenish glycogen will cause early depletion of the muscle glycogen, resulting in high pH and changes in meat colour and tenderness after cooking. Strategies that favour the accumulation of glycogen in the muscle may allow a normal drop of pH and an improvement in the quality of the meat. Six groups of Cobb broilers were housed in boxes. The effects of the administration of saccharose (1g/L) to the drinking water during 24 hours prior to transportation and fasting for either three different pre-slaughter feed withdrawal times (6, 8 and 10h) were assessed on meat quality. After slaughtering at 40 days old, 10 animals per treatment were randomly selected and their hot carcass weight was obtained. Ten additional carcasses were selected and analyzed 24h after slaughter for meat quality parameters on breasts and thighs. Fasting did not affect hot carcass weight but the administration of saccharose did ($P=0,033$). Higher pHs were found at longer fasting times in the breast. The Minolta spectrophotometer showed significant differences in colour inside the breast after blooming for 1 and 5 days due to fasting. Fresh thighs showed less redness at short fasting ($P=0,021$) than longer fasting times. After thawing, these differences increased between treatments. These colour differences remained after cooking. In the breast, no significant differences were observed on WHC and texture among groups. However, on thawed thighs, short fasting showed less WHC ($P< 0,001$) than longer ones. The effect of fasting time on pH has influenced the colour of breast and thighs, turning darker at long fasting times. Nevertheless, saccharose supplementation has little influence on the meat quality parameters analyzed in this study although quality attributes show a tendency to behave in the same direction as the short fasting times.

Keywords: Sugar; Fasting; Broiler; Colour; pH; Water Holding Capacity

[P3-11]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130087)
[Romania]

The influence of using a natural antioxidant in broiler diet enriched in polyunsaturated fatty acids, on meat quality

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The aim of the present study was to evaluate the influence of a natural antioxidant in broiler diet enriched in polyunsaturated fatty acids, on meat quality. A 42-day feeding trial was conducted on 96, day-old Cobb 500 chicks kept in an experimental hall, on permanent wood shaves litter (10-12 cm thick). The broilers were assigned to 2 groups (C, E). Each group consisted of six replicates (8 chick/replicate). During the starter stage (1-14 days) all chicks received a conventional compound feed (C). After 14 days, the diet formulations (C and E) for the grower and finisher stage were enriched in polyunsaturated fatty acids by including 4% flaxseed meal. Compared to C diet, the experimental diet (E) included 0.015% natural antioxidant from red grapes (characterized by 36.75 mg/g GAE total polyphenols and 266.84 mmol/kg ascorbic acid equivalent and 257.82 mmol/kg vitamin E equivalent antioxidant capacity). At the end of the experiment, 6 broilers / group were slaughtered, and meat samples (breast, thigh) were collected. The following parameters were monitored: texture (hardness, springiness, resilience, cohesiveness and gumminess), meat color as lightness (L *); red-green intensity (a *); yellow-blue intensity (b *) and total color difference (ΔE *) and lipid peroxidation (at 0 and 7 days of refrigeration). In the thigh samples, the color parameters did not show any difference between groups. A significant increase in lightness was recorded in the breast of E group compared to C. Except for the springiness that was significantly higher in the chicken thigh collected from group E compared to C, all the texture parameters did not recorded significant differences between groups. In contrast, the chicken breast from group E had a significantly higher hardness, resilience and cohesiveness compared to group C. In the thigh of E group there were significantly ($P < 0.05$) lower values compared to C group for the peroxide index at both 0 days (0.161 vs. 0.289 mil eq O₂ / kg) and 7 days of refrigeration (0.195 vs. 0.301 mil eq O₂ / kg). Similar to the peroxide index, the concentration of malonaldehyde (mg/kg) in the thigh samples showed a significant decrease, with 33% (at 0 days) and 48.5% (at 7 days) in E vs. C group. Also, in the breast samples, the concentration of malonaldehyde was significantly ($P < 0.05$) lower in E compared to C group. In conclusion, the addition of 0.015% natural antioxidant from red grapes in broiler diet enriched in polyunsaturated fatty acids, improved the texture, color parameters and lowered the peroxidation processes of lipids in the meat, characteristics that influence the acceptability to the consumers.

Keywords: broilers, natural antioxidant, texture, color, lipid peroxidation

[P3-12]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130098)
[Spain]

Effects of dietary supplementation of olive pomace acid oil on TBA values, colour and sensory acceptance in poultry meat

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Acid oils (AO) are fat by-products from edible oil refining, characterized by its high proportion of free fatty acids. As AO have a high energetic value, they have been used in feed industry for many years. However, their utilization has some drawbacks, mainly due to the high variability in composition (e.g., MIU, oxidation products). This may limit their use as fat sources in broilers due to their potential negative impact on performance and meat quality traits. Moreover, the effect of these fat by-products on poultry meat quality has been scarcely studied. The aim of this study is to determine if the inclusion of olive pomace oil (OP) and olive pomace acid oil (OPA) in feeds has any significant effect on TBA values, colour, and sensory acceptance of poultry meat. With this purpose, a total of 3,048 one-day-old Ross 308 broilers of both sexes were distributed in 24 pens (127 chicks per pen) and each pen was randomly assigned to 3 dietary treatments from 21 to 39 days of age (8 replicates per treatment). These dietary treatments contained 6% of different fat sources: palm oil (P), OP and OPA. After slaughter, at 39 days, four female broilers per pen were taken and their legs were hand deboned. One leg from each broiler (meat with skin) was used to do the determinations in fresh meat and the other leg in refrigerated meat. Thus, from each pen two plastic trays with 4 deboned legs were packed under commercial conditions (O₂/CO₂; 70/30) and refrigerated at 3 °C - 4 °C. Leg meat with skin from one tray was cut, mixed, ground and analyzed at 24 h after slaughter (fresh meat, n=24). Leg meat with skin from the other tray was ground and analyzed at 7 days after slaughter (refrigerated meat, n=24). TBA and colour values (L*, a*, b*) are being measured in ground meat, and sensory acceptance by a hedonic test in cooked ground chicken patties. TBA results of meat showed higher values for refrigerated and OPA samples. Colour results revealed higher a* and b* values for refrigerated meat samples, higher a* values for P samples and higher b* values for OP samples. Neither dietary treatments nor refrigeration influenced consumer acceptance of chicken meat. It can be concluded that refrigeration increases TBA, a* and b* values of meat. In addition, the inclusion of OPA in feeds increases TBA values (secondary oxidation), the inclusion of P increases the redness (a*) and of OP the yellowness (b*) of meat. Sensory acceptance of meat was not affected by either refrigeration or dietary treatments.

Keywords: Acid oils; poultry meat; TBA value; colour; sensory acceptance

[P3-13]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130108)
[Romania]

The use of grape pomace in broilers diet enriched in polyunsaturated fatty acids

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The polyunsaturated fatty acids (PUFA) Ω -3 composition of the meat is an important quality parameter, especially with regard to the possible impact on human health following the chicken meat consumption. The problem of diet supplementing with oilseed raw materials, in order to improve the meat nutritional value, is that fats are a suitable environment for feeds rancid. Also, this leads to the meat quality deterioration, so it is necessary to use an antioxidant in diet. The aim of this study was to assess the effects of a natural antioxidant inclusion in broilers diet enriched in PUFA. The 4-weeks feeding trial (14-42 days) was conducted on 200, Cobb 500 broilers, assigned to 5 groups (C, E1, E2, E3, E4) and reared in floor pens. The structure of the diet for all 5 groups was enriched in polyunsaturated fatty acids (59.65 g/100 g total FAME) by including 4% flax meal. Compared to the control formulation, the experimental formulation included 2 varieties of grape pomace (GP) as natural antioxidant: 3% (E1) and 6% (E2) white grape pomace; 3% (E3) and 6% (E4) red grape pomace. The white grape pomace (WGP) was characterized by a resveratrol content of 1.99 mg/100 g DM and an antioxidant capacity of 393.99 mmol ascorbic acid equivalent/g DM. The red grape pomace (RGP) had a resveratrol content of 2.25 mg/100 g DM and the antioxidant capacity of 346.36 mmol ascorbic acid equivalent/g DM. The obtained results highlighted an improvement in the quality of the thigh meat samples, compared to C group, relevant to the increase of the eicosapentaenoic acid content (EPA) in the groups with 3% WGP, 3% and 6% RGP, respectively an increase by 4.71% in total PUFA content in the 3% RGP group. Regarding the breast meat samples, a higher EPA content was determined in the 3% WGP group, while in the 3% RGP group increased both the docosahexaenoic acid (DHA) and the total PUFA content by 8.26% compared to C group. It can be concluded that the new feed solutions studied led to the improvement of the polyunsaturated fatty acids profile due to the inclusion of the flax meal in diets and grape pomace, which in addition to slowing down the lipidic oxidation process, shows protective activity *in vivo*, which leads to increased quality of chicken meat.

Keywords: broiler, fatty acids, grape pomace, meat

Effects of breed, gender, and slaughtering age on fatty acid profile of breast and thigh meat of two Italian slow-growing chicken breeds

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The present work aimed to evaluate the effects of breed, sex and their interaction on fatty acid (FA) profile of breast and thigh meat of two local Italian chicken breeds. 320 chicks of both sexes belonging to Bianca di Saluzzo (BS) and Bionda Piemontese (BP) breeds were chosen and homogeneously distributed in 16 pens with outdoor access (20 birds/pen; 4 pens/sex/breed) from 42 until 240 days of age. All the chicks were fed the same commercial feed (ME 11.8 MJ/kg; CP 14.2%). At 5, 6, 7 and 8 months of age, 48 birds (6 males and 6 females for each slaughter age) belonging to each breed were individually identified and slaughtered at a commercial abattoir. Samples of right part of breast and thigh meat were freeze dried and used for the analysis of FAs. A General Linear Model (GLM) has been performed for FA content, using breed, gender and slaughtering age as main effects. Tukey multiple comparisons have been performed after the GLM procedure for slaughtering time. Significant differences are considered at $P < 0.05$. In breast meat, breed showed a significant effect on saturated FA (SFA), monounsaturated FA (MUFA), polyunsaturated FA (PUFA) contents, $\sum n-3$ FA, $\sum n-6$ FA and PUFA/SFA ratio at the fourth slaughtering age ($P < 0.05$). Gender influenced MUFA, PUFA, $\sum n-3$, $\sum n-6$ FA, $\sum n-6/\sum n-3$ and PUFA/SFA ratios mainly at first, third and fourth slaughtering ages. However, the FA profile was influenced by the slaughter age with higher content of MUFA in BS males at 7 and 8 months of age. PUFA contents and PUFA/SFA ratio were higher in both BS males and females at 5 and 8 months of age. Slaughter age did not affect the FA profile of BP males, except for $\sum n-3$ content. With regard to thigh meat, all the FA profile is mainly influenced by gender ($P < 0.05$). BP male presented low SFA and higher MUFA contents at 5 and 6 months of age. On the contrary, BS male have higher MUFA content in thigh meat at 6, 7 and 8 months of age, respectively. PUFA, $\sum n-6$ FA and PUFA/SFA ratio were higher in the thigh meat of BS males and females at 5 and 8 months of age. The results of this study showed that breed, gender and slaughter age affected the FA profile of breast and thigh meat of investigated chicken breeds. The experimental results observed for several valuable meat characteristics might be exploited for the improvement of these Italian pure breeds.

Keywords: Bianca di Saluzzo; Bionda Piemontese; Breed; sex; age; fatty acid

[P3-15]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130216)
[Greece]

Antioxidant status, growth performance and meat quality in chickens raised under conventional and alternative commercial production systems

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Consumers' increasing demand for chicken meat has led industries to intensive rearing systems, which are related to several stressors for the birds. Fast-growing chickens often present health problems and poor performance, resulting in lower nutritional value products. Moreover, increasing awareness on animal welfare leads the poultry industry to alternative rearing systems, using slow-growing breeds and plant extracts as health and growth promoters. This study investigates the antioxidant status, growth performance and meat quality of three commercial production systems. System 1: 45.000 conventional (C) chicken (Ross 308, stocking density: 15 birds/m²), system 2: 6.000 free-range (FR) (Sasso, stocking density: 13 birds/m² and 1 bird/m² of forage paddock), system 3: 3.000 free-range chickens fed with plant extracts (FRP) (Sasso, stocking density: 13 birds/m² and 1 bird/m² of forage paddock). Special diets were designed for each system, age period and genotype. Antioxidant status was evaluated by total antioxidant capacity (TAC) and Thiobarbituric Acid Reactive Substances (TBARS) assays in plasma and muscle tissue, while the concentration of α -tocopherol was measured in plasma. Performance was assessed by recording the mortality, body weight (BW) and Feed Conversion Ratio (FCR). Standard protocols were used for the meat chemical analysis. Organoleptic properties were estimated by 8 testers in roasted thighs. Results in C vs FR chickens have shown that FR chickens presented lower lipid peroxidation ($p < 0,05$) and TAC ($p < 0,05$), whereas α -tocopherol levels didn't present significant difference ($p > 0,05$). Growth performance showed that FR chickens displayed higher FCR, lower mortality and BW. The chemical analysis resulted in higher protein and lower fat content, moisture and water holding capacity (WHC) for the FR group. Ash and pH were similar for the two groups. Moreover, organoleptic evaluation was overall better in the FR chickens. Results in FR vs FRP chickens revealed that the FRP group presented higher TBARS ($p < 0,05$) but increased TAC in plasma ($p < 0,05$), while in muscle tissue, both TBARS and TAC had no significant difference ($p > 0,05$). Also, α -tocopherol levels presented no significant difference between the groups ($p > 0,05$). Growth performance and chemical analysis showed that the FRP group presented higher FCR, mortality, and BW, higher protein content, while the fat content, moisture, ash, pH, and WHC were similar for both groups. Organoleptic characteristics were slightly better for the FRP group. Concluding, this research presents that the free-range system improves growth performance, enhances meat quality, and provides better organoleptic characteristics. In addition, plant extracts in FR chickens may enhance their health, performance, and meat quality.

Keywords: industrial production; oxidative stress; meat quality; plant extracts; fast-growing chickens; slow-growing chickens

[P3-16]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130236)
[Italy]

Influence of feed with high level insect meal inclusion on broiler meat quality

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Insect meal feed, for broilers, turns out to be an alternative and sustainable protein source, particularly to reduce soybean proteins. The aim of this work was to evaluate the effect of two different inclusions of black soldier fly (BSF, *Hermetia illucens*) meal in poultry meat quality. Ninety commercial broilers were divided in three groups: Control (C) fed conventional diet with soybean as protein feed; I50 with 50% soy replaced by BSF and I100 with 100% of soy replacement. Animals were slaughtered at 75 days of age. Liveweight, carcass weight, physical-chemical characteristics and fatty acid profile of thigh meat were determined. Data showed a significant difference among C and both the experimental groups as for live weight (3887g vs 3665g respectively for C vs I50 and I100 on average). Regarding carcass weight we found no differences between C and I50 groups, but I100 group showed a lower value than the other two groups (2959.7 vs 3152.5 g, respectively, for I100 vs C and I50 on average). Physical and chemical composition did not differ among treatments. As for fatty acids composition, our data showed a significant increase of saturated fatty acids (SFA) at both BSF inclusion levels when compared to control group ($p < 0.001$). In particular C12:0, with highest value in I100; I50 contain a higher amount of monounsaturated fatty acid (MUFA) when compared to I100 ($p < 0.054$) and ranked intermediate for PUFA, n6 fatty acids and n3 fatty acids ($p < 0.001$). C group showed the best values for PUFA, n3 and n6 fatty acids ($p < 0.001$). According to our study the 50% inclusion should be preferred for its lower impact on meat quality, in particular for the lower contribution in SFA than I100.

Keywords: black soldier fly; fatty acid; broiler meat quality

Effect of feeding synthetic carotenoid on immunity and shank color in broiler breeders**Prabakar Govindasamy¹, Gopi Marappan², Jaydip Jaywant Rokade², Gautham Kolluri², Jagbir Singh Tyagi², Jag Mohan²**¹Division of Avian Physiology and Reproduction, Bareilly - 243 122, ²ICAR-Central Avian Research Institute, Bareilly - 243122*Corresponding author: prabavet@gmail.com*

A biological experiment was carried out to assess the effect of carotenoids supplementation on body weight change, immune response (cellular and humoral) and pigmentation (yolk and skin) in broiler breeders during hot-dry season (Temp: 42°C; RH: 48%). Broiler breeders (N=72) of 30 weeks old were allocated to three groups (n=24) with three replicates each consisting of 8 birds. The groups are control and two levels of combination of two synthetic carotenoids (Canthaxanthine and Apocarotenoid) supplemented each at 6 and 12 mg/kg feed. The feeding experiment was carried out for a period of 12 weeks. Blood (n=9) was collected three times at weekly interval and serum was separated to assess the humoral immune response against Newcastle disease virus vaccination at 8 weeks of feeding. The cellular immune response was evaluated at 10 weeks of feeding using 0.1ml intra-dermal injection of Phytohaemagglutinin-P@500µg/ml at interdigital spaces. The yolk and shank colour were evaluated in all the birds at four weeks interval using DSM yolk and broiler skin colour fan. No change in body weight of the breeders were observed due to the supplementation. The cell mediated immunity was significantly higher in birds supplemented with 12 mg/kg group followed by 6 mg and control group. The carotenoids supplementation (@6 and 12mg/kg) exhibited higher ($P < 0.05$) serum antibody titre levels than the control. The yolk colour was significantly ($P < 0.05$) improved in 12 mg/kg group followed by 6 mg/kg and control group. Shank colour was higher ($P < 0.05$) in 12 mg/kg fed group when compared to other groups (6 mg and control). In conclusion, the supplementation of combination of synthetic carotenoids at 12 mg/kg each improved the immune response and pigmentation in broiler breeders.

Keywords: Broiler breeder; Carotenoid; Immunity; Shank colour; Yolk colour

[P3-18]: POSTER SESSION 3: HOUSING, MANAGEMENT AND QUALITY OF PRODUCTS (ID: 130184)
[Italy]

Antimicrobial resistance associated genes and mutations in *E. coli* from Italian antibiotic free broiler carcasses

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Improvements in farm biosecurity, animal health management and training, among other strategies, lead to a significant decrease in the use of antimicrobial agents in the Italian broiler sector. The evaluation of the impact of these strategies on the occurrence of antimicrobial resistance (AMR) associated genes and mutations is crucial to assess the efficacy of these strategies in controlling the emergence and spread of AMR to humans through the food chain. In the present study, the occurrence of AMR genes and mutations was evaluated in commensal *Escherichia coli* isolated from carcasses of broilers reared in three antibiotic-free (AB-free) farms in Italy in 2019. Newly sequenced genomes were compared to public genomes of *E. coli* collected in the Italian broiler food chain in previous years. The genetic relationships and resistomes of genomes were assessed by in silico MLST, SNP calling and BLASTn search of AMR gene sequences and mutations. According to SNP calling, genomes were gathered in three clades. Regarding AMR genes and mutations, a statistically significant lower occurrence was observed in newly sequenced genomes in comparison to public genomes in relation to the entire group of AMR genes/mutations identified as well as to sub-groups corresponding to specific antimicrobial classes. Although genes related to resistance to antimicrobial agents of the highest priority were detected in AB-free commensal *E. coli*, this study represents a preliminary observation on the impact of a more rational use of antimicrobial agents on the occurrence of AMR genes and mutations in Italian broiler production chain. Monitoring of AMR genes and mutations on a higher number of genomes should be performed to confirm this first indication.

Keywords: *Escherichia coli*, antimicrobial resistance, AB free, broiler carcasses

Effect of the genetic hen line on fatty-acid composition of egg yolk

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Most of the autochthonous breeds of hens are endangered due to their replacement by more productive selected lines. This is the case for the ‘Valenciana de Chulilla’ (VC) hen, which is the only autochthonous hen breed in the Valencian Community. The maintenance of these local breeds is mostly based in the ex situ preservation (by creating sperm banks or banks of gonads) or the in situ preservation of small populations of live animals. But the long-term preservation of live populations only succeeds if their products are consumed. However, little is known about the characteristics that present the products of these local breeds. In a previous study we observed that the eggs produced by the VC hens presented less albumen but larger percentage of egg yolk than the eggs from Lohmann Brown (LB) laying hens (Mocé et al., 2019). The aim of this study was to compare the egg yolk composition (percentages of saturated and unsaturated fatty acids and of ω -3 and ω -6 fatty acids) between a commercial breed (LB) and the local VC breed. For the study, 79 VC hens and 32 LB hens were used. All of them were fed a commercial feed for laying hens based on maize and soybean meal from the same commercial batch, containing 18.2% protein, 0.98% lysine and 0.4% methionine. Hens were organized in groups of 4 hens/cage in the case of LB and from 2 to 5 hens/cage in the case of VC giving a total of 8 and 17 replicates, respectively. Egg yolks from two eggs per cage (or family lot) were obtained and processed (16 from LB and 34 from VC). These yolks were lyophilized, and the fatty acid profiles analyzed by HPLC. The data were analyzed using GLM procedure including the genetic line as fixed effect. The percentages of saturated ($65.6\% \pm 0.29$ for VC and $65.0\% \pm 0.42$ for LB) and unsaturated fatty acids ($34.4\% \pm 0.29$ for VC and $35.0\% \pm 0.42$ for LB) were similar ($P > 0.05$) for both lines. However, yolks from the LB hens presented higher ($P < 0.05$) percentages of ω -3 ($2.39\% \pm 0.089$) and ω -6 fatty acids ($20.0\% \pm 0.67$) than the yolks from the VC hens ($1.83\% \pm 0.061$ and $15.7\% \pm 0.46$ for ω -3 and ω -6 fatty acids, respectively). In conclusion, although the percentage of saturated and unsaturated fatty acids is similar between lines, the yolks from the LB laying hens exhibited higher percentages of ω -3 and ω -6 fatty acids than the yolks from the VC breed. More studies should be conducted to determine the implications of these differences on egg quality. Acknowledgments: supported by INIA (RZP 2017-00004) and RTC-2015-3265-5 and co-financed by FEDER funds.

Keywords: fatty acid profile; egg yolk composition; autochthonous breed; valenciana de Chulilla hen

Characterization of eggs from Italian chicken breeds: preliminary bromatological results.

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This study was performed to evaluate the chemical composition of eggs from fourteen local breeds preserved at poultry conservation centers from seven Italian Universities involved in poultry conservation projects. The considered Italian breeds are: Ancona, Bianca di Saluzzo, Bionda Piemontese, Ermellinata di Rovigo, Livorno, Mericanel della Brianza, Mugellese, Padovana, Pepoi, Polverara, Robusta Lionata, Robusta Maculata, Siciliana and Valdarnese. The evaluated eggs were twenty-five per breed, laid in mid-May, from hens at the first reproductive cycle, coetaneous and fed the same basal diet for local layers. Lyophilized yolks (n=350) and albumens (n=350) were analysed for crude protein (CP), ether extract (EE; only yolk) and ash. All data were submitted to one-way ANOVA for statistical comparison of means. Significant differences ($p < 0.01$) between breeds were observed for all parameters. The highest yolk CP was observed in the light-size Ancona breed compared with the Veneto breeds (Ermellinata di Rovigo, Padovana, Pepoi, Polverara, Robusta Lionata, Robusta Maculata) and two Tuscany breeds (Mugellese e Valdarnese). The two Veneto heaviest-size breeds (Robusta Lionata and Robusta Maculata) produced yolks with the least protein content, but the highest EE. The egg white protein ranged between 85.6% and 83.7% on dry matter basis; Pepoi showed the highest value, and a statistical difference was observed with the Valdarnese, Padovana and Mugellese (respectively 83.9%, 83.8% and 83.7%). The present study evidenced the need to characterize products from local populations thus, to discover their productive potentials and economic interests for promoting their use. And consequently, for sustaining their conservation since local breeds are determinant genetic sources in the preservation of global biodiversity.

Keywords: local breed; yolk; albumen; chemical composition; dry matter; protein; ash; fat

Epidemiology of non-Typhoidic Salmonella infections in Algeria

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In Algeria and in developing countries, NTS is one of the main causes of salmonellosis in both humans and animals intended for human consumption, especially poultry. The increase of antimicrobial resistance is a major health concern, seriously limiting the control of invasive salmonellosis. Epidemiological surveillance systems and Salmonella infection surveillance programs are essential conditions for providing useful data for the effective detection and control of Salmonella outbreaks. Despite a paucity of available data, Salmonella infections are clearly an emerging problem in several North-African countries, and foodborne Salmonella outbreaks are also commonly observed in Algeria. This study showed controversial results from one region to another and according to rearing systems. We have noted a higher prevalence in slaughterhouses than that observed from the one in broiler buildings. This work also provides a perspective on NTS infections, pathogenesis and antimicrobial resistance with a focus on the epidemiology of salmonellosis in Algeria. In this work we provide genotypic and antimicrobial susceptibility baseline data of all the studies on salmonellosis performed in Algeria and give an approach on the main serotypes, antibiotic type profile, and virulence genes which are in circulation in the country.

Keywords: Keywords: Algeria; Epidemiology; multi-drug resistant; NTS

[P4-01]: POSTER SESSION 4: POULTRY HEALTH (ID: 130181)
[Ecuador]

Detection of antibodies against hemorrhagic enteritis of turkeys in serum samples collected on farms in Ecuador.

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The Hemorrhagic Enteritis is an acute viral disease, presented in young turkeys worldwide, whose etiologic agent is the Avian Adenovirus group II. This disease is characterized by depression, bloody stools, and high mortality. The main objective of this work was to investigate if this virus is present among the turkey's farms in the country through antibodies detection. The disease is not reported, and the vaccination is not allowed in the country. The ELISA indirect test was used for antibodies detection in serum samples. Three hundred sixty turkeys were sampled and divided into four different groups of age (1 day, 35 days, 45 days and 70 days). Each group had ninety turkeys each. The serological results in turkeys at 1 day reported a geometric mean titer (GMT) of 8089.21, coefficient of variation (CV) of 6.5%, in turkeys of 35 days showed a GMT of 6.77, and 106.8% CV, in turkeys of 49 days of age detected a GMT of 5.13 and 96% of CV, in turkeys of 70 days identified a GMT of 4876.76 and 22.5% of CV. Any clinical symptoms were reobserved during the rearing and fattening period. This work identifies an active immunological response. A high dynamic since transmission of titers of antibodies is witnessed, from the turkey breeder to the progeny, these maternal antibodies offer protection until 35 and 49 days of life. Following the normal antibodies catabolism. At age of 70 days, it was observed in all serum sampled a high antibodies activity, becoming seropositive without clinical signs. This result showed a viral challenge coming from the environment, litter, and the rear house. The titers of antibodies observed at this stage can be explained as some other researchers published, the responsible of this immunological activation is an apathogenic virus strain which does not produce clinical signs.

Keywords: Turkeys; Hemorrhagic enteritis; Avian adenovirus group II; ELISA indirect ; Titers of antibodies.

Evaluation efficacy of MEFLUVAC-H5 against early challenge by HPAI-H5N1**Wael Elfeil⁴, Mohamed Rady¹, Walid Kilany^{1,3}, Ahmed Sedeik¹, Magdy Elkady², Magdy Elsayed^{3,5}**

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The highly pathogenic Avian Influenza (HPAI) virus belonging to subtype H5 assumed endemicity in Egypt since its first appearance in 2006, causing severe economic losses since then. The Egyptian government applied the vaccination strategy to control the disease, but all available vaccines either inactivated, subunit or recombinant vaccines provide full protection after 4-weeks from application. The broiler breeders in Egypt use four-dose regime vaccines for HPAI-H5 which yield broiler chicks with high maternal derived antibodies which interfere with the early vaccination. The aim of this work was to evaluate the protection efficacy of a commercial inactivated oil emulsion H5 vaccine in different vaccination regime either as single vaccine dose at 7-day of age, two-dose vaccination at 1 and 10-day of age (prime-boost) or one and half dose at 7-day of age against early challenge at 27-day of age with HPAI-H5N1 clade 2.2.1.2 virus. The chicks obtained from commercial hatchery and 40 one-day old chicks moved to Biosafety level-3 isolators (BSL-3) at MEVAC facility to serve as control non-vaccinated group (G-4) and non-vaccinated non challenge group (G-5) and three commercial broiler station served as field groups with 65,000 commercial bird in each station (G1-3). Blood samples, cloacal swabs and oropharyngeal swabs were collected weekly. Humoral immune response and exposure to any life-threatening Respiratory virus (Avian influenza” AIV”, Newcastle disease “NDV” and infectious Bronchitis “IB” virus) were monitored. At 25-day of age 20 birds from each station (G1-3) moved to BSL-3 and were kept under observation for 36 hours. Cloacal and oropharyngeal swabs were collected three times with 12 hours interval to ensure that the birds were free from any live threatening viral respiratory pathogen (AIV, NDV, IB). The birds in G1-4 were challenged with HPAI-H5N1 clade 2.2.1.2 (106 EID50) in 0.5 ml/ bird PSB via intranasal route and birds in G-5 received 0.5 ml PBS via intranasal route. Birds in G1-5 kept in BSL-3 for 14 days under observation and oropharyngeal swabs collected on 3,6,9 days post challenge (dpc). The birds showed protection against mortality level as 91.7% (11/12), 83.7% (10/12), 75% (9/12), 0% (0/12) and 100% (12/12) in groups 1-5 respectively. Virus shedding in G-1 was significantly lower in comparison to G2/3. In conclusion, using homologous H5 inactivated vaccine in two-dose regime can provide protection to commercial broiler chicken against early challenge with HPAI-H5 virus as early as 26 day of age with significant lower shedding rate and the application of such vaccination strategy can be an effective tool to control HPAI.

Keywords: H5; HPAI; Vaccine; Broiler

[P4-03]: POSTER SESSION 4: POULTRY HEALTH (ID: 130016)
[Tunisia]

Marek's disease in free-range poultry: gross pathology and histopathological investigations

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The pathological study of 33 backyard chickens issued from different farms located in the region of « Grand Tunis », demonstrated that Marek's disease was suspected in both young birds (≤ 24 weeks, 17 animals) and adult birds (> 24 weeks, 16 animals) and in both sexes. Clinically, three main forms were distinguished: the visceral form (14 birds), the mixed form (13 birds) and the nervous form (6 birds). Gross pathology study revealed two types of lesions: tumoral and hypertrophic. Tumors are more present on the liver (57% in the visceral form and 31% in the mixed form) and the lungs (57% in the visceral form and 23% in the mixed form). While the hypertrophy lesions, mainly described in the liver (14% in the visceral form and 31% in the mixed form) and the spleen (64% in the visceral form and 23% in the mixed form). Histopathological analysis showed that specific lesions of Marek's disease were detected in 18 birds (69% of cases) among 26 animals, with a polymorphic lymphoplasmocytic infiltrate in the peripheral nerves and viscera. Nervous lesions were mostly discrete, classified as type C. However, visceral lesions appeared very severe (+++).

Keywords: Free-range chicken; Marek's Disease Histology; Lymphoplasmocytic infiltration; Tunisia

[P4-04]: POSTER SESSION 4: POULTRY HEALTH (ID: 130136)
[Egypt]

A Novel recombinant Herpes virus of turkey expressing F- gene of Newcastle disease (rHVT-F) reduces velogenic genotype VII Newcastle disease virus shedding following challenge in commercial broilers

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Newcastle disease (ND) is a highly contagious notifiable viral disease infecting domestic poultry causing devastating economic losses. In Egypt, the disease is endemic since recent outbreaks from ND infection were detected in poultry farms across the country and, thus, continues to hinder the profitability of poultry industry. As widely accepted, vaccination is a key component of global ND controlling strategy in poultry through increasing resistance of vaccinated chickens to ND infection and reducing the ND virus shedding into the environment. The present study was conducted to survey the prevalence of ND in Egyptian poultry farms and to evaluate the efficacy of various ND vaccines in controlling velogenic ND genotype VIIId viral shedding. Samples collected from problematic broiler flocks have shown prevalence rate of ND of 32% by viral isolation on SPF eggs and further identification by hemagglutination and RT-PCR. A total of 120-day-old commercial chickens were divided into 12 groups and received different ND vaccination programs (ND vector and homologous and heterologous live and inactivated ND vaccines) while 2 groups served as positive and negative controls. Challenge with velogenic ND genotype VIIId was done at 28 days of age using 106 EID₅₀ at 100 µl per bird and chickens were monitored for 10 days later. Monitoring serological responses and tracheal shedding of the challenge virus at 3-, 6- and 9-days post-infection were done in triplicates. The obtained results have shown that rHVT-F vector vaccine-vaccinated group has shown better clinical protection, HI humoral immune responses and significantly reduced the challenge virus shedding as compared to other groups vaccinated with live, inactivated and other competitor ND vector vaccines.

Keywords: Newcastle disease; vaccines; shedding

[P4-05]: POSTER SESSION 4: POULTRY HEALTH (ID: 130170)
[Spain]

Safety of an immune complex vaccine against infectious bursal disease when applied subcutaneously in slow-growing broiler type chickens under field conditions

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Slow-growing broilers are generally considered to be more susceptible to immune complex (ICX) vaccines against IBDV than conventional broilers. It is even suspected that these vaccines could increase mortality and affect growth performance. GUMBOHATCH® is a new immune complex vaccine against IBD in which the virus particles are entirely coated with IgY of egg origin. Susceptibility was not observed previously when GUMBOHATCH® was tested under experimental conditions. The objective of this study was to further test the safety of the above-mentioned vaccine when applied subcutaneously in slow-growing chickens under field conditions. Two flocks of day-old Redbro chickens were vaccinated subcutaneously with either GUMBOHATCH® (Laboratorios HIPRA S.A., Spain) (n=7900) or a commercially available recombinant vaccine against IBD (n=8670). The animals were allocated to separate houses and managed under similar conditions. Mortality, antibody response against IBDV and growth performance were monitored up to 70 days; additionally, the bursa of Fabricius was inspected weekly between 21 and 49 days. The chickens studied were also vaccinated against infectious bronchitis, as usual on the farm. The antibody immunity against IB was evaluated to determine whether the vaccination against IBDV interfered with its production. As expected, the vaccines tested produced an antibody response against IBDV despite the presence of maternally derived antibodies, confirming their correct application and probable action. The two flocks did not show differences in term of growth performance or mortality. A slight atrophy of the bursa of Fabricius was observed in one of the flocks, although this is a common finding in broilers vaccinated with live attenuated vaccines against IBD. Despite this, the antibody response against IB was higher in the flock vaccinated with the new ICX vaccine compared to the other flock. Therefore, it was confirmed that GUMBOHATCH® does not jeopardize the health and the productive performance of slow-growing broilers and thus that it is suitable for application in chickens regardless of the growing profile.

Keywords: "IBD" "immune complex" "slow-growing broilers" "recombinant"

Findings of reassortant IBDV strains of genogroup A3B1 in commercial broiler flocks in Germany

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A total of 20 commercial German broiler farms including 85 houses have been tested for IBDV presence in the bursa of Fabricius from February until October 2021. Flocks were vaccinated against IBDV via drinking water between 14 to 18 days of age with commercial live IBDV vaccines. 65 % of the vaccination programs consisted of an intermediate IBDV vaccine and, 35 % of an intermediate plus IBDV vaccine. Farms were randomly selected by the responsible field veterinarians. 5 bursas per flock were sampled at average 35 days of age and analysed as a pool by IBDV RT-PCR following sequencing. The results showed that 22 % were positive for vvIBDV. Segment A encoding for viral VP2 clustered within a very virulent genogroup A3 according to Islam et al. (2021). Segment B encoding for viral VP1 clustered within a classical-like genogroup B1. The data revealed the spread of reassortant IBDV strains of genogroup A3B1 in commercial broiler farms in Germany. Reassortant strains are probably linked to bad performance, immunosuppression and subclinical disease (Mato et al., 2020). Performance data were out of scope of this survey. Correlation between the respective vaccination program (intermediate or intermediate plus IBDV vaccine) with the lab result, showed that with usage of an intermediate vaccine, 11 % of the samples were negative and in 6 % the reassortant IBDV field strain was found. In case that an intermediate plus vaccine was applied, in only 52 % the vaccine was found, 10 % were negative and in 35 % the reassortant IBDV field strain was isolated. These data suggest that current vaccination programs fail to control infections with reassortant IBDV strains in German commercial broiler flocks. Vaccination failure can be due to many reasons, like improper vaccination age, inaccurate drinking water vaccination technique or earlier breakthrough of maternal antibodies by the reassortant strains compared to the vaccines. Further studies are needed to elucidate the role of this new IBDV reassortant strain especially with regard to clinical and economic impact and current vaccination programs need to be improved as well, in order to control the situation in the near future.

Keywords: IBDV reassortant; drinking water vaccination; bursa colonization; Germany.

Comparison between an immune complex and an r-HVT vaccination program for IBD in one rearing layers farm in Italy.

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The objective of this study was to compare at field level two different vaccination programs for IBD in layers to evaluate their efficacy in the control of Gumboro disease situation in Italy. Two different houses of the same rearing layer farm in Italy were investigated in one trial. Group A received an immune-complex vaccine specifically designed for layers (Novamune®, CEVA), while Group B received an r-HVT vaccine expressing the VP2 antigen for IBD protection. Both groups were vaccinated at day old. ELISA test for IBD was performed on both groups at: day 1, and at 3, 4, 5 and 6 weeks of age. RT-qPCR for IBDV was performed on Bursa pools at 4 weeks of age and on individual Bursas collected at 5 and 6 weeks of age in both groups. Molecular biology evidenced the presence of the vaccine strain SYZA26 in all the Novamune® group samples. In contrast, in the r-HVT-IBD vaccinated birds, all bursas were positive for vvIBDV strain. At sampling, size and macroscopic Bursa appearance was homogenous in the Novamune® group, while they were not homogenous in the r-HVT-IBD group. Regarding serology results, at 5 weeks of age, ELISA titers showed GMT equal to 6827 for Immune-complex group and 7134 for r-HVT-IBD group. At the same time, titers were less homogenous (CV: 35%) and with higher values in the r-HVT-IBD vaccinated birds compared to the Novamune® group (CV: 22%). Layers vaccinated with the immune-complex vaccine showed optimum vaccine take. Vaccine strain SYZA26 actively replicated in their Bursa, preventing their colonization by others vvIBDV strain circulating in this farm through a mechanism exclusion. On the contrary, house vaccinated with the r-HVT-IBD vaccine was susceptible to Bursa colonization by the field strain and the higher titers detected in ELISA for Gumboro could also be indicators of a sub-clinical form of the disease.

Keywords: vvIBDV , RT-qPCR, Bursa colonization, immune-complex, Syza 26

[P4-08]: POSTER SESSION 4: POULTRY HEALTH (ID: 130245)
[France]

Monitoring of a Salmonella live-attenuated vaccine excretion during the rearing and laying periods in broiler breeders.

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Salmonella is one of the zoonotic pathogens responsible for foodborne disease outbreaks, with poultry products being the main source of infection. Most of the outbreaks were caused by Salmonella Enteritidis, with an increase of 36.3% since 2017 (EFSA, 2021). Vaccination is an efficient solution to lower Salmonella infections in poultry operations together with good biosecurity measures and rodent control (Dorea et al., 2010). Both killed and live attenuated Salmonella vaccines are available on the market. Cevac® Salmovac is a live Salmonella Enteritidis vaccine licensed for layers and broiler breeders that has to be administered 3 times during the rearing of the pullets to induce active immunisation of chickens to reduce colonisation, persistence and invasion of the intestinal tract and internal organs by Salmonella Enteritidis and Salmonella Typhimurium. The aim of this study was to monitor the excretion of Cevac® Salmovac throughout the rearing and laying cycle of 2 broiler breeders flocks. The broiler breeder pullets were reared in similar houses and then transferred to the same layer farm for the production period. Three doses of the Cevac® Salmovac were administered in weeks 2, 6 and 10 of age by drinking water. Environmental boot swabs were collected weekly during the rearing period, in addition 4 more sampling collections were performed at 27, 29, 37 and 45 weeks of age. A total of 206 boot swab samples were taken from two identical houses holding in the same farm, from March 2021 to February 2022. All samples were analyzed according to the ISO 6579:2017, and for the differentiation of vaccine and field strain the kit Kylt DIVA 1 (PCR Anicon) was used. Results from the study showed that until week 11, 100% of samples were positive for Salmonella Enteritidis vaccine strain. Thereafter, a significant decrease was observed until week 21 which was the age for transfer the hens to the laying farm, where virtually no vaccine was detected until the end of the study. During the laying period all samples were negative for vaccine and field strain detection. This study demonstrated a good replication of the vaccine strain after the 3 vaccine applications and the clearance from environmental samples before transfer into production. During the laying period the hens did not longer excrete the vaccine strain.

Keywords: Salmonella; monitoring; vaccination, broiler breeder; live-attenuated vaccine

[P4-09]: POSTER SESSION 4: POULTRY HEALTH (ID: 130172)
[Spain]

Assessment of the blue dye in the *Salmonella* vaccine concentration

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Salmonella is one of the main pathogens involved in gastrointestinal diseases in Europe and most industrialized countries, being undercooked poultry products the main source of infection. Thus, prophylactic measures are taken at field level to reduce the *Salmonella* prevalence, like vaccination. Standard practices at field level sometimes involve the application of the vaccine together with a dye to assess vaccine intake. However, little is known of the impact of the dye on the effectiveness of the vaccine at different times and concentrations. In this context, the objective of this study was to in vitro assess the effect of adding Cevamune® dye to a *Salmonella* vaccine solution (CEVAC® Salmovac) at different concentrations (1 tablet in 1 L or 1 tablet in 100 L) and times (2h, 4h and 24h) to ensure non-interference of the dye on the *Salmonella* vaccine solution. To this end, three experimental groups were assessed using different dye concentrations (1 control group and 2 treatment groups). In all the experimental groups the vaccine was diluted in the water simulating field conditions to give a final concentration of 1 and 8×10⁸ Colony Forming Units (CFU). All groups were stored with shaking at room temperature for 24h (65 rpm). Samples from each experimental treatment were taken at 2h, 4h and 24h for *Salmonella* enumeration. The results of this study showed no statistically significant differences regardless of the treatment group and sampling period analysis ($P>0.05$). All the results obtained in this study were between 1-8 CFU/mL. The conclusions obtained from this study showed that regardless of the concentration used, no differences were observed between the treatments and the control group, showing that Cevac ® Salmovac was stable after 24-hour reconstitution with the Cevamune dye.

Keywords: *Salmonella*; blue dye; *Salmonella* live vaccine; concentration

Safety and efficacy of an attenuated *Salmonella Enteritidis* vaccine applied during laying period in commercial hens

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Salmonellosis caused by *Salmonella Enteritidis* is a widespread zoonosis and poultry products are an important source of infection, that is why vaccination of flocks against most common *Salmonella* serovars was one of the measures implemented in the NCPI. The vaccination of laying hens with live vaccines against *Salmonella Enteritidis* applied in a 3-dose vaccination program during rearing, has been one of the measures implemented that has reduced the prevalence of *Salmonella* in poultry and therefore also the risk of transmission of salmonellosis to humans through the consumption of contaminated eggs. The current trend of extending the production period beyond the 90th week of life led Laboratorios Calier to consider introducing a fourth dose of the live Primun *Salmonella E* vaccine during laying to ensure that the poultry were protected until the end of a lengthy productive period. The application of a 4th dose of the vaccine at 55 weeks of age, under laboratory conditions, demonstrates that hens are protected until the end of an extended laying period by performing a challenge to 40 vaccinated hens at 95 weeks of age and to 30 non-vaccinated hens. The colonisation of challenge strains (tested by culture method) in liver, spleen, caeca, ovary, and oviduct of vaccinated animals (n=20) was reduced in comparison to non-vaccinated (n=20): 54% infected organs versus 74% in control the 1st week, and 28% versus 56% the 2nd week of infection. The rates of *Salmonella Enteritidis* excretion in cloacal swabs were reduced within 2 weeks in vaccinated animals, while hens of control group were still positive the 3rd week after challenge. Regarding safety, 65 vaccinated hens were examined. The parameters that were taken into consideration were the spread and dissemination of vaccine strain (tested by culture method), the effect in egg production and any adverse reaction. Vaccine strain was not isolated from eggs (shell and content) laid from vaccinated hens (25 eggs were examined at days 1,3,5,7,10,14,21 and 28 post infection), from cloacal swabs taken for 3 weeks post challenge and neither from internal organs (5 animals were sacrificed at 1, 7 and 14 days). In addition, no adverse reaction and non-effects in egg production were detected after applying a 4th dose of the vaccine at laying.

Keywords: Live attenuated vaccine, *Salmonella Enteritidis*, 4th dose, protection end of laying, safety

[P4-11]: POSTER SESSION 4: POULTRY HEALTH (ID: 130173)
[Spain]

Antibiotic resistance trends of *Salmonella* spp. in poultry farming (2015-2017)

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Salmonella spp. is one of the most important zoonotic pathogens with an economic impact on public health worldwide. Despite of the fact that the poultry sector meets the EU *Salmonella* prevalence target, several studies have warned about the increase of multiresistant *Salmonella* strains due to the high use of antibiotics in intensive production. This way, since 2014 and 2020 the National Antibiotic Resistance Plan (PRAN) and the REDUCE Program, respectively, has been established in order to reduce and promote the rational use of antibiotics. After the beginning of the antibiotic reduction programs in Spain, the aim of this study was to assess the evolution of antibiotic resistance of *Salmonella* spp. strains in poultry farms isolated from the National *Salmonella* Control Programs (PNCS) throughout the period of 3 years (2015 to 2017). To this end, a total of 332 strains were isolated according to the ISO 6579-1:2017 and the antimicrobial susceptibility was analyzed based on broth microdilution technique method (ISO 20776-1: 2017) with Sensititre™ plates. The results of this study showed high rates of antimicrobial resistance (resistance to at least one family of antibiotics) with an increasing development in broilers, turkeys and layers, being the sulfamethoxazole the antimicrobial that showed the highest percentage of resistance in all the poultry production. Concerning multi-resistance, (resistance to 3 or more families of antibiotics), all production orientations showed a decreasing trend throughout the study, achieving a reduction in multi-resistance in layers up to 0%. Besides, other antibiotics to which *Salmonella* had relevant rates of resistance were ciprofloxacin (44%), tetracyclines (37%), nalidixic acid (33%), ampicillin (30%), gentamicin (27%) and trimethoprim (10%). These results suggest that the reduction in the use of antibiotics begins to be reflected in the reduction of the number of multi-resistances, especially in laying hens where multiresistance was not found in the last period analyzed. However, the level of resistance found suggests that we should continue working on limiting the use of antibiotics at field level to achieve a reduction of *Salmonella* resistant strains.

Keywords: *Salmonella*; Antimicrobial resistance; Poultry; Broth microdilution.

[P4-12]: POSTER SESSION 4: POULTRY HEALTH (ID: 130175)
[Spain]

Antimicrobial resistance from 2019 to 2021 in *Escherichia coli* strains from poultry

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For many years, the antimicrobials have been widely used in human and veterinary medicine, including poultry production. Consequently, the development of antimicrobial resistance has become a worldwide public health concern. One of the main concerns in poultry is the transmission of multi-resistant agents through food, due the products of poultry origin are indicated by the European Food Safety Authority (EFSA) as one of the main sources of contamination of various zoonotic agents in humans. *Escherichia coli* (*E. coli*) strains are commonly found in the intestinal tract of animals and humans; thus, it is used as an indicator bacterium because this microorganism acquires antimicrobial resistance more quickly than other conventional microorganisms. The National Antibiotic Resistance Plan (PRAN) was implemented in Spain during the period 2014 to 2018. Recently this plan has been extended until 2021. Moreover, the poultry sector joined to another National Program called REDUCE in 2020 with the objective to reduce and promote the rational use of antibiotics. Therefore, the aim of our study was to analyse the results obtained from *E. coli* strains isolated between 2019 and the first quarter of 2021 from poultry farms. To this end, 274 strains were recovered, and antimicrobial susceptibility was assessed using the broth microdilution technique against common antibiotics used in veterinary medicine. 100% of strains were resistant to at least one of the antimicrobials tested. Two groups of antibiotics were differentiated with opposite results and trends. The antibiotics with highest average resistance rate were erythromycin (100%), tylosin (98%), penicillin (97%), oxacycline (96%), tiamulin (91%), lincomycin (85%), tilmicosin (82%) and sulfamethoxazole-trimethoprim (66%). Except to the last two antibiotics, the resistance trend remained high or even increased during this period. Regarding the other antibiotics tested (tetracycline (38%), lincospectin (37%), amoxycycline (35%), doxycycline (27%), enrofloxacin (13%), colistin (11%), cefotaxime (9%), ceftiofur (5%), neomycin (5%) and cefpodoxime-proxetil (4%)), the observed rates were lower with a decreasing trend. Our results showed that the implanted reduction strategies seem to be effective in reducing the resistance to some families of antibiotics. However, the persistence of high levels of resistance to some antimicrobials indicates the continuing need for further work on monitoring and the use of alternative therapies and prevention strategies.

Keywords: *Escherichia coli*; Antimicrobial resistance; Antibiotics; Poultry; Microdilution broth

[P4-13]: POSTER SESSION 4: POULTRY HEALTH (ID: 130174)
[Spain]

Prevalence and seroprevalence of *Mycoplasma synoviae* in laying and broiler breeders in Eastern Spain

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Mycoplasma species are worldwide recognised poultry pathogens, being *Mycoplasma synoviae* (*M. synoviae*) the second most important species from the clinical point of view that causes considerable economic losses in the poultry industry. This study aimed to assess the seroprevalence, prevalence and phylogenetic variants of *M. synoviae* present in layers and broiler breeders' farms of *Gallus gallus* species located in eastern Spain. Thus, 19 and 23 flocks of layers and broiler breeders, respectively were analysed at 3 different ages. Sera samples were analysed by the ELISA test to assess the seroprevalence. In addition, tracheal swabs were tested by PCR to assess the prevalence. As a result, a *M. synoviae* seroprevalence of 95% and 74% were detected in layers and broiler breeders, respectively. Regarding age-wise analysis, the positive rates obtained seemed to be higher as the age of the sampling increased. According to PCR results, a prevalence of 95% in layers and 35% in broiler breeders was obtained. The genetic analysis showed that the strains present in broilers breeders were vaccine strains (MS-H strain). In contrast, 7 different strains were detected in layer hens: MS-H, IZSVE/4504, MSK-1, MGS 1342, MGS 543, PASC 8 y WT4. In conclusion, this study showed a higher seroprevalence and prevalence of *M. synoviae* strains in layer flocks regarding broiler breeders, highlighting the usefulness of monitoring flocks to control this poultry pathogen. Moreover, our findings suggest that *M. synoviae* vaccination in broiler breeders could be an effective prevention strategy.

Keywords: *Mycoplasma synoviae*; Prevalence; Seroprevalence; ELISA; PCR.

[P4-14]: POSTER SESSION 4: POULTRY HEALTH (ID: 130131)
[Spain]

Antimicrobial resistance characterization from *Campylobacter* strains isolated from poultry breeders and their progeny in Eastern Spain

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Campylobacteriosis is the most common zoonosis reported in humans in UE since 2005. Last data published by the EFSA, reported 246 571 human cases in Europe. The main source of human infection is poultry meat, especially raw or undercooked chicken. Furthermore, antimicrobial resistance (AMR) has become a major threat for public health worldwide. One of the main factors contributing to the emergence of resistant bacteria has been the massive use of antimicrobials for growth promotion and disease prevention for several years in animal production. Currently, the use of antibiotics in poultry is a controlled practice, however, there is a close association between the antibiotic use in animal production and the apparition of AMR bacteria in humans. Nevertheless, there is a lack of information related to *Campylobacter* AMR dynamics through the entire production system: from breeders to their progeny. In this context, the main objectives of this study were to assess the main AMR rates present in poultry production system, to study the relationship between *Campylobacter* AMR profiles from breeders and their progeny, and to study the presence of antibiotic resistance genes with clinical importance in poultry production. To do so, 65 strains isolated from 4 batches of breeders (PF1, PS2, PS3, PS4), and 12 batches of their progeny (3 per breeder batch: A, B and C) were used. Antimicrobial susceptibility was determined by disc diffusion method and detection of antimicrobial resistance genes was performed by means of four different PCRs. In this study, 100% of *Campylobacter* strains analysed were resistant at least one antibiotic tested. In addition, 80% of the isolates were multidrug resistant. Regarding AMR rates obtained, it is important to highlight that CIP and NAL resistance levels were classified as extremely high for both species, being both of them the first-choice drugs in clinical human treatments. This study, also, demonstrated a relationship between the AMR patterns found from *Campylobacter* strains isolated in breeders and those isolated from their progeny. Thus, further field studies are needed to assess the role of horizontal and vertical transmission on AMR spreading.

Keywords: *Campylobacter*, antimicrobial resistance, poultry, breeders, progeny

In vitro characterization and immunogenicity of chitosan nanoparticles loaded with native and inactivated extracellular proteins from a field strain of *Clostridium perfringens* associated with necrotic enteritis.

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There are currently no licensed vaccines against *Clostridium perfringens* which causes necrotic enteritis in poultry. Chitosan nanoparticles were formulated with native (CN) or toxoids (CT) of extracellular proteins (ECP) of *C. perfringens*, both surface-tagged with *Salmonella* flagellar proteins. In a pH stability assay, CN and CT nanoparticles released 6% and 0% of their protein at 8.0 pH. In a protein release assay, CN and CT nanoparticles released 16% and 10% of their protein respectively at 7.4 pH after 24 hours. CN and CT nanoparticles incubated at 100 µg/ml PBS with Chicken RBCs released 1% and 0% hemoglobin respectively. Ninety broilers were randomly assigned to treatments; sham-vaccinated (Control), CN-vaccinated (CN), and CT-vaccinated (CT). Each bird was orally gavaged with 50µg vaccine in 0.5ml PBS or 0.5ml PBS only on d 0, 3, 7 and 14 of age. At 21 d of age, chickens in the CN group had 34% higher anti-ECP IgA than control ($P < 0.05$). At 21 d of age, the CN and CT group had 107% and 82.4% higher anti-ECP IgA ($P < 0.05$) respectively. At 17 d of age, the CN group had 244% higher anti-flagellar IgG ($P < 0.05$). At 10 d of age, the CN group had 14.3% higher anti-flagellar IgA than control ($P < 0.05$). Splenic T cells from chickens in the CN and CT group stimulated with 0.05 mg/ml ECP, had 26% higher ($P < 0.05$) and 107% higher ($P < 0.01$) proliferation than control respectively. Splenic T cells from chickens in the CN and CT groups stimulated with 0.1 mg/ml ECP had 46% and 63% higher proliferation than control group ($P < 0.05$) respectively. Pooled serum from 17 d of age CN and CT-vaccinated birds neutralized toxins in 50µg of ECP by 40% and 44% ($P < 0.05$) respectively. Pooled serum from 28 d of age CN-vaccinated birds neutralized toxins in 50µg of ECP by 34%. The result from this study indicates the potential for chitosan loaded with *Clostridium perfringens* extracellular proteins to be applied to necrotic enteritis challenge studies.

Keywords: Nanoparticle, vaccine, Necrotic enteritis, *Clostridium*

2019 multi-mycotoxin occurrence in Mediterranean poultry feed including emerging and masked mycotoxins

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Mycotoxins are recognized as a potential hazard in poultry production. Different mycotoxins cause different specific symptoms, modulate the immune system, affect the gut integrity and decrease performance of poultry birds. Feed producers and integrators are testing feeds on selected mycotoxins. Biomin is constantly analyzing raw materials and also feeds for animal production. Annually approximately 20 000 samples are tested with different analytical methods. As corn and soybean meal are the main components in poultry feed worldwide these materials are also mainly analysed. Liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS) is currently the state of the art in mycotoxin analysis. Results provide a complete picture of mycotoxin contamination in different kinds of matrices. Analysis of corn 2019 indicates that the emerging mycotoxin beauvericin is the most prevalent mycotoxin in Mediterranean corn (65%, average 91 ppb) closely followed by fumonisin B1, B2 and B3 (all 61%, average 3038 ppb) and deoxynivalenol (58%, 172 ppb). Also the presence of enniatin B (52%, 7 ppb), zearalenone (45%, 23 ppb) and the masked mycotoxin deoxynivalenol-3-glucoside (39%, 50 ppb), aflatoxin B1 (23%, 5 ppb), alternariol (23%, 10 ppb) is confirmed. Mycotoxins that cause beak lesions in poultry such as HT-2 toxin, T-2 toxin, T-2 triol and DAS were found in 19%, 13%, 10% and 6% (23 ppb, 22 ppb, 44 ppb, 7 ppb) of the samples, respectively. 42% of all analysed samples were contaminated with 5- 9 contaminants per sample and 58% were contaminated with more than 10 mycotoxins. Soy bean meal from exporting countries such as Argentina, Brazil and USA was contaminated with similar mycotoxins, however, at lower levels compared to corn in general. Emerging mycotoxin beauvericin was also the most prevalent mycotoxin in soy bean meal (58% prevalence, 19 ppb average contamination) followed by zearalenone (47%, 32 ppb), enniatin B (44%, 13 ppb), fumonisin B1 (22%, 195 ppb), deoxynivalenol (19%, 86 ppb), sterigmatocystin (14%, 1ppb) and aflatoxin (11%, 9 ppb) among others. 16.7% of the samples contained between 1-4 mycotoxins, 50% 5 -9 mycotoxins and 33.3% contained more than 10 mycotoxins. Results indicate that for some mycotoxins – such as aflatoxin in soy bean meal contributes significantly to the total load of mycotoxins in the finished poultry feed. Using LC-MS/MS allows to measure additional mycotoxins in a more accurate way and therefore to better protect the animals against the detrimental effects of mycotoxins.

Keywords: beauvericin, enniatin, deoxynivalenol-3-glucoside, fumonisin, mycotoxin, analysis

[P4-17]: POSTER SESSION 4: POULTRY HEALTH (ID: 130206)
[Spain]

In vitro anticoccidial effects of an organosulfur compound derived from *Allium* extract.

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Avian coccidiosis causes high economic losses to the poultry industry over world. Current treatments with drugs entail high costs and appearance of resistant pathogens and, therefore, alternative anti-coccidian strategies are needed. Among different alternatives, the use Alliaceae extract result highly interesting due to their functional properties. In this study, we analyze the in vitro effects of propyl-propane thiosulfonate (PTSO), an organosulfur compound derived from *Allium* extract on MDBK cells challenged with sporozoites of *Eimeria* spp. To this aim, two different experiments were carried out. In the first experiment, to study the in vitro preventive effect of this compound, MDBK cells were incubated in completed medium (DMEM supplemented with 10% FBS and 1% penicillin-streptomycin) at 37°C, 5% CO₂ and humidity during 24 h at concentrations of 5, 10 and 20 µM of PTSO. Next, a mix of *Eimeria* spp. sporozoites was added to the cells. In the second experiment, sporozoites were previously incubated during 1 h in RPMI-1640 containing 1, 5 and 10 µM of PTSO and after that, sporozoites were added to the cultured cells. In both experiments a negative control (consisting in MDBK cells without any treatment or sporozoites inoculation) and also a positive control (MDBK cells without PTSO and non-pre-treated sporozoites) were included. 72 h after inoculation, MDBK cells were fixed and cell viability was assessed by SRB method, measuring O.D at 450nm by spectrophotometry. The incubation of MDBK cells with PTSO was able to increase cell viability by 23.67 % from 10 µM and 44.17% from 20 µM respect to the positive control indicating a preventive effect of this compound. Moreover, MDBK cells challenged with pre-incubated sporozoites increased viability in a dose dependent way, showing significant differences at 1µM and 5µM respect the negative control and obtaining similar effects to negative control at a concentration of 10 µM. The methodology applied in this protocol can be used as a screening model to study the efficacy of different compounds against *Eimeria* protozoa and indicates that PTSO could be a promising alternative to coccidiosis treatment.

Keywords: *Eimeria*; sporozoites; coccidian; *Allium*; PTSO; MDBK; garlic; onion.

Relation between range use and parasitic infection in Italian organic laying hens

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Organic laying hens have access to outdoor areas that is regarded as a potential source of helminth infections. Helminthic infections with e.g. *Ascaridia galli* (A) have been associated with performance losses. Some studies have found that *A. galli* and *Heterakis* spp (H) are the main species founded in organic and free range systems. The aim of this study was to evaluate: -the relation between parasite eggs in the free-range soil and the intensity of use of the range area in terms of distance to the stable and proportion of chickens using the range area; -the level of individual laying hens, between frequency of use of the range area and faecal egg counts. The study was carried out in 8 Italian organic layer farms (45 to 80 weeks of age), that have had range access >5 months and were not dewormed. Twenty samples were taken per farm: 6 soil samples (5-20-50 m from the pop-holes), 7 mixed manure samples from 70 'outdoor hens' at >50 m from the pope-holes and 7 mixed samples from 70 'indoor hens'. All samples were analyzed for eggs from A/H and *Capillaria* (EPG; McMaster method). Paired samples t-tests and Pearson correlations were performed with IBM SPSS version 25. Manure from outdoor hens had significantly less EPG for A/H compared to manure from indoor hens (47% vs 63%; mean 43 vs 172 P>0.05); EPG for A/H outdoor and indoor were correlated (p=0,37). Soil samples had a high prevalence of *Capillaria* (87%), as well as manure collected indoor and outdoor (33 vs 24). The mean of *Capillaria* eggs were significantly higher in soil then both the outdoor and indoor manure samplings (112,50vs22.22vs12,96; p<0,000). The mean mortality at 60 weeks was 5%, production at 60 weeks and health parameters did not deviate from hybrid standard. The lower presence of A/H both in the soil and in the outdoor manure may indicate a poor use of the farthest location of the range; when investigated on flock level, infection with parasites did not severely impair the performance. Funding: ERA-net Core Organic Cofund FreeBirds

Keywords: Organic laying hens; free range; parasites

Study of the frequency of application of Fluralaner against the poultry red mites in Spain.

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Fluralaner (carbamoyl-benzamide-phenyl-isoxazoline) belongs to a new class of ecto-parasiticides (the isoxazolins). Exzolt® is a solution that contains 10 mg/ml of fluralaner, is an MSD Animal Health veterinary product for the treatment of poultry red mite (*Dermanyssus gallinae*) infestations that helps in the complete and comprehensive control of red mite farms. Exzolt is administered in drinking water, reducing the stress caused by the administration of other treatments such as conventional chemical sprays and powders and minimizing the potential exposure to the people that administered them. Exzolt is easily administered orally with a dosage of 0.5 mg fluralaner/kg of body weight in drinking water applied twice seven days apart. It is rapidly absorbed and reaches the maximum plasma concentration 36 hours after the first dose and 12 hours after the second. The drug has a high bioavailability (~91%), binds strongly to proteins, being widely distributed throughout the body (the highest concentrations are reached in liver and skin / fat), is minimally metabolized, and is eliminated mainly by the hepatic route. Once the drug is ingested by a mite that has been previously fed on a treated hen, fluralaner acts as a potent inhibitor of the arthropod's nervous system. Based on previous experiences, Exzolt allows a rapid and almost complete elimination of mite populations (99%), a situation that can be maintained with adequate biosecurity measures that reinforce the long-term control of mite populations in poultry barns. To test the efficiency of the drug, a total of 526 hen flocks from 295 houses of 105 treated hen farms between October 2017 and January 2021 have been studied. This study analyzes the frequency of the number of treatments performed with Exzolt against the red mite in poultry farms based on different variables such as the size of the house (<5000 hens, 5001-10.000 hens, 10.000 – 30.000 hens, 30.000 – 100.000 hens, > 100.000 hens), type of birds (rearing, layers or breeders), production system (enriched cage, barns, free-range or organic), geographical area (Center, North, South or West) and previous level of infestation (low - less than 200 mg of mites collected in the traps-, medium level - between 250 and 500 mg of mites collected in the traps - or high level - more than 500 mg of mites in the traps-). Retreatment is understood as hens that have been treated 2 or more times. According to the follow-up study carried out in the period of time, retreatments have been carried out in 63% of the houses, with an average time between treatments of approximately 31 weeks. A shorter interval between treatments is observed in those carried out in the colder seasons, both in the percentage of farms retreated (higher in winter and spring) and is also observed in the period until retreatment occurs (lower in winter). More farms with a low level of infestation have been retreated and, in these farms, the retreatment period was significantly higher. No differences have been found in the rest of variables studied (size of the house, type of birds, production system or geographical area).

Keywords: Fluralaner, Red mite, hens, treatment

Effect of total flavonoids of rhizome drynariae in thiram-induced cytotoxicity of chondrocytes

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Tibial Dyschondroplasia (TD) is a prevailing skeletal disorder affecting rapidly growing avian species, resulting in reduced bone strength and lameness and an increased risk of fragility fractures. The total flavonoids of *Rhizoma drynariae* (TFRD) have been frequently applied in the treatment of different bone diseases and have positive effectiveness in humans. The current *in vitro* study was conducted to explore the therapeutic effect of TFRD on thiram-induced cytotoxicity in avian growth plate cells via bone morphogenetic protein-2/runt related transcription factor-2 (BMP-2/Runx2) and Indian hedgehog/Parathyroid hormone-related peptide (IHH/PTHrP) expressions. Chondrocytes were isolated from chicken tibia growth plates and cultured in a special medium and refined. The chondrocytes were treated with a sublethal concentration of thiram (2.5µg/ml) to induce cytotoxicity of chondrocyte and treated with providential doses (100µg/ml) of TFRD. Thiram caused distorted morphology of chondrocytes, nuclei appeared disintegration or lysed along with decreased expressions of BMP-2/RUNX-2 and IHH/PTHrP. TFRD administration not only enhanced the viability of chondrocytes by itself, but also well restored the damage caused by thiram on growth plate chondrocytes by significantly up-regulating the expressions of BMP-2/RUNX-2 and IHH/PTHrP. Therefore, this study provides a novel insight into the further treatment of TD and other skeletal ailments and lays the foundation for prevention and treatment.

Keywords: *Rhizoma Drynariae*, tibial dyschondroplasia, chondrocyte, BMP-2/Runx2, IHH/PTHrP

An overview tibial dyschondroplasia in broilers, molecular pathways, and treatment options

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Avian tibial dyschondroplasia (TD) is a tibiotarsal bone disorder affecting fast growing broiler chickens, characterized by dull white non-mineralized and less vascularized proximal tibial growth plate cartilage, thus making the bones weak and prone to fractures. TD results in serious economic losses manifested by high morbidity rates and is detrimental for welfare of chicken. Our research team investigated the incidence of TD in the main large-scale farms in China through survey questionnaire and reported the incidence of TD to be 8%, and is associated with the farms with high breeding density having Ross 308 and Arber Acres as the main breeds. Our lab focuses on exploring molecular mechanisms involved in the pathogenesis of TD and cost-effective treatment options. The pathogenesis of TD is somehow related to retarded angiogenesis and abnormal differentiation of the growth plate chondrocytes. So far, many pathways have been studied and published like BMP-2/Smad, Ihh/PTHrP, and FGF- β , HIF-1 α /VEGF and AKT/P13k signaling pathways. Likewise, numerous traditional chinese medicines i.e. gambogic acid, epigallocatechin-3-Gallate, apigenin, celastrol, danshen, tetramethylpyrazine, icariin, ligustrazine, salvia miltiorrhiza, total flavonoids of rhizoma drynariae, chlorogenic acid, anacardic acid, astragalosid IV, grape seed extract and osthole have been used against tibial dyschondroplasia by targeting various pathways with outstanding results both in-vivo and in-vitro. Currently, our research team emphasizes on miRNAs involved in the development of TD to find a novel insight underlying TD pathogenesis. These studies have laid the foundation for effective TD control measures in broilers.

Keywords: Broiler; Chondrocyte; Growth plate; miRNA; Survey questionnaire; Tibial dyschondroplasia

Netpoulsafe project: improving biosecurity compliance in the European poultry chain.**Aitor Devesa^{1,2}, Pablo Catalá-Gregori¹, Ramón Jové², Rubén Roca-Torrente², Sandra Sevilla-Navarro¹**¹Centro de Calidad Avícola y Alimentación Animal de la Comunidad Valenciana, Carrer Nules, 16, 12539 Les Alqueries, Castelló, Spain, ²Centre de Sanitat Avícola de Catalunya i Arag. Passeig Nord, 1, 43206 Reus, Tarragona, Spain*Corresponding author: a.devesa@cecav.es*

The poultry sector is a very sensitive sector regarding epidemics and public health outbreaks. Biosecurity is acknowledged as the appropriate answer for preventing diseases spread and safeguarding competitive and sustainable poultry farms. Best practices are known all over Europe but compliance of farmers and other operators to biosecurity may not be optimum. Thus, NETPOULSAFE aims to improve biosecurity compliance in poultry farming by compiling, validating, and sharing supporting measures implemented or close to being into practice in 7 large European poultry producing countries: France, Spain, Netherlands, Belgium, Italy, Poland and Hungary. To this end, (i) firstly it will be established and implemented the National Poultry AKIS, (ii) secondly it will be collected and analysed the application of biosecurity practices and supporting measures (SM) in the participating European countries, (iii) and finally the most promising supporting measures will be implemented and validated in the pilot farms. The first preliminary results obtained from the 406 farmers, advisors and veterinarians questionnaires carried out indicate the needs of the different participating countries in terms of supporting measures have been determined and the measures to be validated in the pilot farms have been selected. Coaching methods, biosecurity training, live workshop, co-construction of courses, group discussion, virtual tour and online sector meetings are some of the supporting measures that will be validated in the 137 pilot farms that have already been recruited. During the project it will be found out which supporting measures are most effective for the whole poultry production chain to improve biosecurity. All these supporting measures will be collected in different formats and disseminated through different channels so that both farmers and advisors can successfully implement them after the end of the project.

Keywords: Netpoulsafe; Biosecurity; biosecurity measures; supporting measures

[P4-23]: POSTER SESSION 4: POULTRY HEALTH (ID: 130190)
[Pakistan]

A Post-Mortem Case Study: Gross pathological /Necropsy investigation of internal laying in Peahens.

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This study reports the gross pathological and necropsy investigation of internal laying in peahens. Birds with fully formed egg in peritoneal cavity is called ectopic egger or internal laying and this occurs due to anti peristaltic movement in oviduct. It reduces the productive efficiency of bird also results to death of bird. One dead adult 6 year's old Indian pea hen (*Pavo cristatus*) was brought for necropsy examination at Department of Pathology, RCVetS. Peahen was anorexic and lethargic from last 48 hours and died suddenly. The bird was reported belong to a confined flock of 30 peafowls. Diarrhea and ataxia were few clinical signs noted before death. Upon external examination, body condition of bird was found poor, dehydrated with sunken eyes, vent gleet and pasting around vent. During necropsy examination it was found that oviduct was blocked between magnum and isthmus part due to the presence of a fully calcified egg (weight about 96 grams and 3.2 inches in length) resulting internal laying. Ovaries were normal with full ovarian clutch. Left unilateral nephritis was also observed. Presence of internal egg has been commonly reported in commercial layers because of inbreeding and can be reduced to promote cross breeding but it was not yet reported in peahens

Keywords: Internal laying, Peahen, Peritoneal cavity.



The Website, the online abstracts submission page of the 7th Mediterranean Poultry Summit and the Book of abstracts have been realized by SaySoft di Ghassan Sayegh.

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OBTENGA TODO EL POTENCIAL



Trabajos de investigación publicados y datos de campo, demuestran que una sola dosis de VAXXITEK HVT-IBD aplicada en la sala de incubación, proporciona **inmunidad temprana**^{1,2} frente a las enfermedades de Gumboro y Marek. A su vez induce **protección clínica**^{1,3} frente a diferentes cepas de Gumboro clásicas, variantes y muy virulentas^{1,2,3}. La protección temprana permite que no exista una ventana inmunitaria^{1,3,4,5,6} entre la inmunidad pasiva y la protección activa generada⁷. Una solidez inmunológica asegura lotes sanos y mejora del rendimiento.

PREVENTION WORKS
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Boehringer
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¹ Bublot M, Pritchard N, Le Gros FX, Goutebroze S Use of a vectored vaccine against infectious bursal disease of chickens in the face of high-titred maternally derived antibody. *Journal of Comparative Pathology*, 2007;137:81-84. ² Goutebroze S, Curet M, Jay ML, Ross C, Le Gros FX. Efficacy of a recombinant vaccine HVT-VP2 against Gumboro disease in the presence of maternal antibodies. *British Poultry Science*, 2003;44:824-825. ³ Cruz-Coy J, Oliveira C, Pereira J, Ambrosino F, Gaudencio A, Le Gros FX, Pritchard N. Efficacy of a Turkey Herpesvirus (HVT-MDV serotype-3)-Infectious Bursal Disease (IBD) Vaccine, Live HVT Vector, IBD-VP2, Administered in ovo and to One-Day-Old SPF Chickens. Poster presentation American Association of Avian Pathologists convention, Hawaii, United States of America, 2006; p135. ⁴ Le Gros FX, Dancer A, Giacomini C, Pizzoni L, Bublot M, Gaziani M, Prandini F. Field efficacy trial of a novel HVT-IBD vector vaccine for 1-day-old broilers. *Vaccine*, 2009;27:592-596. ⁵ Masci P, Iosi G, Fiorentini L. Experimental challenge trial with a very virulent strain of Infectious Bursal Disease virus (vIBDV) in commercial pullets vaccinated with an IBD vectored vaccine or with three different modified live vaccines. *Zootecnica International*, November 2008;50:57. ⁶ Prandini F, Bublot M, Le Gros FX, Dancer A, Pizzoni L, Lamichhane C. Assessment of the immune response in broilers and pullets using two ELISA kits after in ovo or day-old vaccination with a vectored HVT+IBD vaccine (VAXXITEK HVT+IBD). *Zootecnica International*, September 2008;40:50. ⁷ Lemiere S, Gauthier J-C, Kodjo A, Vinit L, Delvecchio A, Prandini F. Evaluation of the Protection against Infectious Bursal Disease (IBD) Challenge in progeny born to parents having received a vaccination program using a Herpesvirus of Turkey Infectious Bursal Disease (HVT-IBD) Vector Vaccine. *World Journal of Vaccines*, 2013, 3, 46-51

Vaxxitek HVT+IBD Suspensión y disolvente para suspensión inyectable. **Composición:** Cada dosis de vacuna contiene virus vivo recombinante vHTD13-69, como mínimo de 3,6 a 5,0 log₁₀ UFP (Unidad Formadora de Placa). **Especies de destino:** Pollitos de 1 día y huevos embrionados de 18 días. **Indicaciones:** inmunización activa de pollitos para prevenir la mortalidad y reducir los signos clínicos y las lesiones debidas a la bursitis infecciosa aviar (inicio de la inmunidad a partir de los 14 días, duración de la inmunidad al menos hasta la 9ª semana) y para reducir la mortalidad, los signos clínicos y las lesiones debidas a la enfermedad de Marek (inicio de la inmunidad a partir de los 4 días. Una única vacunación confiere protección durante el periodo de riesgo). **Gestión, lactancia y puesta:** No usar en aves durante la puesta ni en aves reproductoras. **Reacciones adversas:** Ninguna conocida. **Interacciones:** Por vía subcutánea. Esta vacuna se puede administrar en uso conjunto con las vacunas atenuadas de Marek de la cepa Bispens contra la enfermedad de Marek. También se puede administrar en el mismo día, pero no en uso conjunto con las vacunas atenuadas de Marek contra la enfermedad de Newcastle y la Bursitis infecciosa. **Posología:** Una dosis única de 0,2 ml de vacuna por pollito de 1 día, por vía subcutánea o una dosis única de 0,05 ml de vacuna por huevo embrionado de 18 días, in ovo. **Precauciones:** la cepa de la vacuna es excretada por las aves vacunadas y puede propagarse a pavos. La cepa es segura para los pavos, no obstante, deben adoptarse precauciones para evitar cualquier contacto directo o indirecto entre los pollitos vacunados y los pavos. **Tiempo de espera:** Cero días. **Conservación:** Conservar y transportar congelado en nitrógeno líquido. Conservar la vacuna reconstituida a temperatura inferior a 25°C. Conservar el disolvente a temperatura inferior a 30°C, no congelar y proteger de la luz. **Nº autorización:** EU/2/02/032/001-002. **Presentación:** 1000 dosis de vacuna, en un soporte con 5 ampollas y 2000 dosis de vacuna, en un soporte con 4 ampollas. **Titular:** MERIAL. **Medicamento sujeto a prescripción veterinaria.**



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Somos la empresa líder en la producción y comercialización de piensos para pollos en España. En nuestros centros de investigación desarrollamos programas de alimentación con el fin de mejorar la CALIDAD, SEGURIDAD y RENTABILIDAD del negocio de nuestros clientes.

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El *Metapneumovirus* aviar casi nunca viene solo

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NEMOVAC® liofilizado para suspensión. **Composición:** Cada dosis de vacuna reconstituida contiene Neumovirus vivo, cepa PL21, como mínimo $2,3 \log_{10}$ DI/CC50. **Especies de destino:** Pollos de engorde de 7 a 14 días de edad. Pollitas futuras reproductoras y futuras ponedoras a partir de 14 semanas de edad. **Indicaciones:** Pollos de engorde: Para inmunización activa de los pollos con el fin de reducir los signos del tracto respiratorio superior asociados a la infección por neumovirus aviar. Pollitas futuras reproductoras y futuras ponedoras: Primovacuna para inmunización activa de las pollitas para reducir los signos respiratorios asociados a la infección por neumovirus aviar antes de la vacunación de recuerdo con una vacuna inactivada que contenga neumovirus aviar. **Contraindicaciones:** No vacunar aves enfermas, no usar en aves durante la puesta. **Gestación y lactancia:** No usar en aves durante la puesta. **Reacciones adversas:** Ninguna conocida. **Posología:** Pollo de engorde: administrar una dosis de vacuna entre los 7 y 14 días de edad cuando los niveles de anticuerpos maternos sean bajos. Pollitas futuras reproductoras y futuras ponedoras: Administrar una dosis de vacuna a las 14 semanas de edad antes de la vacunación de recuerdo con vacuna inactivada. **Tiempos de espera:** Cero días. **Conservación:** Conservar en nevera (entre 2 °C y 8 °C), en el envase exterior. Después de reconstitución, conservar a 25 °C. Proteger de la luz. No congelar. Los frascos parcialmente usados no deben ser almacenados. **Nº autorización:** 1312 ESP. **Presentación:** 10 frascos de 5000 dosis. **Titular:** Boehringer Ingelheim Animal Health España, S.A.U. **Medicamento sujeto a prescripción veterinaria.**