XIXth European Symposium on the Quality of Eggs and Egg Products

XXVth European Symposium on the Quality of Poultry Meat

7-9.09.2023, Kraków, Poland

Egg and Meat
7-9.09.2023
KRAKÓW, POLAND

Abstract Book

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Thursday, September 7, 2023

Toward the modulation of the gut microbiome for improvement of poultry meat and eggs

Young Min Kwon

University of Arkansas, USA

Traditionally, the host phenotypes have been understood with the frame of the host genotype and environment. Now gut microbiome has been well recognized as an additional key component that constitutes the interphase between the host genotype and environment, making it an attractive target to modulate for the improvement of important economic traits in poultry. Recent studies have shown connections between the gut microbiome and numerous qualitative aspects of poultry meat and eggs, including woody breast, fat deposit, flavors in meat, and various egg quality parameters. These findings open new potential opportunities to improve the qualities of poultry meat and eggs through strategic modulation of the gut microbiome. In this presentation, first I will present experimental evidence supporting the involvement of gut microbiome in the diverse qualities of poultry meat and eggs from recent studies. Secondly, I will discuss the strategies for effective modulation of the gut microbiome toward the improvement of meat and egg qualities. Thirdly, I will discuss additional factors and challenges to consider for the implementation of these strategies. Lastly, I will discuss recent technical advances in gut microbiome studies that will facilitate our understanding of the gut microbiome-mediated mechanisms and the targeted modulation of the gut microbiome to improve the quality of meat and egg products in poultry.

Microbiological safety of poultry meat and eggs: a never-ending story?

Koen De Reu

Flanders Research Institute for Agriculture, Fisheries and Food (ILVO), Technology and Food Science Unit, Melle, Belgium

With the constant increase in poultry meat and egg consumption worldwide the microbial safety of these poultry products is essential. For years the first and second most reported zoonoses in humans in the EU is campylobacteriosis and salmonellosis, respectively. Followed by yersiniosis, STEC infections and listeriosis. Especially Campylobacter jejuni and Campylobacter coli are leading causes of bacterial human enteritis. Poultry meat is considered as one of the most important reservoirs of Campylobacter and is a very important vector for transmission to humans. Although campylobacteriosis risk management systems are put in place, so far it has not been possible to guarantee Campylobacter free poultry meat to the consumer. Beside, the top five *Salmonella* serovars involved in human infections in Europe are *Salmonella* Enteritidis, S. Typhimurium, monophasic S. Typhimurium, S. Infantis and S. Derby. Contaminated poultry meat is one of the largest contributors to human salmonellosis with some studies suggesting that poultry is associated with 25% of the outbreaks. In the EU, especially S. Infantis followed by S. Enteritidis infections are associated with poultry meat. On the other hand, *Salmonella* and specifically *Salmonella* Enteritidis, is still responsible for the majority of cases of foodborne disease due to egg or egg product consumption notwithstanding the many efforts taken by the primary production as well as by the egg product manufacturing industry. Although Listeria monocytogenes can be found in the laying hen environment and the egg product industry its association with the consumption of eggs and egg products is not so high as for Salmonella. On the other hand studies show the possible high occurrence of L. monocytogenes in chicken carcasses and cuts originated from the production line of slaughterhouses representing a potential risk. During and after slaughtering as well as during egg product production, the bacteria from animal and egg microbiota, the production environment, and the equipment used can contaminate carcasses, their subsequent cuts, and processed meat products as well as the egg products from the egg product industry. Some of these bacteria can grow or survive during food processing and storage. The bacterial communities of those products may include pathogenic species such as Salmonella, Campylobacter and Listeria monocytogenes the main pathogens responsible for human gastroenteritis due to poultry meat and egg and egg product consumption. Finally, the prevalence of the mentioned pathogens in poultry meat and eggs also leads to a greater exposure risk when consumers mishandle raw poultry and eggs in the kitchen.

OP-1 Review on Eggshell translucency: description, causes and consequences for the egg production

Mireille Huard

NOVUS Europe, Zaventem, Belgium

Eggshell translucency is a quality issue that affects not only the appearance of the egg but also could be involved in its resistance to breakage and infection, and concerns both table eggs and hatching eggs. Although the problem is not recent, it is not yet studied enough to be fully explained. This article is proposed as a literature review. As such, it will first describe the phenomenon, which can be measured simply by candling under a lamp using a severity scoring scale. The translucency of the shell is the result of the transfer of moisture from the egg contents through the shell membrane and its accumulation in the shell, which leads to increased light transmission. This translucency is due to structural irregularities in the egg shell and membranes, although the causes are unclear: it is likely to be due to a combination of factors, including pore formation, ultrastructure of the mamillary layer, and possibly calcite formation.

The consequences of translucency are investigated, including its role on shell resistance to breakage, gas exchange and bacterial penetration. As for the effects of translucency on reproductive performance may vary according to the authors.

Some factors may favor its appearance, such as the age of the hens, genetics, rearing conditions (humidity, density), sanitary state of the flock and nutrition. Among the nutritional elements that can have an impact on translucency, certain trace elements such as Copper, Zinc and Manganese can play a role, through their effect on the shell membrane and the structure of the mammillary layer. Further research is needed to show their direct effect on translucency.

OP-2 Phytogenic Feed Additives improve egg quality parameters in laying hens: a meta-analysis

Caroline Donaldson, Manu De Laet, Roberto Montanhini Neto

Delacon Biotechnik GmbH, Engerwitzdorf, Austria
Delacon France SAS, Toulouse, France

With heightened genetic pressures to commence lay sooner and increase laying persistency, supporting the hen nutritionally is crucial. Phytogenic feed additives (PFA) have been shown to improve diet palatability and thereby increase feed intake, which can be associated with longer transit times. Increased transit times are often linked to improved nutrient digestion which can be modulated via a boost of enzyme production (Clunies and Leeson, 1983) and nutrient transporters (Reyer et al., 2017). This supports egg production, especially from the onset of lay when feed intake capacity is still developing. A PFA based on a combination of bitter substances, spices, essential oils, and Quillaja extract (Biostrong™ 510; Delacon Biotechnik GmbH, Austria) was tested in laying hens, and egg production and quality were measured.

Trials from 2000-2022 investigated the effect of PFA on laying performance. Data from over 100 trials were collected; after refinement, 58 case comparisons were included in the meta-analysis. The meta-analysis consisted of birds from different breeds, ages, diets, and systems. All trials selected had a Control treatment and identical diets with the addition of PFA fed at 150 ppm. PFA increased eggshell strength by 3.81%±1.07% relative to Control ($P<0.01$). The relative difference between PFA and Control improved for Albumen Height (1.55%±0.69%), Egg Mass (0.70%±0.41%), Egg Weight (0.40%±0.24%) and Yolk Pigmentation (1.42%±0.80%), all showed improvements when the PFA was fed ($P<0.05$).

Results from the meta-analysis indicated consistent improvements in egg production and quality parameters when PFA was fed, showing the improvements PFA can make to the flock output.

OP-3 Effect of including alternative plant-based protein sources and hermetia illucens in laying hen diets on the sensory characteristics of eggs

Ana Montalbán[1], Silvia Martínez-Miró[1], Cristian J. Sánchez[1], Fuensanta Hernández[1], Eduardo Ruiz[1], Edoardo Fiorilla[2], Caridad Rosique[3], Josefa Madrid[1]

[1] *University of Murcia. Department of Animal Production, Faculty of Veterinary Science, Murcia, Spain*

[2] *University of Turin. Department of Veterinary Sciences, Grugliasco, Italy*

[3] *University of Murcia. Department of Electromagnetism and Electronics. Faculty of Chemistry, Murcia, Spain*

The importance of sustainable protein sources in feed formulations is increasing given the large amounts of soybean meal used in animal diets of the Mediterranean area. The aim of this study was to evaluate the sensory characteristics of eggs produced by hens during their first month of laying phase adapted to Spanish environmental conditions and fed with three different diets: a commercial diet with high content of soybean meal (DIET1); a second diet in which soybean meal was reduced by 32% incorporating plant-origin alternative ingredients (DIET2); and a third diet composed of the second diet supplemented with 5% dehydrated larvae of H. illucens (DIET3). A total of 12 eggs randomly collected from 5 pens per diet were analyzed. All eggs (n=36) were coded and boiled for 15 minutes and offered to a panel of 12 previously trained people (this test was done 2 times). They were asked to rate the sensory characteristics of each egg using a form with a 1 to 5 rating scale. The color intensity, aroma, taste intensity, texture, juiciness, tenderness, and overall quality of both the egg white and yolk separately, as well as the overall appearance of the egg and its general quality were assessed. Results showed no differences in the evaluated parameters between the yolks and whites of eggs from the three diets ($p>0.05$), except for yolk aroma ($p=0.015$), which was rated higher in DIET2 compared to DIET1 and DIET3 (3.0, 2.33, and 2.29 out of 5, respectively). In addition, the score for overall appearance and the general quality of the egg did not differ between diets ($p>0.05$). Generally, the sensory characteristics of eggs were not affected by the inclusion of alternative plant-origin protein sources and H. illucens in diets of laying hen, during the first month of laying.

OP-5 The effect of addition of lysoforte and rapeseed oil in hens' diet on physicochemical and functional properties of table eggs

Nives Marušić Radovčić[1], Lucija Vrhovec[1], Kristina Kljak[2], Zlatko Janječić[2], Helga Medić[1]

[1] *University of Zagreb, Faculty of Food Technology and Biotechnology, Zagreb, Croatia*
[2] *University of Zagreb, Faculty of Agriculture, Zagreb, Croatia*

The aim of this study was to investigate the effects of the addition of rapeseed oil and lysoforte (LFT) in hen diet on the physicochemical and functional properties of table eggs. LFT is a nutritional emulsifier designed to enhance digestion and absorption of energy-rich feed ingredients, including fats, oils and fat-soluble nutrients in poultry feeds. Six treatments were performed: three with oil addition (2%, 3% and 4%) and three with oil addition (2%, 3% and 4%) and 0.5 g/kg LFT. The addition of LFT and rapeseed oil had no effect ($P > 0.05$) on egg yolk colour, pH, texture and foaming properties, and egg turbidity and emulsion activity index. Regarding rheological properties, the addition of LFT and rapeseed oil affected ($P<0.05$) the apparent viscosity of egg yolk, flow behaviour index of whole egg and egg white, and the consistency coefficient of egg white. Also, emulsion capacity and emulsion stability were affected ($P<0.05$) by the oil and LFT addition: samples with 3% oil addition had the highest emulsion capacity, while the samples with 0.5 g/kg LFT + 4% oil had the highest emulsion stability.

OP-6 The impact of the eggshell defects on the table eggs quality

Karolina Wengerska, Kamil Drabik, Kornel Kasperek, Anastasiya Ramankevich, Justyna Batkowska

Intitute of Biological Basis of Animal Production, University of Life Sciences, Lublin, Poland

The aim of study was to analyse the table egg quality depending on the shell defect presence. The material consisted of white-shelled eggs obtained from the same stock of 200 Leghorn hens at the age of 28 weeks. Birds were kept together in the barn system. 320 eggs were collected in two consecutive days and candled to determine the eggshell defect presence. The test groups of eggs were identified as follows: intact, severe stripe marks, points, chalky, wrinkled, marbled, weak ends, pimple, incorrect shape, internal wrinkles. The EQM (Egg Quality Measurement, TSS®) set and Instron Mini 55 apparatus were used. The traits of whole eggs (weight, specific gravity, shape), shell (strength, color, weight, thickness, density), albumen (weight, height, pH) and yolk (weight, color, pH) were evaluated.

It was observed that eggs with wrinkled shells were characterized by the biggest egg weight with the smallest specific gravity. Also in the proportion of shell was the smallest in this group. The new defect, not classified before, was found and identified as internal wrinkles. It was visible only during candling, probably due to white, relatively transparent shell. After brekage wavy ridges inside the shell could be palpably detected. This is especially important as the eggs in this group had the best shell quality. The lowest levels of albumen traits were registered in eggs with chalky shells, the highest in those with marbled shells and in intact ones. Yolk features were not affected by shell defects.

OP-7 Amino acid-complexed minerals supplementation improves laying hen performance, egg quality, intestine morphology and bone' health

Cibele Torres[1], Marcos José Batista dos Santos[2], Carlos Bôa-Viagem Rabello[2], Maria Do Carmo Mohaupt Marques Ludke[2], Mércia Rodrigues Barros[2], Leandro Moreira da Silva[2], Clariane Silva Santos[2], Heraldo Oliveira[2], Fabiano Séllos Costa[2], Jamille Sheila Da Silva Wanderley[2], Alba Fireman[3]

[1] *Zinpro, Madrid, Spain*
[2] *Federal Rural University of Pernambuco, Recife, Brasil*
[3] *Zinpro, Campinas, Brasil*

The objective of the study was to determine the effects of total inorganic mineral (IM) replacement of zinc (Zn), manganese (Mn), copper (Cu), iron (Fe), and selenium (Se) with the Amino acid-complexed minerals (AACM) source in laying hens' diets on performance variables, egg quality, egg yolk mineral deposition, intestinal histology, and bone variables. From 78 to 98 weeks of age, 400 Lohmann White laying hens were distributed in a complete randomized design with 4 treatments and 10 replicates each. The control treatment was supplemented with 60, 60, 7.0, 40, 0.20, and 2.0 mg kg-1 of Zn, Mn, Cu, Fe, Se, and I, respectively, as IM sources. The other 3 treatments replaced the IM source with AACM (except for I) at 70, 50, and 40%, respectively. Data were analysed using a one-way ANOVA and LSD was employed to compare the means when differences were significant at $p<0.05$.The AACM at 40% had better egg output, egg weight, egg mass, feed conversion, as well as eggshell thickness. There were higher percentages of yolk, albumen, and shell in eggs of laying hens fed AACM70. The concentration of Mn, Cu, Zn, and Se in the yolk decreased as the levels were reduced to 40% without differences in eggs produced for hens fed AACM70 or 50%. Laying hens fed AACM 70% presented the shortest villi height and narrowest villi width in the duodenum. A significant reduction of crypt depth was found in the jejunum of hens fed AACM, independent of the level. The replacement of IM by AACM improved ileum morphology with a higher villus:crypt ratio. The greater medial bone densitometry was observed in tibiae of hens fed AACM 40%, without significant differences between treatments in the other bone segments. The concentration of 24, 24, 2.8, 16, 0.08, and 0.8 mg kg-1 of Zn, Mn, Cu, Fe, Se, and I, respectively, met the maximum performance of the old laying hens.

Innovation in mixed egg-plant foods for environmental and health benefits

Valérie Lechevalier, Valérie Gagnaire, Frédéric Guyomarch

INRAE, France

Since the early 1990s, major health and environmental concerns have developed and driven the emergence of diets involving a lower consumption of animal products. However, the transition towards greener diets is being hampered by the poor acceptance of vegan foodstuffs among western consumers. Mixed animal/ plant alternatives to familiar egg products offer a new field of innovation. This review focuses on innovative mixes of egg with plant ingredients – especially legumes – to develop products in which interactions between animal and plant are not usually expected, such as egg gels, emulsions or foams. The opportunities offered by such products in terms of consumer acceptance, nutrition, digestibility and techno-functional properties are reviewed and discussed with respect to their risk-benefit ratios. In many cases, animal/plant mixes offer enhanced protein stability and synergistic interfacial or textural properties that make them a flexible tool for food design. Animal/plant mixes enable reduction in animal protein consumption while preserving amino acid and micronutrient intakes and sensory properties. However, their acceptability to consumers and society will also depend on controlled safety, especially regarding allergies or contaminants, on affordability, their degree of novelty or (ultra)processing, their actual environmental footprint and whether they meet consumer expectations for innovative foods in the transition towards greener diets.

Fighting food fraud in the egg sector

Saskia M. van Ruth[1, 2], Joris Boom[2]

[1] *School of Agriculture and Food Science, University College Dublin, Ireland*
[2] *Food Quality and Design group, Wageningen University and Research, Wageningen, The Netherlands*

All food supply chains are susceptible too food fraud, but some more than others. For centuries scientists focused on the development of analytical methods to detect food fraud. However, in the past decade, focus has shifted from food fraud detection to food fraud prevention. An active approach rather than a reactive approach. This has required the comprehension of the anatomy of food fraud for which various techno-managerial and criminological methods have been applied. Food fraud in general comprises adulteration, dilution, unapproved enhancement, concealment, mislabeling, counterfeiting, and grey market/smuggling. However, fraud in the egg sector is usually limited to mislabeling of the production system; not meeting the production management requirements or swapping eggs to upgrade them illicitly to barn, free range or organic eggs. In this paper, we will discuss approaches to comprehend the frauds occurring in this sector. This includes the assessment of fraud vulnerabilities in the Dutch and German organic egg chain network and analysis of an organic egg case by crime script analysis. Furthermore, the social network of the Dutch organic egg chain network is explored for distinctive characteristics. Finally, we complement these results with findings gathered with an organic egg fraud detection method over the last decade.

OP-8 Sensory analysis of egg and meat of three dual-purpose hen genotypes

Alexandr Torres[1], Sherezade Sigut[1], Noemi Castro[2], Sergio Alvarez[1], Maria Fresno[1]

[1] *Canary Islands Institute for Agricultural Research, Tenerife, Spain*
[2] *Universidad de Las Palmas de Gran Canaria, Arucas, Spain*

The choice of breed is a critical factor for small- and medium-scale producers, which have regard to the capacity of animals to adapt to local conditions, productive performance and poultry product quality. The objective of this study was to evaluate the sensory profile of egg and meat of 3 dual-purpose hen genotypes (Canaria, Novogen Blacktail and Lohmann Dual) reared under free-range conditions and fed with commercial feed. A 61 and 47 untrained consumers performed a sensory acceptability test for eggs and meat, respectively. Eggs were collected at wk 72 and then they were slaughtered at wk 74 for meat sensory evaluations. To assess palatability, eggs were boiled into a water bath for 8 minutes and breasts were cut into 2*2*1 cm pieces, wrapped in aluminium foil, cooked at 200°C on a double-plate grill until the internal temperature reached 70°C. The consumers expressed their external assessment of whole egg (shape, size and eggshell color), internal assessment of raw egg (yolk color and size, egg white thickness), meat juiciness, meat greasiness and overall palatability for egg and meat (aroma and taste) on a 9-point hedonic scale. Sensory evaluation data were analyzed using a Kruskal–Wallis test followed by Dunn test with Bonferroni correction. The samples were coded randomly and were presented in the same conditions for all consumers. The results showed that there was no significant differences for external assessment and overall palatability for the eggs among genotypes. Nevertheless, the eggs from Canaria had a higher score than the eggs from Novogen Blacktail (7.75 vs. 6.70). Likewise, the meat of Canaria was more juiciness (4.26 vs. 3.49) and greasiness (2.96 vs. 2.17) than the meat of Novogen Blacktail. Finally, the panelists gave a higher overall palatability score for meat of Canaria (6.15) and Lohmann Dual (6.15) than the meat of Novogen Blacktail (5.13).

OP-9 From shell eggs to pasteurized egg products: importance of the rearing system on microbiological and technological properties of egg and egg products

Valerie Lechevalier[1], Séverine Chevalier[1], Tino Jamme[1], Sophie Jan[1], Maylis Dop[2], Eve-anne Norwood[2], Guillaume Gillot[3], Julie Evrard[3], Véronique Huchet[3], Amélie Chastagner[4], Angélique Travel[4], Carole Debregeas[5]

[1] *STLO, INRAE, INSTITUT AGRO RENNES-ANGERS, Rennes, France*
[2] *ONIRIS-GEPEA, Nantes, France*
[3] *ADRIA Food Technology Institute, UMT ACTIA, Quimper, France*
[4] *ITAVI, Tours, France*
[5] *ADRO OUEST, Rennes, France*

Hen egg production methods have changed considerably over the last 15 years with the consideration of animal welfare and changes in European regulations. In Europe, fewer and fewer eggs are produced in cage giving way to an increasing number of systems with an access to an outdoor run.

This study determined the impact of the rearing system of laying hens on microbiological quality, diversity and technological properties of shell eggs and egg products. Eggs were collected from cage, barn or free-range rearing systems during a “cold” and a “warm” season. Eggs from Lohmann White and Lohmann Brown hens aged from 57 to 71 weeks old were collected following an equilibrated experimental design. The corresponding industrial egg products (i.e. egg white and whole egg) were also collected in French egg product companies before and after pasteurization. The microbial quality of eggshells and egg products was assayed by total and fecal bacterial counts. The microbial diversity was evaluated by metabarcoding 16S. Technological properties were evaluated by measuring egg white foaming properties and whole egg emulsifying properties as well as cooked angel food cake (for egg white) and sponge cake (for whole egg) color, specific volume and texture.

The first source of variability of microbiological count and technological properties of shell eggs was the hen breed, followed by the season and thirdly the rearing systems. The latter was however found to be the main source of variability of microbial diversity of eggshell. Considering the variability of microbiological an technological quality of industrial egg products, the season and the rearing system were the two main sources for unpasteurized egg products, whereas the rearing system was the only source for pasteurized egg products.

OP-10 Effects of hen genotype, age, and rearing system on egg quality in a sustainable perspective

Cristina Alamprese, Eleonora Loffredi, Giulio Scappaticci, Antonella Brusamolino, Simona Ratti, Paolo Simonetti

DeFENS - University of Milan, Milano, Italy

Goals of the 2030 Agenda for Sustainable Development includes ensuring sustainable consumption and production patterns. All countries are called for urgent actions to maximize the socio-economic benefits of the use of resources, while minimizing the climate, biodiversity and pollution impacts. Promotion of local chicken breeds is important to support biodiversity, contributing also to the environmental impact reduction through extensive rearing systems. The aim of this work was the quality assessment of eggs produced by two Italian local breeds (Bionda Piemontese, BP; Robusta Maculata, RM) and their crossbreeds with the hybrid Sasso (BPxS and RMxS); eggs laid by Lohmann Brown (L) were considered as the reference. All the hens were reared in enriched cages and free-range systems (3 replicates for each system/genotype; 10 birds in each replicate). At the hen age of 26, 49, and 65 weeks, the eggs (20 for each replicate) were collected and analysed for quality attributes, including nutritional properties. The multivariate elaboration of analytical results gave a robust assessment of egg quality depending on hen genotype, age, and rearing systems. Differences in egg nutritional properties were small and not relevant from a human perspective. The most important factor for techno-functionality resulted the hen age: eggs laid by older hens were heavier, with higher yolk percentage, and better foaming properties. Crossbreeds increased egg weight and breaking strain. BP, RM, and their crossbreeds gave gelling properties better than L, which, in contrast, showed higher foaming capacity. Egg yolk and foam consistency resulted increased in the eggs from free-range system.

Acknowledgement: The work was supported by the project “Use of Local Chicken Breeds in Alternative Production Chain: Welfare, Quality and Sustainability - LoChAl”, funded by MIUR (project PRIN, prot. 2017S229WC).

OP-11 Deposition of carotenoids in the egg yolk can be improved by the addition of rapeseed oil and natural emulsifier in the laying hen diet

Veronika Gunjević[1], Dora Zurak[1], Goran Kiš[1], Dalibor Bedeković[1], Zlatko Janječić[1], Marija Duvnjak[1], Vasil Pirgozliev[2], Darko Grbeša[1], Kristina Kljak[1]

[1] *University of Zagreb Faculty of Agriculture, Zagreb, Croatia*
[2] *National Institute of Poultry Husbandry, Harper Adams University, Edgmond, United Kingdom*

This study compared the effect of supplementing two maize-based diets with different levels of rapeseed oil (2, 3, 4%) and with (0.5%) or without natural emulsifier (Lysoforte®, Kemin, USA) on the efficiency of carotenoid deposition (CDE) in the yolk. Maize hybrids were the only source of carotenoids in the diets. A total of 216 Lohmann Brown hens were randomly assigned to 12 dietary treatments (2x3x2 factorial arrangement) with six replicates each (cage with 3 hens). After depletion, the experimental period lasted 6 weeks, during which the eggs were collected for analysis once a week. To calculate CDE, egg production was recorded daily and diet intake weekly. The carotenoids in diets and eggs were quantified by HPLC. The CDE of total carotenoids ranged from 14.41 to 21.06% in all treatments, with up to 17-fold higher deposition of lutein and zeaxanthin compared to other carotenoids. Treatments differing in maize hybrid differed in CDE of all carotenoids except β-carotene, while increasing oil level and adding emulsifier improved CDE of lutein, zeaxanthin and total carotenoids ($p<0.05$; for up to 15% for lutein and 20% for zeaxanthin and total carotenoids). The highest CDE of these carotenoids was observed in both hybrids when 3% oil and emulsifier were added (18.28 vs. 16.05% for total carotenoids). These results suggest that the utilisation of carotenoids from maize grains can be improved by adding a lipid source and an emulsifier in the hen diet.

Funding: This work has been fully supported by Croatian Science Foundation under the project ColourMaize ("Bioavailability of maize carotenoids in laying hens: effect of grain microstructure and diet composition"; IP-2019-04-9063). The work of doctoral student Dora Zurak has been fully supported by the "Young researchers' career development project – training of doctoral students" of the Croatian Science Foundation.

OP-12 Addition of natural emulsifier and rapeseed oil to laying hen diet affects the content of carotenoids and tocols in eggs

Dora Zurak[1], Veronika Gunjević[1], Goran Kiš[1], Dalibor Bedeković[1], Zlatko Janječić[1], Marija Duvnjak[1], Vasil Pirgozliev[2], Darko Grbeša[1], Kristina Kljak[1]

[1] *University of Zagreb Faculty of Agriculture, Zagreb, Croatia*
[2] *National Institute of Poultry Husbandry, Harper Adams University, Edgmond, United Kingdom*

The study focused on investigating the effects of rapeseed oil level (RO) and natural emulsifier (NE) in hen diet on the content of carotenoids and tocols in eggs. Hens were fed diets differing in maize hybrid (H1 and H2), RO level (2, 3 and 4 %) and NE addition (Lysoforte®, Kemin, USA; 0.05% and no addition). These were arranged in a factorial design (2×3×2), resulting in 12 treatments. Lohman Brown hens (216) were fed for 8 weeks and eggs for analysis were collected once a week after yolk colour stabilised. As maize was the only source of carotenoids in the diet, hybrid affected the content of yolk carotenoids. The addition of NE had no effect on the yolk carotenoid content, while increasing RO levels increased the content of total carotenoids, lutein and zeaxanthin ($p<0.05$). The highest yolk carotenoid content (35.54 µg/g) was obtained when 3% of RO was added. On the other hand, RO had no effect on the yolk tocol content, while the adding NE increased the content of α- and γ-tocopherol ($p<0.05$), resulting in an increase in yolk total tocol content from 19.77 to 22.36 µg/g. Both the effect of RO on carotenoids and the effect of NE on tocols were more pronounced in eggs from hens fed H1 hybrid diets, and these effects were significant for all carotenoids and tocols. Among the treatments tested, the optimal diet for the highest yolk content of carotenoids and tocols contained 3% RO and 0.05% NE, regardless of the maize hybrid in the diet.

Funding: This work has been fully supported by Croatian Science Foundation under the project ColourMaize ("Bioavailability of maize carotenoids in laying hens: effect of grain microstructure and diet composition"; IP-2019-04-9063). The work of doctoral student Dora Zurak has been fully supported by the "Young researchers' career development project – training of doctoral students" of the Croatian Science Foundation.

OP-13 Microbiology and texture stability of an innovative egg product

Insa Mannott[1], Tingting Chu[1], Daniela Marino-Gonzalez[1], Gunnar Bosse[1], Arjen Sein[2], Victoria Kiehne[3], Anne Rehkamp[3], Clemens Bertram[4], Bernard Schneppe[3], Monika Gibis[5], Ramona Bosse[1]

[1] *Department of Food Technology, Institute EcoMaterials, University of Applied Sciences Bremerhaven, Bremerhaven, Germany*
[2] *DSM Food & Beverage, Delft, The Netherlands*
[3] *OVOBEST Eiprodukte GmbH & Co. KG, Neuenkirchen-Vörden, Germany*
[4] *Hebold systems Gmbh, Cuxhaven, Germany*
[5] *Department of Food Physics and Meat Science, Institute of Food Science and Biotechnology, University of Hohenheim, Stuttgart, Germany*

For many people, pursuing a healthy and sustainable diet has become the focus of interest. Eggs are considered a valuable protein source because the content and ratio of essential amino acids correspond to the human body's needs. In the context of sustainability, it makes sense to further process eggs that don't meet Grade A. Due to the high protein, low fat, and carbohydrate content, egg white is ideally suited for producing healthy and sustainable-oriented foods. The research aims to develop an innovative egg white-based product to better utilize the side streams of the egg industry.

In this study, an innovative product with dessert-like character similar to a mousse was developed from egg white. Egg formulation was mixed with ingredients (e.g. hydrocolloids, flavors), pasteurized, and homogenized to create an innovative egg product. The finished product was subjected to analysis and stored at 8°C for 8 weeks. On the one hand, the microbiological stability of the product was examined, as this is an important factor for consumer health and retail. For this purpose, the samples were subjected to microbiological analyses; they were analyzed for the total aerobic bacterial count, *Enterobacteriaceae*, *Enterococci*, *Bacillus spp.*, *and Salmonella spp.*. Furthermore, the textural stability was examined with a texture analyzer using backextrusion cell.

The microbial counts were below 1000 CFU/ml (LOD) over the whole storage period. The stability of the product measured as firmness increased over the storage period from 200 to 350 N. This study has shown that it is possible to produce an innovative product from egg white that remains microbiologically and texturally stable over the period of 8 weeks. This opens up new possibilities for the refinement of egg products for the retail market.

OP-14 Phages against bacterial pathogens in meat production

Marta Kuźmińska-Bajor[1], Maciej Kuczkowski[2], Paulina Śliwka[1], Anna Woźniak-Biel[2]

[1] *Department of Biotechnology and Food Microbiology, Faculty of Biotechnology and Food Sciences, Wrocław University of Environmental and Life Sciences, Wrocław, Poland*
[2] *Department of Epizootiology and Clinic of Birds and Exotic Animals, Faculty of Veterinary Medicine, Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

Phages are self-replicating and self-limiting bacterial viruses since they multiply only at the site where the host is located and are eliminated gradually when the host bacteria is cleared. Therefore, we made attempts to evaluate the phage's usefulness as a therapeutic and preventive agents against bacterial pathogens important for the poultry industry. As regards the entry of *Salmonella* into the food chain, poultry products are the main sources of this pathogen. *Salmonella* can be easily transmitted between birds with water and drinkers containing multispecies biofilms, which are extremely difficult to prevent and eradicate. Phages have been considered an effective tool in inhibiting biofilm formation and eradication. In this study, we found that UPWr_S phages exhibited a great ability to decrease the number of *Salmonella* from biofilm structures. We also showed the high effectiveness of the UPWr_S phages in reducing the symptoms of S. Enteritidis infection in a murine model and the number of *Salmonella* in experimentally infected broiler chickens. On the other hand, for poultry producers one of the most important bacterial pathogen are avian pathogenic E. coli (APEC) caused colibacillosis. Moreover, APEC are frequently resistant to multiple drugs including antibiotics, entailing the treatment and control of these infections extremely difficult. UPWr_E phages exhibited great activity in biofilm removal. Moreover, gastric gavage with UPWr_E124 phage cocktail resulted in a highly reduced number of APEC in mice's internal organs in contrast to intraperitoneal injection of phage cocktail in mice. Additionally, the UPWr_E124 phage cocktail's ability to eradicate APEC from internal organs and blood was confirmed in an experimentally infected chicken model. Our results indicate that both types of phages are promising antibacterial tools in poultry.

OP-15 Comparison of two Strategies to Prevent Harmful Effects of Ochratoxin on Broiler Chicken Performance and Meat Quality

Márta Erdélyi, Zsolt Ancsin, Zoltán Kovács, Erika Zándoki, Miklós Mézes, Krisztián Balogh

Hungarian University of Agriculture and Life Sciences, Institute of Physiology and Nutrition, Department of Feed Safety, Gödöllő, Hungary

Ochratoxin (OTA) is a common mycotoxin produced by *Aspergilly* and its main target organ is the kidney. According to the EU Recommendation of 2006/576/EK the safe limit value of OTA is 0.1mg/kg feed for poultry. However, according to literature data even in lower concentration it can compromise performance of birds.

In our experiment four groups of Ross 308 day-old chickens were created (140 birds/group, 35 birds/pen, 4 repetions). Besides the control (commercial diet), 1mg/kg ochratoxin contamination was applied in the complete feed of birds in the three treatment groups from hatching till 21 days of age. No further treatment was applied to any of the groups from day 21 till slaughter. In one treatment group the feed was inoculated with KM2362 strain of *Aspergillus albertensis* for biodegradation of OTA before feeding. In another treatment group the OTA contaminated diet was supplemented with a commercial toxin binder. Performance traits (live weight, feed intake, fedd conversion) were recorded weekly, as well as some meat quality parameters (pH, colour, OTA concentration) were measured at the end of the gorwing period (42 days of age).

Live weight and feed conversion were similar to the control due to biodegradation and were significantly better than that of the birds fed with a diet loaded with 1 mg/kg OTA. Ochratoxin content in the meat samples were not detectable in any of the treated groups, and no marked changes in the pH and colour of the meat were found.

In conclusion ochratoxin contamination of the broiler diet resulted in reduced performance. However, toxin binders might reduce the harmful effect of OTA, but the production is affected in some way. The new biodegradation method seems to be a successful alternative to toxin binders in the future in the case of OTA contamination in the broiler diet.

OP-16 Effect of a triple strain Bacillus-based probiotic on the reduction of flock variability, slaughter condemnations and curative antibiotic treatment in broilers

Antoine Meuter, Christophe Bostvironnois, Guilherme Borchardt

Chr. Hansen, A/S, Hørsholm, Denmark

It is our hypothesis that improved broiler productivity with probiotics measured in well-controlled, challenge-type studies or in field observation trials are due to a greater percentage of the birds in the probiotic-fed group simply being normal and healthy thanks to a more robust intestinal microbiome. As the percentage of healthy birds increases in one group versus another, then all variables of economic importance should likewise improve. Concomitantly, variation among the birds in the probiotics-fed group should decrease. To test this hypothesis, we worked with a major global broiler integrator and fed 1.8M Ross birds from 72 flocks from the same complex, placed as hatched (males and females mixed); half receiving a standard feed supplemented with a triple strain Bacillus-based probiotic (1.6x106 cfu/g of feed) and the other half only receiving the standard diet. Average ages at market were 35,7 and 35,2 days respectively. Feed conversion ratio (FCR) was significantly improved (P=0,03; Mann–Whitney U test). The distribution of observations from the probiotic-fed group compared to the control group was shifted in an economically positive direction and variation was significantly reduced for FCR (1.617 ± 0.074 vs 1.651 ± 0.106; P=0,03), livability (96.12% ± 1.70% vs 95.73 ± 2.33%; P=0,06) and condemnation (0.64% ± 0.39% vs 0.86% ± 0.64%; P=0,04). The use of antibiotic treatment was also reduced by 26% in the probiotic group. In conclusion, daily feeding of a commercial triple strain Bacillus-based probiotic did sustainably improve broiler growth and flock uniformity and may have contributed to better and safer meat quality due to lower condemnation rate and use of medication.

OP-17 Testing practice of Listeria monocytogenes within the framework of Regulation (EC) 2073/2005 in food processing plants producing Ready to Eat Products

Patrick Hearse

Stanlab Sp. Z o.o., Nakło nad Notecią, Poland

Testing practice of Listeria monocytogenes within the framework of Regulation (EC) 2073/2005 in food processing plants producing Ready to Eat Products

Listeria monocytogenes research practice under CR (EC) 2073/2005 in food industry enterprises producing ready-to-eat products Patrick Hearse Stanlab, Naklo nad Notecia, part of Ariana Laboratories and Consulting Group

Listerias are gram-positive, rod-shaped, facultatively anaerobic, non-spore bacteria of the family *Listeriaceae*. Optimal conditions for bacterial growth occur at a neutral to slightly alkaline pH. It is exceptionally tolerant of high temperatures and pH fluctuations, and resistant to high salt concentrations of up to 10%. It is one of the most virulent food-borne pathogens, causing the disease called listeriosis. A large part of the listeriosis diseases in both humans and animals is attributable to infections with the species *Listeria monocytogenes*. The source of infection is the consumption of contaminated food of animal and plant origin: smoked fish, raw milk and raw milk products, cheese, cold cuts, raw sausage and raw minced meat. Very often transferred to foods during processing due to poor hygiene. There is a particular risk associated with ready-to-eat foods: which were no longer subject to a germ killing treatment (e. g. heat treatment) after processing. The preventive measures against infection can include avoiding stagnated water in production rooms, regular cleaning of drains and evaporators, considering general hygiene rules at work (good manufacturing practices, appropriate cleaning, hygiene programs and effective temperature control throughout the food production, distribution and storage chain), avoidance the consumption of foods, such as: raw meat products and raw sausages. Relevant legislation on certain microorganisms and implementing rules for food business operators is the CR (EC) No. 2073/2005 on microbiological criteria for foodstuffs. Conventional sampling methods in the case of listeria environmental monitoring are swabs and sponges.

OP-18 Impact of empirical mobility patterns and contact networks on spread of infectious diseases in poultry

Andrzej Jarynowski[1], Mitchell Welch[2], Terence Sibanda[3], Isabelle Ruhnke[3], Andrea Palmini[4], Vitaly Belik[4]

[1] *Aidmed/IBI, Gdańsk/Głogów, Poland*
[2] *Precision Agriculture Research Group, School of Science and Technology, Faculty of Science, Agriculture, Business and Law, University of New England, Armidale, Australia*
[3] *School of Environmental and Rural Science, Faculty of Science, Agriculture, Business and Law, University of New England, Armidale, Australia*
[4] *System Modeling Group, Institute for Veterinary Epidemiology and Biostatistics, Department of Veterinary Medicine, Freie Universität Berlin, Berlin, Germany*

We analyzed 2644 laying hens who survived whole observation (56 weeks) using RFID sensors and were subject to necropsy at the end of their laying period for the presence of some diagnosed infectious diseases. We calculated time series of: 1) the time that individuals spent at the lower feeder, upper feeder, in the nest boxes, and on the range area in minutes; 2) each potential contact of every 2 individual hens (animals as nodes) which are in the range of a given antenna with duration in minutes; 3) each movement of a single hen between two consecutively visited antennae being nodes.

Using logistic regression models, we have tested the ability of mobility and contact patterns for prediction of Spotty Liver Disease (bacterial infection), *Ascaridia galli* and Cestodes infections (both parasites) as assessed by postmortem investigation. We also proposed a SEIR model for a hypothetical infectious disease with characteristics similar to common bacterial and viral infections. We applied social network analysis, representing the hens and antennas with nodes in the network, to map/predict/detect infectious diseases spread and within the aviary system.

For a hypothetical disease model we have tested whether the point of introduction of the disease (by interaction with the wildlife vs. no adequate biosecurity adherence of workers) is manifested in variables measured in PLF context (i.e. laying productivity and hen mortality). From actual registered diseases, we have identified a possible exposure due to going outside of the shed with a 3.15 odds ratio per hour of ranging daily for *Ascaridia galli* infection chance ($p<0.001$). Up to our knowledge it is the first approach of modeling within-farm transmission network dynamics using empirical contact data (from sensors) in poultry (with AUC>0.65). We will discuss the ongoing experiments with computer vision for monitoring contact.

OP-19 Effect of a triple strain Bacillus-based probiotic on prevention of myopathies and bruises in relation with stress reduction in broiler chickens

Antoine Meuter[1], Almeida Paz[2], Rogerio Frozza[1], Guilherme Borchardt[1]

[1] *Chr. Hansen, A/S, Hørsholm, Denmark*
[2] *Department of Animal Production and Preventative Veterinary Medicine, UNESP, Botucatu, Brasil*

Although the health of affected birds is not impaired, myopathies cause carcass condemnations and economic losses to the poultry industry. Raising broilers in a situation of low stress can prevent meat quality defects. Probiotics do have many benefits, ranging from disease prevention to reduction of anxiety behaviors. A triple-strain Bacillus-based probiotic was tested to assess its effect on broiler performance and meat quality in relation to well-being. 1600 day-of-hatch AP95 male broilers were equally distributed to four treatments of eight replicates each. The groups were: 1) Negative control with no supplement (NC), 2) Halquinol, 3) Probiotic (PRO), and 4) Phytogenics. Behavioral responses were assessed using latency-to-lie and approximation tests. Plasma levels of corticosterone (CORT) and serotonin (5HT) were measured as indicators of stress. Feed conversion ratio and bodyweight were improved ($P<0.05$) in PRO. PRO-fed birds were less stressed and less skittish compared to the other groups, as significantly evidenced ($P<0.05$) by longer standing times and allowed proximity as well as lower CORT (80 µg/mL) and higher 5HT (402 µg/mL) compared to NC (166 and 100 µg/mL). Mechanisms that enable the beneficial synaptic actions of 5HT (5-HTT, SLC6A4, and TPH1) were also expressed to a greater degree in PRO. PRO showed lower incidence ($P<0.05$) of myopathies such as dorsal cranial myopathy (32,5%) compared to NC (60%) as well as spaghetti meat (50%) compared to NC (62%). Incidence of bruises was also lower ($P<0.05$) in PRO (45%) compared to NC (60%). In conclusion, the triple-strain Bacillus-based probiotic enhanced well-being of broilers through the gut-brain-microbiome axis leading to improved productivity and meat quality with potentially less slaughter condemnations.

Challenges in the relation between carcass quality and poultry welfare

Wim Tondeur

Tondeur VTCA, The Netherlands

A carcass lesion monitoring program has been developed in the past 10 years under the name of Perfect Carcass tool®. Within this model 4 main categories for lesion monitoring have been defined: skin lesions, vascular lesions, skeletal lesions and myopathies. The tool is applied in several poultry abattoirs all over Europe and Middle East. First of all it is the starting point to bench mark various flocks within an abattoir, between abattoirs, but also at national and international level. Beside manual monitoring on random samples within a flock, video camera monitoring on the production line of each individual carcass matches perfectly within this system. The economic impact of the total lesion scoring per flock can be estimated as well. Via all the collected data the average per lesion type can be calculated, followed by setting standards for acceptable levels. Both hock dermatitis and pododermatitis were the first lesions to monitor within national reduction programs especially on stocking density. 5 years ago a reduction program on wing lesions (bleedings, fractures and dislocations) started in the Netherlands with a maximum scoring level of 2%. Soon this maximum scoring level will be reduced to 1%. These wing lesions are very strongly related to the catching and loading of animals in the final hours of their life. New Dutch and EU regulations on animal welfare are on the way: a ban on lifting birds on their legs, only in upright position of 1 or 2 birds at a time. The stunning of animals is still a topic for improvements: levels of electric stunning, gas stunning technology and how to deal with ritual slaughter. Animal stress issues will be addressed by new regulations as well, like the current discussion on heat stress, should animal transport be banned with environmental temperatures above 35° Celsius or better to be put at a maximum at 30° Celsius. In November 2022 a 4-year project started under the name of “aWISH” (animal Welfare Indicators at the Slaughterhouse) in 13 European countries to work out the use of a digital video camera and sensors monitoring program on the various carcass lesions. Every individual poultry abattoirs have their own data collecting systems, including relevant information of the whole growth phase, including the animal welfare. The objective is to streamline the data collection systems and to come to best practices protocols.

OP-20 Dietary inclusion of Chlorella vulgaris and heat-stress in broiler chickens: effects on growth performance and product quality of broiler chickens.

Marija Bošković Cabrol[1], Almudena Huerta Palacios[1], Francesco Bordignon[1], Marco Birolo[1], Gerolamo Xiccato[1], Angela Trocino[2]

[1] *University of Padua/Department of Agronomy, Food, Natural resources, Animals and Environment (DAFNAE), Legnaro, Italy*
[2] *University of Padua/Department of Agronomy, Food, Natural resources, Animals and Environment (DAFNAE)/Department of Comparative Biomedicine and Food Science (BCA), Legnaro, Italy*

The present study aimed to evaluate how the use of *Chlorella vulgaris* (3% or 6% replacing the same quantities of soybean meal from the control diet) affected growth performance and carcass traits of 576 broiler chickens (half males, half females) kept under thermoneutral or heat-stressed conditions until slaughtering (41 d). The 6% inclusion level of *C. vulgaris* resulted in lower final body weight (BW), body weight gain (BWG), and feed intake (FI) in comparison with the other dietary treatments (P <0.01) as well as higher breast and *Pectoralis major* muscle proportions compared to the control group (P < 0.05). Regarding environmental temperature, FI and breast proportion were higher in birds reared under thermoneutral conditions (P < 0.01) than in those kept in a heat-stress environment, while the opposite was observed for hind legs. Regarding the effect of sex, BW, BWG, and FI were significantly (P <0.01) lower, and feed conversion ratio was higher in females than in males. Males had also heavier carcasses (P < 0.01) and higher hind leg proportion (P < 0.01) than females, whereas females showed higher (P < 0.01) dressing percentage, breast, and *P. major* muscle yields than males. Regarding meat quality, the dietary inclusion of microalgae resulted in a color change (P < 0.05) and, at the highest inclusion level, in increased n-3 fatty acids (P < 0.05) and decreased n6/n3 ratio (P < 0.01). The heat stress led to higher meat pH and cooking loss (P < 0.01) and lower thawing loss (P < 0.05) compared to the control group.

OP-21 The effect of phytobiotic (PBC - AdiCox® AP, AdiFeed, Poland) addition to a diet on the quality of breast and thigh muscles of broiler chickens

Patrycja Ciborowska[1], Paulina Abramowicz-Pindor[2], Iwona Wojtasik-Kalinowska[3], Andrzej Półtorak[3], Damian Bień[1], Arkadiusz Matuszewski[4], Jakub Urban[1], Anna Zalewska[1], Karolina Chodkowska[5], Monika Michalczuk[1]

[1] *Department of Animal Breeding, Institute of Animal Sciences, Warsaw University of Life Sciences, Warsaw, Poland*
[2] *AdiFeed Sp. z o.o., Opaczewska 43, 02-201 Warsaw, Poland (Research Development), Warsaw, Poland*
[3] *Department of Technique and Food Development, Institute of Human Nutrition Sciences, Warsaw University of Life Sciences, Warsaw, Poland*
[4] *Department of Animal Environment Biology, Institute of Animal Sciences, Warsaw University of Life Sciences WULS-SGGW, Warsaw, Poland*
[5] *Krzyżanowski Partners Sp.z o.o., Pionki, Poland*

The aim of this study was to evaluate the effect of the addition of phytobiotic (PBC - AdiCox® AP, AdiFeed, Poland) in the diet of broiler chickens on the properties of chicken's breast and thigh muscles (chemical composition, physicochemical parameters) and the volatile compounds (VC) profile, which was analyzed with an electronic nose. Breast muscles were also evaluated visually against defects (white stripping, wooden breast, spaghetti meat).

The experiment was conducted on 130 000 Ross 308 broiler chickens randomly divided into 2 groups (n=65 000). Birds in the control group (CON) were fed grain-based feed mixtures. The feed of the experimental group (EXP) was enriched with PBC (100g/MT of complete feed), consisting mainly of red bell pepper fruit, white mustard, turmeric, soapwort root and calamus rhizome. At the end of the experiment, the chickens were slaughtered. Breast and thigh muscles (15 pc./group) samples were collected for further analyses. Statistical analyses were performed using SPSS software (PS IMGO PRO 8.0).

The experiment found that the percent drip loss and WHC in breast muscles were significantly lower for the EXP group ($p \leq 0.01$). The samples were also characterized by desirable significantly less shear force, a higher proportion of redness and higher collagen content ($p \leq 0.05$). The percent of thermal loss and fat content were lower in the EXP group ($p \leq 0.01$) in the thigh muscles, and at the same time significantly higher WHC and the share of red color in the meat ($p \leq 0.01$). The addition of PBC changed the profile of VCs in chicken's meat. In the EXP group 3 additional VCs were identified with sensory descriptors - aldehyde, floral, cinnamon.

The addition of PBC had a positive effect on selected parameters of breast and thigh muscles quality in broiler chickens.

OP-22 Effect of the addition of crude fibre concentrate in the feed on growth performance and meat quality of broiler chicken

Jakub Urban[1], Monika Michalczuk[1], Martyna Batorska[1], Damian Bień[1], Arkadiusz Matuszewski[1], Patrycja Ciborowska[1], Anna Zalewska[1], Adriana Jaroszek[2]

[1] *Department of Animal Breeding, Institute of Animal Sciences, Warsaw University of Life Sciences, Warsaw, Poland*
[2] *RETTENMAIER Polska Sp. z o.o, Warsaw, Poland*

The aim of this study was to determine the effect of the addition of crude fibre concentrate in the feed on growth performance and meat quality of broiler chickens. The study material consisted of 990 male chicks of the Ross 308 line divided into 3 groups in 5 replicates each - control - (C), experimental 1 - (A1), experimental 2 - (A2). The differentiating factor was the addition of ARBOCEL® crude fibre concentrate in the feed for the experimental groups (group A1: Starter - 0.4%, Grower 1 - 0.8%, Grower 2 - 0.8%, Finisher - 0.2%; group A2: Starter - 0.6%, Grower 1 - 1.0%, Grower 2 - 1.2%, Finisher - 0.4%). In the experiment, body weight and feed intake were controlled on day 10, 21, 35 and 42. After slaughter at day 42, 60 birds (20 from each group) were used for slaughter analysis. The breast muscles were subjected to chemical composition analysis, verification of physicochemical parameters and visual evaluation of muscle defects (white striping, woody breast and spaghetti meat). The higher ($P \leq 0.001$) final body weight was observed in birds from the experimental groups. Slaughter analysis showed higher ($P \leq 0.05$) percentage of leg muscles in the carcass for birds from the experimental groups. For the other slaughter analysis parameters, there were no differences ($P \geq 0.05$) between the experimental and control groups. The addition of crude fibre concentrate used in both experimental groups (A1 and A2): reduced the percentage of water content ($P \leq 0.05$) in the breast muscle structures and the percentage of breast muscle with the quality defect white stripping ($P \leq 0.05$) To sum up, the addition of ARBOCEL® crude fibre concentrate improved final body weight, % of leg muscles and selected quality parameters of breast muscle (decreased water content and white stripping defects) of broiler chickens.

OP-23 The effect of breed, gender, and dietary energy on breast meat yield and serum levels of insulin-like growth factor-1 in broiler chickens

Regiane R. Santos, Vanessa Lagos, Roger Davin, Francesc Molist

Schothorst Feed Research, Lelystad, The Netherlands

The hormone insulin-like growth factor-1 (IGF-1) is linked to cell proliferation and meat production. However, it is important to consider several factors when measuring serum levels of IGF-1. The aim of this study was to analyze the correlation between breast meat yield and serum IGF-1 of broiler chickens as influenced by breed, gender, and dietary energy level.

The trial was conducted as a 2×2×2 factorial design with fast- or slow-growing broiler chickens, divided into pens of male or female birds, fed a conventional diet or a diet with decreased energy level (-150 kcal AMEn). The fast-growing birds were kept until day 37, and the slow-growing ones until day 56. Besides carcass and breast meat yield, serum IGF-1 levels were assessed.

There was a 3-way interaction between breed, gender, and dietary energy on the serum levels of IGF-1 ($P<0.01$), where the highest IGF-1 levels were observed in slow-growing female birds fed the low caloric diet (1.1 pg/ml) and the lowest ones in fast-growing male birds fed the conventional diet (0.6 pg/ml). Similarly, the lowest breast meat yield was observed in slow-growing birds, regardless of gender and diet (~ 16%), and the highest one in fast-growing male birds fed the conventional diet (21%) ($P<0.001$).

Breast meat yield was in a linear negative correlation with serum IGF-1 (r= -0.40; $P<0.05$). This correlation was not related to breed (r=0.11; $P=0.7$) or gender (r= -0.50; $P=0.08$). However, when the broiler chickens were fed the conventional diet, no correlation between breast meat yield and serum IGF-1 was observed (r= -0.01; $P=0.97$), but when the birds were fed the low caloric diet, a negative correlation was observed between breast meat yield and serum IGF-1 (r= -0.66; $P<0.01$).

These findings suggest that IGF-1 serum levels are negatively correlated with breast meat and this correlation is mainly affected by dietary energy.

OP-24 Coccidiosis Control: Current and Future Practices in Poultry Farming

Madalina Diaconu, Twan Van Gerwe

EW Nutrition, Visbek, Germany

Coccidiosis is a devastating enteric challenge in the poultry industry, costing over 14 billion USD annually. This abstract provides an overview of current and future strategies for coccidiosis control, focusing on market and regulation drivers, and the specific role of natural anti-coccidial feed additives.

Market and regulation drivers influence current and future control strategies. EU Regulation (EC) No 1831/2003 distinguished coccidiostats from antibiotics, and the continued authorization of ionophores reflected their indispensability in profitable poultry production at the time. Natural solutions, including vaccines and anti-coccidial feed additives offer effective alternatives, and might make the industry less reliant on coccidiostats.

Natural feed additives, especially plant-based phytochemicals, have antimicrobial and antiparasitic properties. Compounds like saponins, tannins, flavonoids, terpenoids, artemisinin, and phenols have shown specific anticoccidial effects, reducing oocyst shedding, improving performance, and enhancing immune responses. The mode of action of these phytochemicals will be discussed in detail.

The use of natural feed additives, either alone or in combination with other control measures like vaccination and (chemical) coccidiostats, can contribute to reduced drug dependency and enhanced sustainability. Different future coccidiosis control strategies will be highlighted.

In conclusion, effective coccidiosis control in poultry farming is an evolving topic, with depends on Market and regulation drivers and. With their adoption, the industry aims to manage coccidiosis while curbing antibiotic resistance and maintaining profitability.

OP-25 Effect of Cannabidiol and Nano-selenium on the microstructure of the chicken breast muscle after *C. perfringens* infection

Paweł Konieczka[1], Dominika Szkopek[1], Misza Kinsner[1], Paweł Kowalczyk[1], Monika Michalczuk[2], Joanna Banach[3], Paulius Matusevičius[4], Joanna Bogucka[5]

[1] *Kielanowski Institute of Animal Physiology and Nutrition, Polish Academy of Sciences, Department of Animal Nutrition; University of Warmia and MazurDepartment of Poultry Science and Apiculture*
[2] *Warsaw University of Life Sciences, Institute of Animal Sciences, Department of Animal Breeding, Warsaw, Poland*
[3] *Institute of Natural Fibres and Medicinal Plants – National Research Institute, Poznań, Poland*
[4] *Lithuanian University of Health Sciences, Department of Animal Nutrition, Kaunas, Lithuania*
[5] *Independent Research Laboratory STANLAB LLC; University of Bydgoszcz, Bydgoszcz, Poland*

The aim of the study was to determine the effectiveness of the use of Cannabidiol (CBD) and Nano-selenium (Nano-Se) in broiler chickens, in the case of necrotic enteritis caused by *C. perfringens*, by evaluating the blood supply to the superficial breast muscle and pathological changes. This study showed potential of *Cannabis*-derived CBD and Nano-Se in modulation of muscle fiber lesions in the breast muscle under *C. perfringens*-induced stress response in chickens. The study design included 5 experimental groups, with 8 replicates in each group. Chickens were fed a complete feed mix for broilers divided into 3 feeding periods according to the Ross 308 chicken feeding recommendations. Chickens from groups CON positive, CBD, Nano-Se and CBD+Nano-Se were infected with *C. perfringens* on days 15, 16, 17 and 18 of age. The experiment used CBD extract obtained from industrial hemp (*Cannabis sativa*) (15 g/kg feed) and/or nano-Se (0.3 mg Se/kg feed), which were added to the experimental diets. Dietary supplementation with CBD and Nano-Se had an impact on the quality of chicken meat during *C. perfringens* infection. Adding of these substances in supplementation diet had a positive effect on chickens' response to this infection because was increased the number of capillaries which supply individual muscle fibers. Using of CBD and Nano-Se resulted in a decreased number of fiber splitting as well as in lower count of myofiber necrosis in breast muscle. The lowest number of atrophic fibers was found in the muscles of the chickens of the CBD group. The use of CBD, Nano-Se, CBD + Nano-Se significantly reduced the extent of decomposition compared to the CON group in chickens ($p<0.05$). Further studies are necessary for fully evaluation of the mechanism of action of the tested substances on the chicken breast muscles.

Friday, September 8, 2023

50 Years of Poultry Meat Symposia

Roel Mulder[1], Michael Grashorn[2]

[1] *Spelderholt Poultry, The Netherlands*
[2] *University of Hohenheim, Germany*

In 1963 the European Federation of WPSA branches established working groups on the quality of poultry products - 4a Quality of Eggs and Egg Products, 4b Poultry Meat Quality. The main objectives of the group were to provide a platform for exchange of basic knowledge on the whole field of poultry carcass and meat quality between the members of the different European WPSA branches. In the early 1970ies it was decided to combine regular working group meetings biennially with scientific symposia. This was stimulated by scientists from the USA, who already had a poultry meat project running. The first symposium was organized 1973 in Roskilde, Denmark and the official group name was changed to WG 5 'Poultry Meat Quality'. In 1981 it was decided to organize symposia together with WG 4 'Quality of Eggs and Egg Products'. Since the first meat quality symposium in 1973 symposia have been organized by 12 European branches, France and The Netherlands acted as hosts four times, each. Over time, 10 chairpersons managed the group and new research ideas for international cooperations and recommendations for methods for assessing carcass and meat quality features were developed to improve the value of poultry meat and were published in the World's Poultry Science Journal. The attendance of the symposia increased from less than 100 participants to more than 200 but declined in recent years, slightly. In the 1970ies topics concentrated mainly on meat safety, meat yield and carcass confirmation, whereas, in 2019 choice of topics was distinctly more diverse, e.g. quality aberrations, nutritive value, methods to predict quality, impact of feeding on quality, safety, genomics and proteomics. Also, alternative animal protein sources like cell cultured meat and insects gained increasing interest.

Integrated poultry production system

Małgorzata Gotz

Cedrob S.A., Poland

Cedrob S.A. is Poland's largest poultry meat producer. With over 30 years of experience in the agricultural and food industry, the Company is an important part of the Polish economy. The Company's activities are based on integrated poultry production systems according to the „from grain to table" concept. Today, thanks to a well thought-out and consistent investment policy, CEDROB S.A. delivers its products to the tables of millions of consumers around the world.

The priority of the Management Board and the Cedrob S.A. team is to constantly improve the quality of the products offered, which are produced using modern and specialised equipment. This requires active monitoring of the market situation and quick reaction to new trends and consumer behaviour. In practice, this means large investments in development and modernisation, as well as continuous improvement of already implemented technologies. Thanks to this, Cedrob is at the forefront of innovative solutions in poultry production and is a role model for other companies, even on a global scale.

The Cedrob brand portfolio includes a wide range of chickens, broilers, ducks and geese. They are available in a permanent offer in fresh and frozen form in Poland and in over 50 countries - worldwide in EU countries, Africa, Asia and the Middle East.

In its daily work, Cedrob S.A. faces the challenge of feeding the world's population while respecting and reducing the negative impact of agriculture on the environment. Many of the Company's initiatives are in line with the UN's global sustainable development goals and contribute to Poland's food security.

Methodologies on in ovo sexing

Matthias Corion[1], Simão Santos[1], Bart De Ketelaere[2], Dragana Spasic[1], Maarten Hertog[3], Jeroen Lammertyn[1]

[1] *KU Leuven, BIOSYST-MeBioS Biosensors group, Leuven, Belgium*
[2] *KU Leuven, BIOSYST-MeBioS Biostatistics group, Leuven, Belgium*
[3] *KU Leuven, BIOSYST-MeBioS Postharvest group, Leuven, Belgium*

In ovo sexing is related to methods to determine the sex of chicken embryos before or during incubation. Its objective is to eliminate the traditional practice of euthanizing male chicks after hatching, thereby enhancing animal welfare within the laying hen industry. Numerous researchers and institutions have been developing in ovo sexing technologies, with five of them being also commercially available in Europe. With upcoming EU-wide legislation, the topic has become increasingly relevant, drawing attention to the need for highly accurate (> 98%) technologies that can be applied early before pain perception (< incubation day 13), with minimal hatchability impact, at an acceptable cost, and for all types of breeds. To comprehensively assess the current advancements in the field, we performed an extensive search using the Web of Science and Patstat/Espacenet databases for papers and patents, respectively. The analysis encompassed a total of 49 papers and 115 patent families reported worldwide. This comprehensive review led to the identification of 11 technology categories, comprising six non-optical techniques (DNA analysis, immunosensing, ion mobility- & mass spectrometry [IMS & MS], genetic engineering, volatile organic compounds [VOCs], and other techniques) and five optical techniques (Raman & fluorescence spectroscopy, infrared & Terahertz spectroscopy [IR & THz], visible-near-infrared spectroscopy [VIS-NIR], radio-frequency & nuclear magnetic resonance spectroscopy [RF & NMR], and morphometric studies). Every category was described for its characteristics while assessing its potential for application. Regarding technology status, diversity was predominantly observed among patents, while certain approaches lacked scientific evidence such as IMS & MS that were not reported in papers. Moreover, genetic engineering and NMR were mentioned in a limited number of papers. Conversely, a well-rounded representation was found in both papers and patents for Raman & fluorescence spectroscopy, VOC analysis, VIS-NIR, DNA analysis, and immunosensing. Concerning in ovo sexing in practice, DNA analysis, immunosensing, IMS & MS, NMR, and VIS-NIR are currently implemented in a total of approximately 14 European hatcheries, with the latter being the most widespread. Finally, invasiveness was considered an important characteristic. Typically, non-optical methods tend to be invasive, except for VOC analysis, whereas optical methods are non-invasive, except for Raman. Moreover, non-optical approaches are earlier applicable on incubation day 9 with a desirable accuracy, while current optical approaches obtain a desirable accuracy around days 12 and 13. Although none of the technologies complies with all the industry requirements and more efforts might be necessary to meet these, five companies have already entered the market. On the one hand, more research and harmony

between consumers, industry, and governments is necessary. On the other hand, close monitoring of the market performance of the currently available techniques will offer valuable insights into the potential and expectations of in ovo sexing techniques in the poultry industry.

OP-26 Identifying VOC Differences in Intact Hatching Eggs from Different Breeds using Advanced Analytical Techniques HSSE-GC-MS, PTR-ToFMS and SIFT-MS

Matthias Corion[1], Miguel Portillo-Estrada[2], Maarten Hertog[1], Bart De Ketelaere[1], Jeroen Lammertyn[1]

[1] *MeBioS KU Leuven, Leuven, Belgium*
[2] *PLECO University of Antwerp, Antwerp, Belgium*

In the past decade, advanced analytical techniques have been exploited to study volatile organic compounds (VOCs) in eggs. These VOCs can provide information on factors such as freshness, fertility, presence of cracks, sex of the embryo, and breed. Our study evaluated three mass spectrometry-based VOC analysis systems (HSSE-GC-MS, PTR-ToFMS, and SIFT-MS) to profile and identify VOCs of intact hatching eggs from three different breeds (Dekalb White, Ross 308, and Shaver). The eggs were measured on incubation days 2 and 8, aiming to identify VOCs that differentiate breeds regardless of incubation day.

VOC measurements were performed on 15 eggs per breed by enclosing eggs together with PDMS-coated stir bars in inert Teflon air sampling bags. After 2 h of accumulation, the headspace was respectively analyzed on the PTR-ToFMS and SIFT-MS, whereas the VOCs adsorbed to the stir bars were analyzed using GC-MS for compound identification. PLS-DA models for breed distinction were built and variable selection was performed. Consequently, a collection of 11 to 13 VOCs enabled all three devices to effectively distinguish the breeds. Generally, heavier compounds were selected in the GC-MS-based models whereas lighter molecules were selected for the PTR and SIFT-based models. This potentially indicates that the GC-MS is complementary to the direct trace gas mass spectrometers in identifying VOC biomarkers. Our study confirms that breed-specific VOCs exist and can be discriminated with the help of HSSE-GC-MS, SIFT-MS, and PTR-ToFMS techniques. This is the first study that reports the usage of these mass spectrometry-based systems for intact eggs. Accordingly, they hold the potential to provide the egg industry with more insights into other biological factors measurable through VOCs.

OP-27 Effect of neutral electrolyzed water on desinfection and physical properties on egg (Gallus domesticus)

Victor Manuel Hernández-Pimentel[1], Jesus Sánchez-Hernández[1], Diana Victoria Melo-Sabogal[2], Erika Noemí García-Sánchez[1], Diana Alonso-Segura[1]

[1] *Technological University of Corregidora, Queretaro, Mexico*
[2] *Autonomous University of Queretaro, Queretaro, Mexico*

The egg has been used as a food in the human diet, due to its high nutritional value among proteins, lipids, minerals and vitamins. The shell is made up of 4 layers and is composed of 85-87 % protein, 3.5-4.4 % carbohydrates and 2.5 -3.5 % lipids. In Mexico, the law does not allow egg washing for consumption and distribution, however, in other countries such as the United States, it is allowed through various chemical agents. Neutral Electrolyzed water (NEW) is an antimicrobial agent used in the food industry for its disinfection properties. The aim of this work is to determine the NEW effect on disinfection and physicochemical properties of chicken eggs (*Gallus domesticus*). Treatment was 50 mg/L of NEW, a negative control with distilled water and two positive controls peracetic acid (PA) at 150 mg/L and sodium hypochlorite (NaClO) at 50 mg/L. A microbiological analysis was performed on a population of *S. typhimurium* of 8 log CFU/mL. Thickness and color were measured after treatments as well as the visualization of egg surface by scanning electron microscopy. Means comparison were analyzed by JMP statistical package using Tukey test. Antimicrobial activity of NEW (50 mg/L) reduced 2.35 FCU/mL against *S. typhimurium* population, similar to NaClO and PA treatments, highlighting that PA was used in a concentration 3 times higher. Regarding the shell thickness, NEW does not present a significant difference between the water control and the NaClO (50 ppm) treatments, unlike PA which significantly reduced the thickness of the shell besides the NEW handling is safer during its manipulation with respect to the PA. NEW treatment does not present significant changes in the color change with other treatments, and showed the least corrosive activity on the superficial structure of eggshell. NaClO showed greater cracks and PA greater corrosion against NEW treatments.

OP-28 Does oviposition interval affect the deposition of cuticle on the eggshell?

Ian Dunn[1], Peter Wilson[1], Sarah Struthers[1], Björn Andersson[2], Matthias Schmutz[2], Lina Hattendorf[2]

[1] *The Roslin Institute, University of Edinburgh, Midlothian. United Kingdom*
[2] *Lohmann Breeding, Cuxhaven, Germany*

We have previously hypothesised that the oviposition interval might be related to egg shell cuticle deposition. The cuticle prevents bacterial penetration and is the last event of egg formation. As genetic selection optimised egg production and the interval between eggs laid became closer to 24 hours, cuticle deposition may have been reduced.

Data collected from five breeds of White Leghorns with records of oviposition time was used to calculate oviposition interval. By definition we could only use data from hens that laid sequential eggs. In fact we chose to use only hens that had laid 5 eggs over 7 days to give good estimates (n= 473). Eggs were stained with a cuticle specific dye and measured using a Minolta colorimeter

Analysis of variance indicated that there was a significant effect of breed for cuticle deposition (P=0.04). However, the differences were small in terms of the distribution of the trait within lines. Regression analysis indicated no relationship between oviposition interval and cuticle deposition (P=0.11) although one breed did have a significant regression (P=0.02). The effect was only a 3% increase in cuticle deposition for a +1 hour oviposition interval. As expected the greater the number of eggs laid the shorter the oviposition interval (P<0.001). There was no difference in the cuticle deposition when analysed by the number of eggs laid.

In conclusion, there is very limited evidence of any relationship between cuticle coverage and the interval between ovipositions. That is not to say that in a population where no selection had been practiced for increased egg production there might not be. Further studies will be required to identify the factors that do underlie genetic and phenotypic variance of cuticle deposition.

OP-29 Would correlative elemental imaging explain the assimilation of essential trace elements in eggshell?

Iris H. Valido[1], Rosa Mary Lopez Alvarez[1], Florent Penen[1], Maria Angels Subirana[1], Stéphane Faucher[1], Pascale Senechal[1], Peter Moonen[1], Sandra Mounicou[1], Dawid Kołacz[2], Dirk Schaumlöffel[1]

[1] *CNRS, Université de Pau et des Pays de l'Adour, Pau, France*
[2] *Animine, Annecy, France*

Broken eggs represent an important source of economic loss for the egg industry. Shell defects are even more often in old layer hens, which have eggs with thinner shells. Trace mineral (TM) supplementation can help to improve the eggshell quality, thanks to the role of TM on shell formation. The objectives of this study were to evaluate the effect of TM supplementation on eggshell quality and understand how TM is incorporated into eggshells. 936 Leghorn layers (60 weeks of age) were distributed in three treatments with 12 replicates of 26 birds. Treatments were: negative control (NC) diet, without TM supplementation (54 ppm Zn, 60 ppm Mn); Zn diet, NC + 90 ppm of Zn from HiZox; Mn diet, NC + 110 ppm of Mn from ManGrin (Animine, Annecy, France). After 20 week trial, eggs were collected and analyzed for fracture force, shell thickness, and correlative imaging (X-ray tomography, Laser ablation LA-ICPMS, and NanoSIMS). Shell thickness was improved ($P<0.05$) by both Zn and Mn supplementation (0.35 mm) in comparison to NC (0.34 mm). However, fracture force was improved ($P<0.05$) when hens received the Mn diet (37 N) than Zn or NC diets (35 N on average). Correlative imaging results (X-ray tomography and LA-ICPMS) showed that Mn and Zn are located in the outer membrane of the eggshell and in the cuticle, whereas Ca is mainly found in the palisade and mammillary layers. NanoSIMS images revealed that Ca in eggshells seems to be more present in Mn supplemented diets, which may be related to the impact of Mn on calcium-binding proteins, and would explain the better fracture force in these eggs. In conclusion, TM supplementation improves eggshell quality but the effect of Mn seems to be more important than Zn.

OP-30 CIRCUIT: solution against male chick culling

Ana E. Blanco García

Respeggt GmbH, Cologne, Germany

Respeggt technology is the earliest method used in daily operation in hatcheries to end chick culling in Europe.

It is a liquid-based process that determines the gender by endocrinological analyses on the 9th day of incubation. The process has 3 parts:

a) Sample collection (CIRCUIT): The detection of the candled hatching egg's blood vessels and measurement of the egg size determines the exact place for the perforation. A laser makes a hole of 0.3 mm in the eggshell. A sample of a few drops of allantoic fluid is extracted by suction. After sampling, the hole is sealed with a beeswax seal, which optimizes hatchability.

b) Sample analysis (LAB): By an ELISA test and a patented marker, the level of estrone sulfate is measured in the samples. A colour change of the sample indicates a great quantity of hormone, which determines that the embryo is female.

c) Sorting of eggs (SORTER): According to the analysis´s results, the machine sorts the hatching egg into male and female. Female hatching eggs are returned to the incubator to continue the conventional incubation process. Male hatching eggs are discarded to be processed into high protein feed. These are used as supplements in pet food, piglet feed, and aquaculture (critical role in the circular approach to nutrient use).

The technology has 98% accuracy, and it can analyse the gender in hatching eggs of all colours and genetics. High-performance pipetting leads to a sampling time of one hatching egg per second in a non-invasive way. Additionally, it is compatibility with all setter trays (150/88).

Therefore, respeggt was the first pain-industry-ready solution on the 9th day of incubation.

Innovative biotechnologies for improving poultry meat quality.

Lorenzo Siroli

University of Bologna, Italy

Poultry meat production and consumption is increasing globally. In particular, chicken meat represents the most popular and preferred poultry worldwide. However, poultry also remains one the food categories mainly associated to infectious diseases caused by the major foodborne pathogens Campylobacter, Salmonella, and Listeria monocytogenes. In addition, in the last decades, the poultry industry has changed from retailing mainly whole carcasses to cut-up portions or further processed products. This new interest in more convenient products (i.e., cut-up, ready-to-eat) comes with its own challenges on safety and quality aspects. In fact, the intensive production and processing of poultry meat is not always accompanied by adequate safety and quality parameters as demonstrated by the increasing of foodborne diseases associated to the consumption of poultry meat and the rise in meat color, texture, and quality inconsistencies. To address these issues various innovative and promising biotechnological strategies such as biocontrol and biopreservation have been proposed to improve food safety and quality and extend shelf-life. In particular, natural compounds are the most appealing due to their potential antimicrobial activities and because associated to a “green” consumering and are environmentally friendly. Natural compounds including lactic acid bacteria, bacteriocins, bacteriophages, enzymes, essential oils and probiotics can also be used at farm level are able to improve poultry health and performance. In addition, lactoferrin, bacteriocins, bioactive peptides, cell-free supernatants, essential oils and biosurfactants are also of significant interest for their potential application as natural antimicrobials for improving the safety of raw poultry meat. These approaches, in combination with hurdle and mild technologies (i.e. active packaging, high Pressure Processing, Marinade solutions), can guarantee both safety by reducing both spoiling and pathogenic microorganisms and also improve the sensory characteristics (e.g., desirable flavor, texture, aroma) and increasing the shelf-life of meat-based products.

OP-31 Supplementing inorganic or chelated trace minerals with different protein sources on growth performance and meat quality of broilers

Lucas Schmidt Bassi[1], Marcin Hejdysz[1], Katarzyna Perz[1], Silvia Peris[2], Stanisław Budnik[3], Sebastian Kaczmarek[1]

[1] *Poznań University of Life Sciences, Poznań, Poland*
[2] *Novus International, Inc. Catalonia, Spain*
[3] *Novus International, Inc. Warsaw, Poland*

A study was conducted to test the hypothesis that protein sources with different concentrations of phytic acid could trigger an interaction with the dietary supplementation of trace minerals when added via inorganic or chelated forms, influencing their availability, and affecting performance and meat quality of broilers. A total of 600 broilers were assigned to a completely randomized design in a 3x2 factorial scheme, comprising 3 protein sources: soybean meal (SBM), rapeseed meal (RSM), or yellow lupine (YLM); and the inclusion of Zn, Cu, and Mn through either inorganic or bis-chelated sources, totalling 6 treatments with 10 replications of 10 birds. Data was submitted to a two-way ANOVA and Duncan's test ($P<0.05$). No interaction between treatments was observed. Use of YLM led to lower feed conversion ratio (1.44; $P<0.05$) than SBM (1.48) or RSM (1.47), but lower breast meat yield. Incidence of wooden breast was also higher in birds fed YLM compared to other protein sources. Bis-chelated minerals resulted in lower feed intake (4.89 vs. 4.93 kg) and feed conversion ratio (1.45 vs. 1.48) compared to inorganic source ($P<0.05$). The inclusion of minerals on bis-chelated form reduced the excretion of Zn (27.8 vs. 32.5 mg/kg of DM), Cu (6.5 vs. 8.8), and Mn (40.1 vs. 53.2) and improved breast vascularization ($P<0.05$) by increasing the lb of capillaries/lb of fiber (1.84 vs. 1.52) in relation to the inorganic source. Carcass yield and incidence of wooden breast or white striping were not influenced by trace minerals form. In conclusion, YLM improved performance but was detrimental to meat quality. Inclusion of trace minerals to broiler diets in bis-chelated form optimizes their retention regardless of the amount of phytic acid in the ingredients, improving muscle vascular tone and performance.

OP-32 Effects of betaine supplementation on the intestinal barrier function of broiler chickens

Wageha Awad[1], Ana Gavrău[2], Michael Hess[1]

[1] *Clinic for Poultry and Fish Medicine, Department for Farm Animals and Veterinary Public Health, University of Veterinary Medicine, Vienna, Austria*
[2] *Agrana Sales & Marketing GmbH/ currentlyAGRANA Stärke GmbH, Vienna, Austria*

Betaine acts as an osmolyte to help maintain cellular water balance and as a methyl donor through methionine recycling. Increased water retention due to the osmolytic effect of betaine increases the volume of the cell, thereby increase the anabolic activity, integrity of cell membrane and overall performance of the bird. This study was conducted to evaluate the effect of dietary betaine on gut integrity and permeability in broiler chickens by Ussing chamber measurements. Changes in the transepithelial flux of the small hydrophilic mannitol largely reflect changes in the permeability of the paracellular pathway. Hundred and five 1-day-old broiler chicks were randomly assigned into three treatments: control, natural betaine and betaine-HCL (1 kg active Betaine /ton).

It was found that betaine-HCL negatively affects the integrity of the intestine by increasing the intestinal paracellular permeability in both jejunum and cecum as evidenced by a higher mannitol flux. Since it was demonstrated that the feeding of synthetic betaine-HCL to broiler chickens resulted in a decreased barrier function via up-regulation of the cytosolic TJ protein occludin (OCLN), as well as down-regulation of the barrier-forming TJ protein (CLDN-5) and are therefore able to alter the epithelial permeability. On the contrary, feeding of natural betaine induced no significant changes in intestinal permeability.

This finding indictates that natural Betaine osmoprotectant properties supports the intestinal integrity and health, whereas synthetic Betaine HCL increased the intestinal paracellular permeability in both jejunum and cecum, and the supplementation of feed with different sources of betaine is not equal at the gut level, which can consequently affect animal performance and welfare.

OP-33 Effect of dietary supplementation with vitamin E and organic selenium on turkey meat quality during storage

Cibele Torres[1], Francesca Soglia[2], Federico Sirri[2], Massimiliano Petracci[2], Marco Zampiga[2]

[1] *Zinpro, Madrid, Spain*
[2] *University of Bologna, Cesena, Italy*

Turkey meat is prone to oxidative reactions that can affect its storage stability due to its high PUFA and heme pigment contents. This study evaluated the effect of dietary supplementation of vitamin E level (vitE; dl-tocopheryl acetate at 70 [Basal-B] vs. 300 ppm [High-H]) and selenium (Se) sources (inorganic [I] vs. organic zinc-L-selenomethionine [O], both at 0.3 ppm) on quality traits and oxidative stability of breast and desinewed minced thigh meat. A total of 1,064 day old female turkeys were randomly divided into 4 experimental groups: BI, BO, HI, and HO. At processing (100 d, avg live weight 9.7 kg), 200 Pectoralis major (PM; 50/group) were sampled to evaluate main quality traits, technological properties of fresh meat at 48 hours post-morten and oxidative stability after 3, 7, 10, and 12 days of storage at 4°C in modified atmosphere packaging (30% CO_2, 70% O_2). Desinewed minced thigh meat was analysed after 3 and 90 days of frozen storage at -20°C. Data were analyzed as a 2×2 factorial design, using ANOVA at $P < 0.05$. Supplementation with O increased Se breast deposition and reduced cooking losses at 3 d. Regardless of Se source, H-vitE resulted in darker breast meat at 3 d and increased oxidative stability of the lipid fraction up to 10 d; at the end of storage period, the BO and HO exhibited the greatest and lowest values, respectively, whereas BI and HI did not differ from each other. Regardless of vitE, O supplementation decreased breast lipid oxidation at 12d. H-vitE significantly increased the lipid fraction stability of desinewed minced tight after 3 d of frozen storage but not after 90 d storage. Due to its time-dependent antioxidant effect, the supplementation with H-vitE and O may be considered as a promising feeding strategy to control oxidative reaction in turkey meat during storage.

OP-34 Precision biotics modulates cecal microbiome and metabolites and improves broiler performance

Phokela Segobola[1], Cristiano Bortoluzzi[1], Philippos Fidiarakis[1], Irene Eising[1], Katarzyna Asman[2], Karol Kopec[2]

[1] *DSM, Kaiseraugst, Switzerland*
[2] *DSM, Warsaw, Poland*

Global efforts to reduce antibiotic use in the poultry industry have gathered momentum over the last decade, prompting the development of new technologies to improve animal health, performance, welfare, and sustainability. Precision biotic (PB; Symphiome™, DSM Nutritional Products) is a novel glycan complex designed with specific glycosidic linkages and varying chain sizes, that can redirect the functions of the gut microbiome and change the metabolites produced by the gut microbiome which have important roles in intestinal homeostasis. It has been observed that PB modulates pathways related to protein metabolism and utilization and short-chain fatty acid (SCFA) production, improves the growth performance of chickens and increases resistance against enteric stress. PB fed to broilers at 0.9 kg/ton increases cecal concentrations of metabolites such as butyrate and valerate by 20% compared to the control. Additionally, the cecal concentration of cadaverine and putrescine increased by 43% and 48% respectively. The microbiome analysis showed PB significantly enhanced the abundance of several *Lactobacillus* species in the ileum while promoting the growth of beneficial microorganisms such as *Blautia* and *Lactobacillus* in the ceca. PB has been found to increase the abundance of butyrate kinase and pyruvate carboxylase genes in the cecal microbiome, increasing SCFA production. In a commercial study, PB at 0.9 kg/ton modulated the abundance of microbial metabolic pathways associated with amino acid fermentation and putrefaction, particularly from lysine, arginine, proline, histidine, and tryptophane, and the zootechnical performance was significantly improved. Overall, PB induces beneficial changes in microbial metabolism that change the production of microbial metabolites and lead to improvements in growth performance.

OP-35 Microminerals to reduce meat and carcass quality issues

Mireille Huard, Stanislaw Budnik, Silvia Peris

NOVUS Europe, Zaventem, Belgium

In recent years, the genetic selection of fast growing birds associated to management practices such as high densities, litter management and other challenges has lead the poultry industry to face regularly the occurrence of carcass quality issues and growth-related muscular abnormalities. The meat and carcass quality issues have consequences at farm level (foot pad dermatitis), slaughterhouse level (skin, bones), and transformation (wooden breast, white striping, spaghetti meat). Due to their role in enzymatic processes involved in muscle tissue development (collagen production and cross linking, vascularization) and oxidative stress in broilers (as cofactors of Superoxide dismutase), Zinc, Copper, and Manganese have been identified for their proven positive effects on performances, but also as a help in the regeneration process if damage occurs. In a recent trial, 800 Ross 308 broilers were placed in 16 pens and reared from 0-42 days. At d30 they removed 14 chicks/pen to achieve 36 chicks/ pen at slaughtering. Each group of 8 pens received feed differing only by the supplementation : the first group (ITM) received 50 ppm of Zn, 10 of Cu and 80 of Mn from inorganic sources, and the Second group (MINTREX) received 50 ppm of Zn, 10 of Cu and 50 of Mn in the form of bis chelate of hydroxy analog of methionine. At day 42 there was no statistical difference on LW, FCR and mortality, between the 2 groups, although MINTREX group performed numerically better on LW (3,317 kg vs 3,280 kg) and mortality (4,5% vs 6,5%). FPD scores were significantly better for MINTREX group (60% vs 39% without lesions, $P<0,03$). There was numerically a better percentage of fillet without Wooden Breast (61,7% vs 51,7%) for MINTREX group. The use of organic trace minerals is a cost-effective way, compared to other nutritional strategies, to optimize profitability of poultry production chain.

OP-36 Effects of lipid sources on the growing performance and carcass and meat quality of broiler grillers

Elisabeth Baéza[1], Michel Lessire[1], Pascal Chartrin[1], Hervé Juin[1], Karine Méteau[2], Mathieu Guillevic[3], Guillaume Chesneau[3]

[1] *INRAE, Nouzilly, France*
[2] *INRAE, Surgères, France*
[3] *Valorex, Combourtillé, France*

The aim of the present study was to increase the amount of n-3 fatty acids (FA) in the edible part of broiler grillers dedicated to export market by replacing soybean oil by different levels of extruded linseeds (LS) and rapeseed (RS) oil in growing and finishing diets. For that purpose, 2112 chickens from JV15 line were distributed into four groups. Each group comprised eight pens with 66 chickens per pen. The groups were: G1=control diet, G2=3- 5% LS + 2- 1% RS, G3=4-6% LS + 1.6-1% RS, G4=5-7% LS + 1-1% RS. The growing performance were recorded. At 31 days of age, all chickens were slaughtered in a commercial slaughter plant at an average weight of 1322 g. Thirty carcasses per group were cut to determine cut yields. The edible part of half carcass was removed to determine the chemical composition and FA composition of meat with skin. The sensorial quality of thigh meat was evaluated on 20 carcasses per group after roasting. The dietary treatment had no effect on the growing performance neither on carcass composition. There was no difference between groups for the sensorial quality of thigh meat. The differences between groups only concerned the FA composition of meat plus skin with higher levels of n-3 FA in groups G2 to G4 compared to G1 ($P < 0.05$). In conclusion, it is possible to enrich with n-3 FA meat plus skin of broiler grillers dedicated to export (0.4 to 0.5 g n-3 FA/100 g meat plus skin vs. 0.3 g in control group) without modifying growing performance, carcass composition and sensorial quality of thigh meat.

Biosecurity in Animal Production

Ilias Chantziaras

University of Ghent, Belgium

What is biosecurity?

Biosecurity, consists on the combination of all measures implemented that reduce the risk of introduction and spread of disease agents. Biosecurity can be considered at different levels such as country, region, herd or flock, and even the individual animal. Implementing biosecurity requires the adoption of a set of attitudes and behaviors to reduce the risk in all activities involving animal production or animal care. Biosecurity is based on the prevention of and protection against infectious agents. The measures to be established should not be seen as constraints but rather as part of a process aimed at improving health of animals, people and the environment. Biosecurity can be subdivided in two main components: external biosecurity which is focused at keeping pathogens out of the herd and internal biosecurity which is focusing at preventing the spread of pathogens within the herd.

Why is biosecurity important?

Biosecurity is considered the basis of any disease control program. The combination of all biosecurity measures aims preventing both the introduction as well as the spread of infectious agents in a group of animals. Biosecurity is key at preventing the introduction and spread of epidemic / transboundary diseases (e.g. Avian Influenza) that can have detrimental impacts on farm animal production chains. Likewise, biosecurity's role is crucial in preventing zoonotic infections (e.g. Campylobacter, Salmonella) and therefore also benefits human health in a stable to table approach. It addresses as well the daily concerns of farmers linked to the endemically present infections that need to be kept under control to prevent the adverse health effects and economic consequences, as well as increased antimicrobial use and impaired animal welfare.

How to move forward?

The faculty of Veterinary Medicine of Ghent University, Belgium, in collaboration with CID LINES, an Ecolab Company, has created an Academic Chair on biosecurity in animal production in June 2022. Through this, research and education programs on biosecurity in animal production are being developed. Biosecurity initiatives are linked with One Health topics (e.g. trends on antimicrobial usage). With the industry facing multiple challenges (e.g. one health threats, environmental burden, responsible use of antimicrobials), this Biosecurity Chair strives to create meaningful output with a strong focus on keeping animals healthy via applying preventive biosecurity measures. Improving biosecurity is expected to improve resilience and sustainability of agriculture.

Nutrition of laying hens and egg quality: The Brazilian experience.

José Henrique Stringhini, Bruno Serpa Vieira, Renata Rodrigues Gomes, Thamirys Vianelli Maurício de Souza, Fernanda Alves Duarte, Laura Alves Duarte, Itallo da Silva Faria, Jade Martins de Souza Tavares, Rafaella Cruz de Araújo

[1] *Universidade Federal de Goiás, Goiânia, Brazil*
[2] *Universidade Federal de Uberlândia, Uberlândia, Brazil*
[3] *CNPq fellowship*

Brazil, a leading global food producer, has witnessed significant advancements in egg production alongside its notable achievements in grain and meat production. The per capita consumption of eggs in Brazil has risen from approximately 90 eggs per capita/year to around 250 eggs per Brazilian in 2022 (ABPA, 2023). Total production has surged from 1.6 million dozens in 2020 to nearly 4 million dozens in 2022. The COVID-19 pandemic played a significant role in driving the increased egg consumption among Brazilians (EMBRAPA, 2020; ABPA, 2023). While export numbers for eggs from Brazil have historically been lower compared to poultry meat, they have witnessed substantial growth in recent years, particularly in 2023. In the first half of 2023 alone, export figures have already surpassed those of 2022, with Japan and Taiwan emerging as the primary destinations for Brazilian egg exports. Poultry science has identified critical methodologies to assess the quality of poultry products. Both internal and external quality assessments performed in Brazil are commonplace in poultry research worldwide. De Blas and Mateos (1991) identified various factors by which nutritional and dietary changes can influence the quality of commercial eggs. Wang et al. (2017) provided insights into the current understanding of these effects, including the relationship between laying hen nutrition and its environmental impact. Several studies have highlighted key aspects of bird nutrition that contribute to enhancing the internal and external quality of eggs, such as specific amino acids and fatty acids that directly influence the albumen and yolk quality. Notably, Obianwuna et al. (2022) suggested that various natural compounds can influence intestinal health and consequently impact albumen quality. Egg quality tournaments are conducted in Brazil to recognize producers across different regions. These evaluations employ electronic egg quality equipment to guide producers in achieving high-quality eggs. Additionally, numerous research papers published in recent years have assessed eggs from laying hens under different climatic and storage conditions, underscoring the significance of controlling both internal and shell quality in a country with diverse environmental conditions. Poultry nutrition experiments have been a major focus of studies involving laying hens in Brazil. In the 1990s, research predominantly revolved around nutritional requirements and the use of synthetic and industrial amino acids in laying diets. Presently, studies on additives, including enzymes, probiotics, and herbal extracts, are the main driving force behind research in Brazil. These additives encompass various plant and fruit processing waste generated within the country. Moreover, there is growing attention towards utilizing birds with longer production cycles (100 weeks and 500 eggs per

housed bird), and the rise of out-of-cage rearing systems has dominated nutrition studies, with published articles extensively exploring the resulting egg quality. This presentation summarizes the key findings obtained in Brazil in recent years and provides a comprehensive discussion of the main outcomes.

Biotechnological applications of egg shell

Joanna Kobus-Cisowska, Krystyna Szymandera-Buszka, Maciej Jarzębski, Daria Szymanowska, Ryszard Rezler

Poznan University of Life Sciences, Poland

The production of chicken eggs at the industrial level leads to a significant amount of shell residue, which most often constitutes production waste. Consumer egg shells are considered to have no economic value, despite the fact that they are rich in minerals that could provide an alternative to synthetic dietary supplements. A wide range of possibilities for the processing and use of egg shells as a source of minerals and a raw material with functional properties was demonstrated. Egg shell supplementation of food for example fried cheese (bread spread) is not technologically easy, and the problem is texture. The solution can be the use of raw material that has previously undergone a supercritical micronization process. The possibility of obtaining powders containing small particles of less than 100 um in size is an important part of the process. The results of the implementation calcium from egg shell in fried chees was evaluated. Impact of the additives in calcium mixture, such as vitamins for the bioavailability were also investigated. For technological aspects, rheological test of modified fried cheese studies were performed. Finally, sensory tests during the refrigerated storage were made. Our results, proved that selected components added to fried cheese with calcium from the shell have an effect of on the bioavailability of calcium in the in vitro digestion. Egg shell can be an attractive biofunctional food additive, because its high concentration of easily digestible calcium and the suitable technological treatment. An interesting application of it, is the fried cheese enriched in not solely micronized egg shells, but also enriched in the lysine particles, vitamins K and D. The application of egg shell to the fried cheese does not affect negatively the physicochemical, rheological and sensory factors and it does not change the storage stability.

OP-37 Total Replacement Technology™ (TRT) improves eggshell strength and keel bone health, while reducing mineral excretion

Joel Estevinho[1], Harriet Walker[2], Jules Taylor-Pickard[3]

[1] *Alltech Portugal, Sintra, Portugal*
[2] *Alltech UK, Stamford, United Kingdom*
[3] *Alltech Biotechnology Centre, Dunboyne, Irland*

A study was performed in brown laying hens, over five cage-free farms, to investigate the effect of organic (OTM) and inorganic trace minerals (ITM) on eggshell strength, mineral excretion, keel and tibia traits. Each farm had a control and treatment group of the same breed and date of hatch. The control and treatment birds received diets of the same specifications, except for Zinc (Zn), Copper (Cu), Manganese (Mn), Iron (Fe) and Selenium (Se): control birds received a diet supplemented with conventional levels of ITM, while the treatment group had the ITM replaced with lower levels of organic minerals (Total Replacement Technology™, TRT) for Zn, Cu, Mn and Fe (Bioplex®, Alltech Inc.) and Se (Sel-Plex®, Alltech Inc.).

Despite the reduced mineral supplementation, eggshell strength was significantly improved in treatment (TRT) birds during the trial ($p<0.05$), whereas the mineral content in the faeces of Zn, Mn, Cu, Ca, K and Na was significantly lower ($p<0.05$). Tibia breaking strength, Ca and P were unaffected by treatment, despite greater tibia ash in the control. Calcium and Phosphorus percentages in keel ash were greater in TRT birds, while ash percentage and keel breaking strength were lower. However, TRT birds had lower percentage of damaged keels (fractures and/or deviations) than the control in the caudal ($p=0.004$), middle and cranial portions.

These novel findings demonstrate that TRT can simultaneously increase eggshell strength and reduce mineral excretion, while alleviating keel damage in laying hens.

OP-38 Biosecurity gaps in poultry breeder and layer farms in EU – a farmers perspective

Arthi Amalraj[1], Hilde Van Meirhaeghe[2], Rozenn Souillard[3], Artur Zbikowski[4], Jeroen Dewulf[1]

[1] *Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium*
[2] *Vetworks BV, Aalter, Belgium*
[3] *ANSES French Agency for Food, Environmental and Occupational Health & Safety, Epidemiology, Health and Welfare Unit, Ploufragan, Belgium*
[4] *Institute of Veterinary Medicine, Warsaw University of Life Sciences, Warsaw, Poland*

Poultry breeder (n=46), layer (n=37) and free-range layer (n=21) farms part of the H2020 NetPoulSafe project, were assessed with focus on 46, 45 and 54 biosecurity measures (BM) respectively in each production. The farmers responded to the frequency of implementation and the reasons for non-compliance. Most measures (75% of all the answers collected) were frequently implemented due to regulatory control. However, a compromise was noticed on implementation of some measures. Wheel disinfection (BM1), cleaning and disinfection of the rendering tank after each collection (BM2) and egg storage room (BM3) after each collection, showering of personnel (BM4)/ visitors (BM5) and farm-specific clothing and shoes for egg transport drivers (BM6) were less implemented compared to other measures. A descriptive analysis of the collected data showed that from the total respondents, only 78% breeder, 59% enclosed layer and 62% free-range layer farms practiced BM1; only 46% breeder, 67% enclosed layer and 42% free-range layer farms practiced BM2; only 47% breeder, 63% enclosed layer and 69% free-range layer farms practiced BM3 and only 75% breeder, 67% enclosed layer and 56% free-range layer farms followed BM6. In only 65% breeder, 11% enclosed layer and 19% free-range layer farms, farm personnel showered before entering into the poultry house and in only 72% breeder, 24% enclosed layer and 24% free-range layer visitors showered before entering into the poultry house, often reported “excessive measure” in some productions. The main reasons for non-compliance were “lack of time”, “not knowing risks/advantages”, “expenses incurred” or “not considered useful”. This study suggests that intervention is needed in order to further improve biosecurity compliance in the participating farms.

OP-39 The impact of dietary supplementation with an Aspergillus oryzae-derived postbiotic on productive performance of laying hens under commercial conditions from 13 to 35 weeks of age

Cesar Ocasio Vega, Fernando Bargo

BioZyme Incorporated St. Joseph, Missouri, United States

We evaluated the impact of dietary supplementation with an Aspergillus oryzae-derived postbiotic (AOP) on performance and the productive lifespan of Lohmann Brown Classic hens from 13 to 35 wk of age. A CRD with 2 treatments that consisted of a commercial diet (CON) or the same diet supplemented with 50 g AOP/metric ton of feed (AOP) was used. Each treatment was replicated 3 times (the experimental unit was the barn with an average of seven thousand hens/barn). The field trial lasted 22 weeks. Egg production, percentage of discarded eggs, number of sellable eggs, and mortality were recorded weekly. Data were reduced to weekly means and their standard deviation and analyzed as a CRD with the treatment as main effect by using the GLM procedure of SAS. The number of sellable eggs/week was standardized to seven thousand animals/barn. The Inclusion of AOP in the diet from 13 to 35 wk of age improved layer performance, egg quality, and the productive lifespan of the flocks. Dietary supplementation with AOP resulted in 15% higher egg production (P=0,007; 72,8% vs. 84,0% for CON and AOP groups, respectively). Furthermore, AOP supplementation reduced the percentage of discarded eggs by 39 % (P=0,058; 3,96% vs. 2,41% for CON and AOP groups, respectively) and increased the number of sellable eggs by 12% (P=0,004; 1,83 vs. 2,05 million eggs sold for CON and AOP groups, respectively). In addition, feeding AOP reduced flock mortality by 21% (P=0,44; 6.86% vs. 5.38% for CON and AOP groups, respectively), improving hen lifespan which is related to more animals under production throughout the production cycle. It can be concluded that feeding 50 AOP/metric ton of feed has a positive effect on the performance and productive lifespan of laying hens. Preliminary results from research work aiming to document the mode of action of AOP are in line with the postulated targets of postbiotics.

OP-40 Optimizing biosecurity in breeding and egg laying poultry through qualitative and quantitative surveys

Arthi Amalraj[1], Hilde Van Meirhaeghe[2], Rozenn Souillard[3], Artur Zbikowski[4], Jeroen Dewulf[1]

[1] *Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium*
[2] *Vetworks BV, Aalter, Belgium*
[3] *ANSES French Agency for Food, Environmental and Occupational Health & Safety, Epidemiology, Health and Welfare Unit, Ploufragan, Belgium*
[4] *Institute of Veterinary Medicine, Warsaw University of Life Sciences, Warsaw, Poland*

Good practices prevent diseases and economic losses, and ensure high production standards in poultry farming. Poultry breeder (n=46), enclosed layer (n=37), free-range layer (n=21) farms and egg collection facilities (n=11) were interviewed (study 1) on implementation of biosecurity measures (BM) and supporting measures (SM). The most successfully applied SMs (to improve the implementation of the biosecurity measures) were advisor support (e.g. coaching) followed by training using group discussion and biosecurity checks by stakeholders and government. Biosecurity checks helps with constant monitoring and to maintain a high level of vigilance and attention to biosecurity. Farm biosecurity tested with Biocheck.ugent breeder surveys (study 2) showed that the average farm scores (n= 63) for egg transport and egg management were 67% and 66%, respectively. In 88.9% farms, egg trays were cleaned and in only 82.5% farms both cleaned and disinfected after each outgoing egg transport. The drivers have no access to the egg facilities in 56% farms or have access to only the specific storeroom in 33% farms. The quantitative scoring and benchmarking shows there is more room for improvement. Descriptive analysis from study 1 showed that the least implemented biosecurity measures in egg collection facilities were: wheel disinfection, use of farm-specific clothing and shoes, shower for visitor and personnel, using disposable egg trays, C&D of egg trucks and loading areas. Only 47% breeder, 63% enclosed layer and 69% free-range layer farms practiced C&D of egg storage room and only 75% breeder, 67% enclosed layer and 56% free-range layer farms had farm-specific clothing and shoes for egg transport drivers. Intervention is needed to further improve compliance in the participating farms.

OP-41 Potential of a triple strain Bacillus-based probiotic to prevent egg contamination with Salmonella in layers

Antoine Meuter[1], Samiullah Khan[2], Kapil K. Chousalkar[2], Dorthe Sandvang[1], Anna Karwacinska[1]

[1] *Chr. Hansen, A/S, Hørsholm, Denmark*
[2] *School of Animal and Veterinary Sciences, The University of Adelaide, Roseworthy, Australia*

Salmonella reduction for production of safer eggs and egg products has always been a priority for the poultry industry. Salmonella Tythimurium has the potential to disturb microbiota balance in the hen's gut causing continuous fecal shedding that can result in contaminated eggs. In this study, the potential of a triple strain Bacillus-based probiotic to restore gut microbial equilibrium and reduce Salmonella load was investigated. Day old female chicks were divided into six treatment groups (7 chickens per group), reared in pens until week 14 and then transferred into individual cages. The groups were:1) negative control, 2) Salmonella challenge, 3) Salmonella challenge, continuous probiotic supplemented, 4) non challenged, continuous probiotic supplemented, 5) Salmonella challenge, intermittent probiotic supplemented, 6) non challenged, intermittent probiotic supplemented. At 18 weeks of age, pullets from the challenge groups were orally inoculated with Salmonella Typhimurium. Salmonella challenge negatively impacted the diversity and abundance of many gut microbial genera involved in key metabolic functions. Probiotic supplementation improved the gut microbiota by balancing the abundance of most of the genera displaced by the Salmonella challenge. Clearer effects were observed with continuous supplementation of the probiotic that significantly decreased the overall mean load of Salmonella in feces and its presence in internal organs ($P<0.05$). Strategic feeding of a triple strain Bacillus-based probiotic helps restoring many of the microbial genera displaced by a Salmonella challenge while contributing to food safety by limiting its shedding and preventing organ contamination with this foodborne pathogen.

OP-42 Effect of a Mycotoxin deactivator on the Growth, Reproductive Performance, Immunity, Egg Quality, Oxidation and Intestinal Status of Broiler Breeders and their Offspring Broilers

Damien Preveraud[1], Shiping Bai[2]

[1] *Adisseo, Antony, France*
[2] *Sichuan Agricultural University, Chengdu, China*

A total of 480 Cobb breeders (50 weeks-old) were allotted into 30 replicates and randomly assigned to 6 experimental treatments for 4 weeks: a commercial diet (Control), a low dietary concentration of mycotoxins with (LML) or without (LM) the supplementation with 2 kg/t of mycotoxin deactivator (MD), a high dietary concentration of mycotoxins with or without (HM) the supplementation of 2.0 (HML) or 2.5 kg/t (HMH) MD. Besides the recording of performance, two birds were randomly selected from each replicate and blood, jejunum and liver tissues were collected. Live body weight was not influence by the treatments. Mycotoxins in the diet impaired the laying (egg production and feed efficiency, P0.05) and reproductive performances (hatchability and embryonic mortality; P0.05) but MD can restore them to their initial level. Egg quality (shell thickness, Haugh unit, yolk color) were somehow affected by the challenge but the MD aimed to significantly increase these technological parameters. Some redox (SOD) and immune (IgA, lysozyme, pro-inflammatory cytokines) markers in blood were also negatively modulated by the dietary mycotoxins but the mycotoxin solutions were enable to promote them even higher to the non-challenged control. Finally, liver cells were distended with fat in mycotoxin groups. The size of the vacuoles were larger in the HM group than in the LM group as well. MD addition decreased the fat deposition in the hepatocytes and restore an healthy status of the liver. In conclusion, the MD addition could improve the antioxidative function and intestinal immunity of breeders, resulting in the increases of the production and reproduction performance, and the MD addition in maternal diets could also increase the growth performance and immunity of offspring chicks.

New and old insights on genetic and production factors affecting the spaghetti meat abnormality in broilers

Avigdor Cahaner

The Hebrew University of Jerusalem, Israel

Since the 1950s, higher growth rate has been the main broiler breeding objective, being essential for efficient meat production. Breeding for more rapid growth has been very successful, with broilers growing faster every year, reaching higher body weights at earlier ages.

Over the years, several growth-related ‚defects' (e.g., excessive fatness, leg problems, ascites) have emerged. Due to their association with elevated growth rate, initially each defect was considered a biological limit to selection for further higher growth rate, and growth-reducing diets were suggested to mitigate its negative effects.

Eventually these defects were shown to be heritable and genetically independent of growth rate, allowing to select against the defects, while continuing to select for rapid growth and other traits.

In recent years, breast muscle myopathies have emerged, mainly White Striping (WS, first reported in 2007), Wooden Breast (WB, 2011), and Spaghetti Meat (SM, 2015). As with the earlier defects, management strategies have been suggested to reduce the incidence and severity of these myopathies, but breeding companies have amended their programs with selection against them. Indeed, WS has been declining, and similar decline is observed in WB, with low incidence/severity, and only among males reared to high body weights.

It appears that SM is not declining yet, in part due to its later emergence. The different nature of SM (compare to WB) further complicates its management and genetic mitigation. Whereas WB clearly increases with higher body weight and breast meat yield (hence not commonly found in females), incidence and severity of SM are higher in females than in males. Also, within sex SM is hardly associated with body weight and breast muscles size. Moreover, although the tendency to SM develops in broilers during rearing, it cannot be assessed on live broilers, and SM observed in slaughterhouses reflect not only inherent tendencies, but also random effects of processing.

OP-43 Proteomics on postmortem meat with white striping myopathy

Byungwhi Kong[1], Casey Owens[2], Walter Bottje[2], Majid Shakeri[1], Janghan Choi[1], Hong Zhuang[1], Brian Bowker[1]

[1] *US Department of Agriculture, Agricultural Research Service, Athens, United States*
[2] *University of Arkansas, Fayetteville, United States*

White striping (WS) is a major meat quality defect that results in significant economic losses on the global poultry industry. WS is the occurrence of white lines on raw breast fillets. The exact etiologies for WS are still unclear. Proteomic analyses of co-expressed WS and woody breast phenotypes previously demonstrated dysfunctions on carbohydrates metabolism, protein synthesis and calcium buffering capabilities in muscle cells. In this study, we conducted shotgun proteomics with WS only meat samples collected postmortem. Chicken breast fillets were collected at approximately 6 h postmortem from a university pilot plant. After determining WS severity, protein extractions were conducted from WS meat with no WB condition (n=5) and normal non-affected (no WS) control meat (n=5). Shotgun proteomics was conducted by Orbitrap Lumos, tandem mass tag (TMT) analysis. Proteins were identified using a Scaffold program, and differential abundance were calculated using t-tests. The annotations of proteins and pathway analyses were performed using Ingenuity Pathway Analysis software. In this study, 146 differentially abundant proteins (|fold change|>1.4; p value < 0.05) were identified in the WS meats compared with controls. The significant canonical pathways include serine biosynthesis, aldosterone signaling, protein ubiquitination, and NAD salvage pathway. The potential upstream regulators include LIPE, let-7, NID1, UCP1 and KLF15. The results of this study provide additional insights into the cellular mechanisms on WS myopathy and meat quality.

OP-44 Current state of breast meat quality in fast-growing, standard-yielding modern strains of broiler chickens

Chaima Hammemi, Amani Askri, Nabeel Alnahhas

Laval University, Quebec, Canada

Increased genetic selection pressure to improve broiler breast meat yield (BMY) has led over time to the occurrence of multiple breast meat quality defects. It is thus important to provide new data on the current state of breast meat quality in modern broiler strains. Consequently, this study aimed to evaluate the effect of strain, sex and their interaction on slaughter performance and breast meat quality traits in fast-growing modern broiler strains. To achieve this, a total of 432-day-old chicks (n = 216 Cobb 500 and 216 Ross 308 chicks, 108 chicks/strain/sex) were distributed in a randomized complete block design consisting of four treatments in four blocks with four repetitions per treatment (n = 16 pens) and reared in an experimental poultry house. At d 35, 10 birds/pen (n = 40 birds/strain/sex) were individually weighted (BW5) and processed. The findings revealed a significant strain effect on BW5, BMY and thigh (TY) yield ($P < 0.001$, $P = 0.02$, $P < 0.001$, respectively). The sex effect was significant for BW5 ($P < 0.001$), but not for BMY or TY. In this study, the average score of wooden breast myopathy (WB) differed between strains ($P = 0.04$) and sexes ($P < 0.001$) and a significant interaction between strain and WB category was evidenced for BMY ($P < 0.001$). As for quality traits, the strain had a significant impact on pHu ($P = 0.03$), on drip and cooking losses ($P = 0.01$ for both), but not on the meat texture. Finally, an in vitro glycolysis model revealed a significant strain effect ($P < 0.001$) on the rate and extent of the post-mortem decline of breast muscle pH. In conclusion, yield characteristics, breast meat quality traits and defects are significantly determined by genetics as evidenced by the divergence between the strains investigated in this study.

OP-45 Quality of chicken meat from medium-growing genotypes approved by the European Chicken Commitment

Francesca Soglia, Mara Antonia Gagliano, Marco Zampiga, Federico Sirri, Massimiliano Petracci

Department of Agricultural and Food Sciences, Alma Mater Studiorum - University of Bologna, Bologna, Italy

The present study aimed to evaluate the main quality traits of breast and thigh meat belonging to some medium-growing (MG) genotypes - selected among those approved by the European Chicken Commitment - and compare them with those of the main fast-growing (FG) hybrid (Ross 308) used for meat production purposes. A total of 3,512 broilers was reared in an experimental environmentally controlled poultry facility. Four genotypes were considered, 1 FG and 3 MG, slaughtered at 42 and 50 d of age with an avg weight of 2.5-2.6 and 2.9-3.1 kg for females and males, respectively (n=439/group). Then, 12 pectoral muscles (PM) and thighs (T) were selected per group and used to assess the main quality traits (pHu, colour) and technological properties (drip and cooking losses, shear force) of meat. Data for PM and T were analyzed by factorial ANOVA considering the main effects of genotype (G), gender (g) and their interaction. When significant, means were separated by Tukey-HSD test ($p<.05$). The interaction term was not significant for none of the parameters. G strongly affected the main quality traits of both PM and T meat. MG had lower pHu ($p<.001$) associated with a higher water holding ability as depicted by lower drip ($p<.05$) and cooking losses ($p<.01$). These results could be explained by considering muscle hypertrophy characterizing the FG broilers which is often associated to an impaired protein functionality. A significant ($p<.01$) effect of gender was observed for PM and T weight with male broilers exhibiting higher weights (+35 and +32%, respectively) if compared to females. The first exhibited higher a* values due to a higher myoglobin content at muscular level. Overall, this study evidences the potential of MG genotypes as alternatives to the FG broilers to achieve the ECC goals.

OP-46 Effect of reduced crude dietary protein (CP) content on the quality of breast meat in broiler chickens

Sahar Benahmed, Amani Askri, Théophane De Rauglaudre, Marie-Pierre Létourneau-Montminy, Nabeel Alnahhas

Laval University, Quebec, Canada

In context of increased global demand for poultry meat, strategies to alleviate the environmental impact of poultry meat production are required. Reducing CP content in broilers' diets represents one such strategy that has been shown to decrease nitrogen and ammonia emissions. However, very little is known about the impact of this strategy on breast meat quality. Thus, this study was designed to bridge this gap in the literature. A total of 1,692 one-day-old male Ross 308 chicks were distributed in a randomized complete block design with 4 treatments replicated 9 times (n = 36 pens of 47 chicks each) in 6 blocks. The isoenergetic experimental diets were distributed during the grower (d11 – d22) and finisher (d23 – d35) phases and included: a control diet (20.4 and 19.5% CP, respectively), a CP-1.5% (19.0 and 18.0%, respectively), a CP-2.0% (18.5 and 17.5%, respectively) and a CP-3.0% (17.5 and 16.5%, respectively) diet. At 35 d, a total of 144 birds (4 birds/pen/treatment) were commercially processed and technological quality traits of breast meat including the ultimate pH (pHu), the color (L*, a*, b*), the cooking loss (CL), and the shear force (WBSF) were evaluated. Reducing CP content was not associated with significant changes in these traits except for CL ($P < 0.001$) which decreased with decreasing CP content. The myofibrillar fragmentation index and functionality of myofibrillar and sarcoplasmic proteins including their solubility, emulsion activity and stability indexes also were not influenced by the reduction in CP content. Additionally, dietary treatments did not alter breast meat proximate composition. In conclusion, this study has demonstrated that a reduction of 3.0% in CP content can be achieved without negative consequences for final breast meat quality.

OP-47 Physico-chemical properties of fiber and its impact on health, immune function and performance in poultry nutrition: A review

Julia Kern

J. Rettenmaier & Söhne GmbH & Co.KG, Rosenberg, Germany

As there is a need to identify ways to improve health and performance in today's new antibiotic restricted era, it is important to determine the influences of the nutrients we have in the feed and the role of their physical properties and chemical composition. Traditionally crude fiber was considered an antinutritional factor in poultry nutrition as it shows inconsistent effects on feed intake and digestibility. Studies showed a strong influence of fibers on the development of the gastrointestinal tract, intestinal physiology and the digestive process. Since these influences are indistinct it is necessary to record the similarities and differences between the fiber sources. One of the most often used differentiations is the solubility. Soluble fibers like pectins, arabinoxylans or β-glucans increase the intestinal viscosity, lower the passage rate of the digesta and thereby reduces the nutrient digestibility, while insoluble fiber is described to have the opposite effects. A very defined source of insoluble fiber is lignocellulose. Yokhana et al. demonstrated that these insoluble fiber has a beneficial influence on the enzyme activity in the digestive tract. Furthermore Hussein et al. showed the influence of the insoluble fiber lignocellulose on the immune system in layer pullets with a possible influence on lifetime immune function. The results of these trials implement that there is a certain need to take the chemical and physical characteristics of fiber in account in feed formulation to allow animals to show the performance they are genetically selected for. As the chemical definition seems to be not enough more focus should be on the physical parameters.

OP-48 Counteracting the detrimental effects of peptidoglycans in the gut by muramidase result in higher broiler performance, health and welfare

Irene Eising[1], Jean-Paul Ruckebusch[1], Katarzyna Asman[2], Karol Kopec[2], Philippos Fidiarakis[1], Phokela Segobola[1], Estefania Perez-Calvo[1]

[1] *DSM-firminich, Kaiseraugst, Switzerland*
[2] *DSM-firminich, Warsaw, Poland*

Improving gut health by applying feed additives is a wide used strategy to reduce antimicrobial resistance. Muramidase (MUR) breaks down peptidoglycans (PGNs, part of bacterial cell walls) from dead bacterial cell debris in the gastro-intestinal tract. During the natural bacterial turnover, PGNs are released from the bacterial wall into the lumen. PGNs, after recognition by the immune system might activate inflammatory reactions. Intestinal inflammation imposes several threats to the chickens, resulting in reduced growth performance. Dietary MUR supplementation (144 Ross 308 broilers in the trial, 9 replicates per treatment, 8 birds/pen, 0 vs. 35.000 LSU(F)/kg MUR) has demonstrated to modulate the immune response, by showing an increased the amount of goblet cells (P=0.0006) and intra epithelial lymphocytes (P=0.0003), while reducing the total CD3+ lymphocyte area (P=0.026) in the small intestine of broilers indicating a reduction of intestinal inflammation. Moreover, MUR supplementation (408 Ross 308 broilers, 8 replicates/treatment, 30 birds/pen, 0 vs. 35.000 LSU(F)/kg MUR) has shown positive effects on nutrient absorption (18% higher vit A plasma levels, P<0.05) and apparent ileal digestibility (2% increased total fatty acid digestibility at d9 of age, P<0.05; and 5% increased crude protein digestibility at d35 of age, P=0.0002)) of broilers which could be explained by the reduction on intestinal inflammation. As a results of these effects on the gastrointestinal functionality, MUR supplementation has showed a consistent improvement on feed efficiency and body weight gain. In a meta-analysis of 81 broiler trials, 35.000 LSU(F)/kg MUR fed to day 42, improved FCR with 4 points (control 1.64; MUR 1.6, P<0.05), and body weight with 43 g (control 2806g; MUR 2849g, P<0.05). MUR supplementation caused higher breast weights detected at the slaughterhouse (ranging from 2 – 11% improvement in commercial conditions). Additionally, MUR has shown a reduction on footpad dermatitis (two trials, 1920 or 1104 Ross 308 broilers, 0 vs. 35.000 LSU(F)/kg MUR showed 50 or 88% reduced footpad scores, P<0.05) as indicator of animal welfare. Therefore, dietary MUR supplementation optimizes gastrointestinal functionality which implied energy saving for the chicken metabolism which translated into productive improvements on feed efficiency, meat yield and animal welfare.

Saturday, September 9, 2023

Kipster: Changing the Food System

Bas Timmers

Kipster, The Netherlands

Changes aren't made by consumers alone. The whole chain needs wo work together. Kipster is changing the system of producing Eggs by combining the foodchain and listen to people/organisations with a vision. Main focus is to listen to the environment at the animals involved when producing an egg. Better Animal welfare We see chickens as more than just layers of eggs. They have desires, instincts and feelings. They suffer and enjoy. They're beings just like us – but then forest birds. They're not fans of open plains and they hate rain. That's why we created a natural-like wooded environment with plenty of variety, daylight, fresh air and free-range scurrying space. The park is fenced and netted off to minimize the chance of predators and bird flu. From waste to taste Over 70% of the world's agricultural land is used for livestock feed. This has an enormous impact on ecosystems, biodiversity and nature. It's why Kipster aims to bypass using agricultural land altogether. Our chickens in the USA and Netherlands are fed with a newly developed feed made of about 87% residual flows from bakeries and other food producers. Roosters for meat It's an awkward fact: the same number of laying hens and roosters are born every day. But what happens to the boy chicks? Billions of one-day-old roosters are gassed every year. Since we can't digest this reality, the brothers of our laying hens are raised raised in friendly homes before being sent to a slaughterhouse after 15-17 weeks. As for the spent hens, we make various meat products that are then sold at supermarkets. Healthy position farmer Farmers receive a fair price for their eggs.

Breeding and management of White Kołuda geese®

Katarzyna Połtowicz

Department of Poultry Breeding, National Research Institute of Animal Production

Poland is considered one of the largest goose producers in the EU. In the past year, a total of almost 199 million heads of poultry were raised in our country, of which 978 thousand were geese. A the same time, goose meat production amounted to almost 23.5 thousand tons. The dominant breed is the White Kołuda geese®, which account for more than 98% of all geese kept in Poland. This goose has been bred for 60 years at the Experimental Station of the National Research Institute of Animal Production in Kołuda Wielka according to an original breeding program. The White Kołuda geese® are characterized by very good reproductive traits, high meat content in the carcass, and excellent down and feather quality. Since 1990, genetic improvement of the population of these birds has been carried out in two breeds, W11 and W33, with different levels of performance. The W11 breed is characterized by outstanding reproductive traits and is continuously improving in laying performance, while the W33 breed is characterized by very good meat productivity. Both breeds are used for the production of commercial hybrids (W31), which are usually kept in accordance with oat feeding technology. The technology is constantly improved to obtain a high-quality product known as „the young Polish oat-fed goose." The meat of this goose is highly valued both within Poland and internationally. Most of the goose meat produced in Poland is exported, mostly to Germany, Hong Kong, the Czech Republic, and France. Moreover, White Kołuda goose® down is the best in the world and is valued by Japan and many Western countries. At the Experimental Station in Kołuda Wielka, research is being done on improving the breeding value, functional characteristics, and rearing technology of the geese. At the same time, actions are also taken to popularize the consumption of goose meat, among them by promoting production in ecological conditions and small farms, where geese are fed naturally with access to pastures and water reservoirs.

Antibiotic-free production system

Damian Konkol[1], Ewa Popiela[2], Sebastian Opaliński[2], Małgorzata Korzeniowska[3], Stanisław Trawicki[4], Zbigniew Idziaszek[4], Jakub Kucharski[4], Mariusz Korczyński[1]

[1] *Department of Animal Nutrition and Feed Science, Wrocław University of Environmental and Life Sciences, Poland*
[2] *Department of Environmental Hygiene and Animal Welfare, Wrocław University of Environmental and Life Sciences, Poland*
[3] *Department of Functional Food Product Development, Wrocław University of Environmental and Life Sciences, Polamd 4IKO Poultry Company, Poland*

The problem of antibiotic resistance of pathogenic bacteria in animal production is becoming more and more widespread. This carries a direct threat to human health, which is why solutions are sought to reduce or eliminate the use of antibiotics in animal production. In recent years, many nutritional solutions have been developed that provide an alternative to the use of antibiotics. These solutions include probiotics, prebiotics and synbiotics, phytoncide preparations, as well as salts of organic acids. These solutions, despite their effectiveness and positive impact on the health and productivity of animals, do not allow for the complete elimination of entibiotics. The aim of the work was to select the optimal broiler chicken rearing program, which after tests in the experimental center was transferred to farm conditions. The research was carried out at the Research and Didactic Station in Swojczyce. The tests were performed on 1260 chickens of the Cobb 500 line, aged 1-35 days. The hatched, one-day-old chickens were divided into 5 groups (7 repetitions/litter boxes per group) according to the scheme resulting from a different nutritional and prophylactic program: C-I: standard hatched chickens, feed with the addition of salinomycin, C-II: chickens hatched from disinfected eggs immediately after laying, vaccinated against coccidiosis, E-I: chickens hatched from eggs disinfected just after laying, vaccinated against coccidiosis, fed with the addition of amino acid chelates, E-II: chickens hatched from disinfected eggs just after laying, vaccinated against coccidiosis, fed with the addition of amino acid chelates and receiving an innovative herbal preparation in the feed in the amount of 200g/t of the feed mixture, E-III: chickens hatched from eggs disinfected just after laying, vaccinated against coccidiosis, fed with the addition of amino acid chelates and receiving an innovative preparation based on citrus fruit extracts in the feed (250g/t in starter and grower 1 mixes, 210g/t in mixes grower 2 and finisher). The analysis of the obtained results showed that the birds from the D-II group were characterized by the highest productivity, and the applied treatments did not affect the quality of chicken meat.

Nutrition of senior laying hens for extending the laying cycle

Evelyne Delezie, Annatachja De Grande, Sam Moeyersons

ILVO, Animal Sciences Unit, Melle, Belgium

Extending the laying cycle can improve sustainability as well as profitability of laying hen (LH) production. However, there are several bottlenecks when doing this, such as declining laying percentage, egg quality, decreased bone quality, health and welfare in particular after 60 weeks of age. New insights in how to responsibly obtain longer LH production cycles are needed, especially concerning the nutritional requirements of these older LH. This knowledge is almost non-existent, while it is essential for the Longer-Lay goal to support the hens. To date, there is no clear evidence that LH's energy and protein requirements vary during the day or that LH can adjust their daily intake accordingly. This is important as this may result in a nutrient imbalance. Secondly, while Ca level in layer diets is usually increased throughout the production period, P levels are reduced as hens become older. In fact, the exact nutritional P requirement for LH is uncertain and several studies have shown that current recommended requirements might be overestimated. Finally, the transition from the rearing to the laying period is a crucial period in which the hen is exposed to many (non)-physiological changes and must be able to anticipate them. Optimal nutrient utilization and gut health, will help them to adapt and perform optimally. It is not clear which feeding strategy is most effective, but a negative nutrient balance can result in liver disease or bone breakdown. Small scale experiments were conducted to evaluate different feeding concepts and find the most effective feeding strategy. Results showed that aged LH (> 60 weeks) can be fed diets with an energy and crude protein reduction of 10%. Also diets without supplementation of inorganic P did not negatively affect LH performance, health or welfare. Levels of 0.11% available P were sufficient for brown LH, but deficiencies were noticed for white LH. Feed composition and structure during pre-peak period had a significant effect on gastro-intestinal tract development and health. Evaluating precision feeding, defined as supplying the optimal nutrients for LH performance and health, resulted in reduced LH performance variability. However, these results cannot be generalized for all LH strains as a significant breed effect (white vs brown) was seen. The LH's rearing and genetic background determines their capacity to cope with high nutrient metabolism demands but also their behavior as reflected in their welfare status.

OP-49 Dietary Echium plantagineum oil increases n-3 LC-PUFAs in Canarian laying hen eggs

Jesús Villora[1], Alexandr Torres[2], Sergio Álvarez[2], José Antonio Pérez[1], Nieves Guadalupe Acosta[1], Maria Fresno[2], Covadonga Rodríguez[1]

[1] *Universidad de La Laguna, Departamento de Biología Animal, Edafología y Geología, Grupo NUTRAHLIPIDS, San Cristóbal de La Laguna, Spain*

[2] *Unidad de Producción Animal, Pastos y Forrajes en Zonas Áridas y Subtropicales, Instituto Canario de Investigaciones Agrarias, San Cristóbal de La Laguna, Spain*

Vegetables such as corn, soy and sunflower constitute the base of industrial livestock diets formulation, generating products such as eggs containing an unbalanced n-6/n-3 ratio, particularly rich in linoleic acid (LA; 18:2n-6) and arachidonic acid (ARA; 20:4n-6). Dietary supplementation with eicosapentaenoic acid (EPA; 20:5n-3) and docosahexaenoic acid (DHA; 22:6n-3), or with vegetable sources of α-linolenic acid (ALA; 18:3n-3) in laying hens diets is a common strategy to enrich eggs. Echium plants are characterized by a more balanced LA/LNA ratio, also including unusual high proportions of stearidonic acid (SDA; 18:4n-3) and gamma linolenic acid (GLA; 18:3n-6), both with increasing metabolic and pharmacological interest. The aim of this study was to compare the effect of three different dietary vegetable oils on egg yolk fatty acid profiles and egg sensory analysis from Canarian lying hens. A total of 48 animals were fed for 30 days using the same defatted cereal base supplemented with a different oil for each experimental group: Soy group (1.25% soy oil) mainly containing LA; Echium group (1% Echium plantagineum oil + 0.25% linseed oil) richer in SDA and ALA; and Linseed group (1.1% linseed oil + 0.15% animal fat) particularly rich in ALA. Although no sensory attributes were affected by the diet, the percentages of ALA, EPA and DHA increased ($P<0.05$) in the egg yolk of the Echium group being 1.76 ± 0.83%, 0.14 ± 0.05% and 1. 95 ± 0.38%, respectively. Due to the unique combination of n-3 and n-6 fatty acids, as well as the presence of SDA, Echium oil was more effective than linseed oil in increasing the synthesis and deposition of n-3 LC-PUFA, EPA and DHA, in the egg yolk of Canarian laying hens.

OP-50 Effect of feeding different vitamin levels on the deposition of vitamins in the egg

Sergio R. Fernandez[1], Verane Gigaud[2], Gilberto Litta[3]

[1] *Poultry nutrition Consultant, Mexico, Mexico*
[2] *DSM Nutritional Products, Paris, France*
[3] *DSM Nutritional Products, Milan, Italy*

The objective of this study was to evaluate the efficiency of vitamin transfer, in egg yolk and egg white, by laying hens supplemented with different levels of vitamins. 450 32-week-old Bovans were randomly divided into 3 treatments. At week 32, all hens were fed ad libitum a sorghum-SBM diet, formulated to meet the nutritional requirements of Bovans and supplemented with vitamins according to National Research Council (NRC, 1994). At 38 weeks of age, feed intake was limited to 105 g/h/d and hens were fed the same diet supplemented with vitamins: T1, vitamin level according to NRC; T2, vitamin level according to Optimum Vitamin Nutrition® (OVN) (DSM; 2016); T3, vitamin level, on average, 163% above T2. After 20 weeks, a sample of 200 eggs from each of the 3 randomly selected replicates per treatment was collected.The yolk and albumen were then separated, weighed, freeze-dried and sent to the laboratory for analysis of all vitamins. Data were analyzed as a Completely Random Design. If treatment effect was significant ($P < 0.05$), mean differences were evaluated by applying the Least Significant Difference method.

All vitamins, with the exception of vitamin C, were detected in the eggs. The level of supplementation, with the exception of Biotin, B6, influenced the vitamin content of eggs. The vitamin content of eggs from T1 hens was lower than the vitamin content of standard eggs supplied by various national authorities. Overall, eggs from T2 and T3 hens had a significantly ($P<0.01$ minimum) higher vitamin content, than eggs from the T1 group. For example, the vit A content rises from 224 IU to 301 and then 373 repectively for T1, T2 and T3. Total vit D3 content rises from 29 IU for T1 to 115 and 205 respectively for T2 and T3. The results of this study may help egg producers to design vitamin supplementation for egg fortification, more focused on their specific needs.

OP-51 Yolk vitamin D content and eggshell quality traits as affected by hen genotype and housing system

Federico Sirri[1], Raffaela Piscitelli[1], Marco Zampiga[1], Alice Cartoni Mancinelli[2], Cesare Castelini[2], Cristina Alamprese[3], Massimiliano Petracci[1]

[1] *Department of Agricultural and Food Sciences, Alma Mater Studiorum - University of Bologna, Bologna, Italy*
[2] *Department of Agricultural, Environmental and Food Science - University of Perugia, Perugia, Italy*
[3] *Department of Food, Environmental and Nutritional Sciences - University of Milan, Milan, Italy*

A novel approach to fortify egg with vitamin D consists in sunlight exposure of hens as they are capable of endogenous vitamin D synthesis.

The present study aimed to investigate the yolk vitamin D content and the eggshell quality traits of 5 hen genotypes (GT): 2 Italian local breeds (Bionda Piemontese [BP], Robusta Maculata [RM]) and their respective crossbreeds (CB) with a commercial strain (Sasso) compared to Lohmann brown (LB) as well as the effect of the housing system (HS) (enriched-cage [EC] vs. free-range [FR]).

300 hens were raised from 18 to 66 wks of age in EC and FR (3 replicates of 10 hens/GT/HS) and fed the same commercial feed (vitamin D = 3,000 IU). 100 eggs/GT/HS were collected in fall, spring and summer for the evaluation of eggshell breaking strength (EBS) and eggshell/egg proportions. Yolk vitamin D3 and 25(OH)D3 content was analyzed in 2 pools/GT/HS of 5 yolks each collected at the same sampling times. Data were submitted to two-way ANOVA (main effects: GT and HS) with interaction.

Overall, vitamin D3 and 25(OH)D3 content of yolks from LB, BP and RM was increased (+109, 116 and 385%, and +108, 400 and 200% respectively; $P< 0.01$) when hens were housed in FR rather than in EC. HS did not affect yolk vitamin D content of both CB. EBS was positively influenced by the HS (EC < FR), although significant differences were observed only for LB and RM (4.44 [43.5] vs. 4.84 [47.5] and 3.69 [36.2] vs. 4.00 [39.2] kg [N], respectively for EC and FR) whereas eggshell/egg proportions were not remarkably affected.

In conclusion, the sunlight exposure of hens raised in FR stimulated vitamin D synthesis with positive repercussion on yolk enrichment and EBS in all seasons, even though the effect was deeply influenced by the hen genotype.

OP-52 Effects of reduction of soybean meal in the diet of laying hens on the quality of the eggs

Ana Montalbán[1], Josefa Madrid[1], Fuensanta Hernández[1], Cristian J. Sánchez[1], Eduardo Ruiz[1], Achille Schiavone[2], Edoardo Fiorilla[2], Silvia Martínez-Miró[1]

[1] *University of Murcia. Department of Animal Production, Faculty of Veterinary Science, Murcia, Spain*

[2] *University of Turin. Department of Veterinary Sciences, Grugliasco, Italy*

Soybean meal is a highly valued ingredient in animal feed due to its high protein content. However, its use in the Mediterranean area has a significant environmental impact. The aim of this work was to investigate the effect of partially replacing soybean meal with alternative ingredients on egg quality in the first month of lay in hens adapted to the western Mediterranean area. Two isoenergetic and isonitrogenous diets were formulated, a standard diet with usual ingredients (CON) and an alternative diet in which one soybean meal was partially substituted by a high level of sunflower meal, pea meal and dried distiller grain and solubles (ALT). Twenty eggs randomly collected from 5 pens per diet were analyzed for egg weigh, shape index, egg composition (% yolk, albumen, and shell), shell thickness, Haugh units, and yolk color. There were no statistical differences between most parameters measured, except for egg weight, in which a tendency was found (60.04 g and 62.29 g to CON and ALT respectively) ($p = 0.084$), indicating that ALT diet may slightly increase in egg weight. Moreover, a difference was found ($p = 0.030$) in the yolk color indicator a^* of CIELAB system. Both treatments showed negative values near the green spectrum but, the ALT yolks (-6.41) were less negative than the CON yolks (-7.02). Our results suggest that partial substitution of soybean meal with alternative plant-origin protein sources can be used in laying hen feed without compromising egg quality, at least during the first month of laying for hens adapted to the Mediterranean area.

OP-53 Iron complexed to amino acids improves laying performance

Cibele Torres[1], Leonardo Linares[2], Alba Fireman[3], Liu Bing[4], Dongyou Yu[4]

[1] *Zinpro, Madrid, Spain*
[2] *Zinpro, Missouri, United States*
[3] *Zinpro, Sao Paulo, Brasil*
[4] *College of animal Science, Zhejiang, China*

As essential trace mineral, iron (Fe) helps blood to carry oxygen thru the body. Fe is present in almost all feed ingredients used in poultry diet and is often supplemented in diets as iron sulfate ($FeSO_4$). This study investigated the effect of supplementing Fe Lysine and Glutamic Acid complexes (FeAA) or $FeSO_4$ on hen´s performance and blood parameters. A total of 1260 Beijing White laying hens were randomly assigned to 7 treatments with 12 replicates, each with 15 hens. From 20 to 44 weeks of age hens were fed basal diet (75 ppm Fe from raw materials) supplemented with 0 (negative control), 15, 30, 45, 60 and 75 ppm Fe in the form of FeAA or 45 ppm Fe as $FeSO_4$ (positive control). The supplementation with 30 to 75 ppm Fe from FeAA markedly increased ($P<0.05$) egg production and egg weight compared to hens fed both control treatments; hens fed 45 to 75 ppm Fe had better feed conversion. Iron supplementation did not affect egg quality (albumen height, Haugh unit, yolk color, eggshell strength, thickness, yolk, albumen and eggshell ratio). Hens fed 45 ppm Fe as FeAA increased Fe yolk content related to the same level of $FeSO_4$ supplementation. Red blood cell counts and hemoglobin content increased in the groups fed with 30 to 75 ppm Fe as FeAA comparing to both control groups. The Fe inclusion as FeAA and $FeSO_4$ enhanced the copper/zinc-superoxide dismutase activity and decreased malonaldehyde content in serum. Supplementing 45 ppm Fe of diet in the form of FeAA significantly improved laying performance, antioxidant activity, yolk iron content and hematological and serum status of laying hens relative to same level as $FeSO_4$. This study supports the supplementation of diets of White laying hens, 20 to 44 weeks old, with 45 ppm of Fe as FeAA completely replacing eSO_4.

OP-54 Italian market chicken breeds: exploring biodiversity through macroscopic analysis of colorful eggs

Eleonora Erika Cappone[1], Elena Gosso[2], Achille Schiavone[1]

[1] *Department of Veterinary Sciences, University of Torino, Grugliasco, Italy*
[2] *University of Gastronomic Sciences, Pollenzo, Italy*

The consumer growing demand for organic and alternative products led to the increased interest for autochthonous chicken breeds. Consumers may appreciate chicken biodiversity through macroscopic egg characteristics, such as the eggshell and yolk color. Thus, the aim of our preliminary study was to describe those macroscopic traits in 14 chicken breeds reared in Italy to promote a possible commercial purpose, while valorizing alternative poultry farming systems.

Ten eggs per breed were collected and analyzed for their external and internal parameters. Among the 14 breeds, Polverara bianca (PB), Robusta maculata, Millefiori di Lonigo, Ermellinata di Rovigo, Robusta Lionata (RL), Padovana dorata, Padovana camosciata (PC), Pepoi, Polverara argento, Polverara nera, Araucana, Marans (M), Bianca di Saluzzo (BS) and Bionda Piemontese were considered. The egg weight, shape index and eggshell color were registered before recording the weights of the eggshell, albumen, and yolk. Data were analyzed by one-way ANOVA and LSD post-hoc, considering the breed as main factor of variation.

The shape index did not display any significant differences among breeds. For what concerns the egg weight, RL registered the highest value, whereas PB the lowest ($p<0.001$). Interestingly, the latter one displayed the highest value for the yolk percentag\e, while BS registered the lowest ($p<0.001$). Surprisingly, M registered the highest albumen percentage ($p<0.001$). Focusing on the eggshell color, the highest value for brightness (*L) was that of PC ($p<0.001$). Instead, M showed the highest values for redness (*a) and yellowness (*b) ($p<0.001$).

Preliminary results show how the mentioned chicken breeds should be considered as a valid choice in alternative farming systems, with unique products characteristics that have the potential to dynamize the egg market with their colorful contribution.

Poultry meat quality as affected by alternative farming systems

Alice Cartoni Mancinelli

Department of Agricultural, Environmental and Food Science University of Perugia, Italy

In recent years, there has been a growing interest towards alternative rearing systems for poultry (i.e., organic, free-range and agroforestry) whose pillars, such as animal welfare, environmental impact and human health, are well represented by the "One Welfare" concept. This approach highlights the direct and indirect links between animal and human welfare and its applicability is becoming widespread in the productive chains. The principal characteristic of alternative rearing systems is the presence of an outdoor area available for the animals, whose utilization can influence productive performance, animal welfare and product quality. For instance, pasture can represent a source of bioactive compounds such as vitamins, antioxidants and n-3 fatty acid precursors, which can enrich meat of molecules playing a positive effect on consumer health. On the other hand, the chicken grazing activity can affect meat quality as a result of the balance between pro- and anti-oxidant content, which in turn strictly depends on the animal locomotor behavior and bioactive compounds intake. In general, a chicken genotype that shows a high locomotor activity also ingests a high amount of grass and consequently has a greater content of bioactive compounds in the meat. However, in some cases, the antioxidants quantity deriving from the grass consumption is not enough to counteract the increased oxidation processes triggered by the high locomotor activity resulting in a low meat quality. Another important aspect affecting the meat quality is the animal metabolism. In fact, the "fast-growing" chicken genotypes are generally more oriented to the storage of molecules coming from the diet instead of synthetizing new ones. On the contrary, the "slow-growing" chicken genotypes show a high synthesis capacity of important molecules for human health (e.g., n-3 long chain fatty acids), but at the same time exhibit a low storage ability. Therefore, in alternative rearing systems, the use of a genotype able to balance the locomotor activity with the grazing behavior and the synthesis with the storage capacity is crucial to guarantee high meat quality standards. This lecture will present a multifactorial approach to investigate the main factors and their relationships influencing poultry meat quality in alternative rearing systems.

OP-55 Poultry sector stakeholder's expectations in terms of product quality and rearing systems: the H2020 INTAQT project

Marie Bourin[1], Cécile Laithier[2], Florence Bedoin[2], Verena Bühl[3], Rennie Eppenstein[3], Alice Cartoni Mancinelli[4], Eline Kowalski[5], Shannon McLaughlin[6], Christèle Couzy[2], Bruno Martin[7], Cécile Berri[8]

[1] *ITAVI, Nouzilly, France*
[2] *IDELE, Paris, France*
[3] *FiBL, Frick, Switzerland*
[4] *University of Perugia, Perugia, Italy*
[5] *Ghent University, Ghent, Belgium*
[6] *The Queen's University of Belfast, Stranmillis, United Kingdom*
[7] *INRAE, Saint-Genès-Champanelle, France*
[8] *INRAE, Nouzilly, France*

INTAQT project aims to characterize the links between farming practices and quality of poultry meat, beef and dairy products. The first stage of the project consisted of a wide-ranging consultation of poultry industry stakeholders to ascertain their expectations in terms of product quality. These consultations were carried out at national level for Belgium, Switzerland, Italy and France, but also at European level. This made it possible to identify the different perceptions and points of view of producers, processors, retailers and some representatives of citizens' and consumers' associations. If the intrinsic qualities of the product (organoleptic, sanitary, visual) come in first position, stakeholders spontaneously expressed the importance of considering extrinsic criteria related to sustainability (animal welfare, environment, socio-economic aspects). From the data that will be generated in the project, it is also planned to create a multi-criteria meat quality assessment tool. Stakeholders think that such a tool could be useful for the sector if used as a continuous improvement tool and would be an opportunity to have a more general overview of different production systems for a wide range of criteria. However, they express some doubts about the interpretation of the results that will come out of it regarding the complexity and the diversity of the criteria that will be used to build it. Results of poultry sector stackeholder's interviews are consistent with consumers' views and are directly linked to the expectations in terms of quality criteria that will be addressed in the project. The points of attention raised in the multi-stakeholder groups will be taken into account by the project partners in order to best meet the expectations of stakeholder and consumer.

OP-56 Characteristics of carcass traits and meat quality of slow-growing Korat chickens reared under conventional, free-range, and organic production systems

Wittawat Molee, Wichuta Khosinklang, Sirirot Khotsalee, Amonrat Molee

School of Animal Technology and Innovation, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, Thailand

The objective of this study was to determine the effect of different production systems on growth performance, carcass composition, and meat quality of slow-growing Korat chicken (KRC). Three hundred and seventy-five (1-day-old) mixed-sex KRC were randomly allocated to 3 treatments with 5 replications containing 25 birds each. In the control group (CO), chicks were housed in an indoor pen (5 birds/m^2); in the free-range group (FR), chicks were housed in an indoor pen (5 birds/m^2) with free access to a grass paddock (1 m^2/bird); and in the organic group (OR), chicks were housed in an indoor pen (5 birds/m^2) with access to a grass paddock (4 m^2/bird) from d 28 to d 91 of age. From the results, it has been revealed that KRC raised under OR had the lowest growth performance, while the feed intake in OR and FR did not differ ($P>0.05$), but the CO group had the highest feed intake ($P<0.05$). Furthermore, different raising systems did not affect carcass characteristics or meat quality ($P>0.05$), excepted for the percentage of eviscerated carcasses, abdominal fat, shear force, and meat and skin color ($P<0.05$). The chicken raised in CO had the highest percentage of eviscerated carcass and abdominal fat. In contrast, the highest shear force and yellowness of meat and skin were detected in the FR and OR groups ($P<0.05$). In conclusion, our findings revealed that OR had the lowest growth performance when compared to FR and CO, respectively. However, it could decrease the amount of abdominal fat which has an impact on chicken carcass quality. In addition, OR improved meat and skin color as well as shear force, all of which have a direct effect on meat quality and consumers perception.

OP-57 Modulatory effect of the C18 n-6/n-3 dietary profiles on the n-3 LC-PUFA (EPA and DHA) biosynthetic capacity of Canarian chicken

Covadonga Rodríguez[1], Jesús Villora[1], José Antonio Pérez[1], Mónica Betancor[2], Daniel González-Silvera[2], Nieves Guadalupe Acosta[1], Alexandr Torres[3], Rafael Zárate[4], Sergio Álvarez[3]

[1] *Universidad de La Laguna, Departamento de Biología Animal, Edafología y Geología, Grupo NUTRAHLIPIDS, San Cristóbal de La Laguna, Spain*

[2] *Institute of Aquaculture, Faculty of Natural Sciences, University of Stirling, Stirling, United Kingdom*

[3] *Unidad de Producción Animal, Pastos y Forrajes en Zonas Áridas y Subtropicales, Instituto Canario de Investigaciones Agrarias, San Cristóbal de La Laguna, Spain*

[4] *Fundación Instituto Canario de Investigación del Cáncer,San Cristóbal de La Laguna, Spain*

Humans cannot produce EPA (20:5n-3) and DHA (22:6n-3) from ALA (18:3n-3) at significant amounts. We hypothesize that under a balanced C18 n-6/n-3 dietary formulation, poultry could become a sustainable terrestrial alternative for the production of healthy omega-3 LC-PUFAs for human consumption. Sixty Canarian chickens were divided into 3 groups and raised for 45 days with a commercial cereal-based feed supplemented with soy oil highly rich in LA (18:2n-6); Echium plantagineum oil, a balanced LA/ALA mixture also rich in SDA (18:4n-3) and GLA (18:3n-6), or linseed oil rich in ALA. Liver, gut and brain gene expression (elovl2; elovl5, fads1 and fads2), was assessed as described by Marrrero et al. (2022). Metabolic monitoring of radiolabelled LA and ALA in isolated hepatocytes (H) and enterocytes (E) was also assessed as described by Rodríguez et al. (2002) and Díaz-López et al. (2010). Transformation of the incubated [1-14C]FA by desaturation/elongation processes was determined and quantified to obtain the percentage distribution of the radioactivity using an image analysis software. Statistical differences were determined by a one-way ANOVA followed by a Tukey multiple comparison post-hoc test ($p<0.05$). The inclusion of linseed oil and E. plantagineum oil induced an increase of EPA and DHA in both cell types (H: 0.5 vs 2.7-2.9 %, and 2.5 vs 3.0-3.3; E: 0.3 vs 1.2-1.3%, and 0.7 vs 0.8-1.0, respectively), reducing the formation of the ARA (20:4n-6) by 30-40% in the isolated cells. Dietary modulation in favour of n-3 LC-PUFA biosynthesis was also clear in tissue's desaturase and elongation gene expression, which was more pronounced for Echium oil. These results correlate with the fatty acid profiles obtained in chicken breasts and thighs. A feed formulation with a balanced n-6/n-3 ratio and higher SDA, enhance the nutritional quality and health benefits of poultry products.

OP-58 Echium plantagineum oil is more effective than linseed oil to enhance n-3 LC-PUFAs contents in Canarian chicken breast

Jesús Villora[1], Alexandr Torres[2], Sergio Álvarez[2], José Antonio Pérez[1], Nieves Guadalupe Acosta[1], Davinia Sosa[2], Pilar Méndez[2], Covadonga Rodríguez[1]

[1] *Universidad de La Laguna, Departamento de Biología Animal, Edafología y Geología, Grupo NUTRAHLIPIDS, San Cristóbal de La Laguna, Spain*

[2] *Unidad de Producción Animal, Pastos y Forrajes en Zonas Áridas y Subtropicales, Instituto Canario de Investigaciones Agrarias, San Cristóbal de La Laguna, Spain*

Terrestrial animals like chicken might be a sustainable source for n-3 long-chain polyunsaturated fatty acids (LC-PUFAs) such as eicosapentaenoic acid (EPA; 20:5n-3) and docosahexaenoic acid (DHA; 22:6n-3), since both can be synthesized from their dietary precursor α-linolenic acid (ALA; 18:3n-3). Linseed oil is very high in ALA whereas Echium oil has got a more balanced ALA/linoleic acid (LA; 18:2n-6) also containing important quantities of stearidonic acid (SDA; 18:4n-3), an intermediary fatty acid in the biosynthetic pathway conversion from ALA to n-3 LC-PUFAs. In this study, we evaluated the capability of Echium oil, compared to linseed and soy oils, to enhance n-3 LC-PUFAs deposition in tissues of Canarian chickens. A total of 60 animals were divided into three balanced groups and raised for 45 days to evaluate fatty acid profile and sensory analysis of chicken breast. Diets were prepared by replacing the lipid proportion of a commercial cereal-based feed with three different oils supplementation: Soy group (1.5% soy oil + animal fat 1.5%), Echium group (2% Echium plantagineum oil + 1% animal fat) and Linseed group (1.5% linseed oil + 1.5% animal fat). Variations in oil sources had no influence on evaluated sensory attributes of breast ($P>0.05$). In contrast, dietary E. plantagineum generated chicken breasts with significant increments in n-3 LC-PUFAs ($P<0.05$) (7.21 ± 1.24%) compared to linseed and soy oil diets (5.06 ± 1.62% and 4.21 ± 0.85%, respectively). Our results indicate that a well-balanced n-3/n-6 ratio and the presence of SDA of Echium oil are more effective than linseed oil to positively modulate n-3 PUFAs conversion and deposition of EPA and DHA in Canarian chicken breast.

OP-59 Effects of cannabidiol and nano-selenium on intestinal barrier function in chickens challenged with Clostridium perfringens

Misza Kinsner[1], Dominika Szkopek[1], Paweł Konieczka[2]

[1] *Department of Animal Nutrition, The Kielanowski Institute of Animal Physiology and Nutrition, Polish Academy of Sciences, Jablonna, Poland*

[2] *Department of Animal Nutrition, The Kielanowski Institute of Animal Physiology and Nutrition, Polish Academy of Sciences/ Department of Poultry Science, University of Warmia and Mazury in Olsztyn, Olsztyn, Poland*

The gastrointestinal tract (GIT) in broiler chickens constitute the first line of defense against pathogens and determine the immune response. Nutritional modulation of the GIT, through the addition of bioactive substances, provides an opportunity to improve animal welfare and effectively strengthen the birds resistance to stress factors. The present study tested the activity of *Cannabis sativa*-derived cannabidiol (CBD) and selenium nanoparticles (nano-Se) in modulating the host response to *C. perfringens* infection in broiler chickens subjected to a mild infection model. 360 Ross 308 broiler chickens were divided into V groups of 72 each: (I) negative control, (II) positive control infected with *C. p.*, (III) with CBD 15 g/kg feed infected with *C.p.*, (IV) with nano-Se 0.5 mg/kg feed infected with *C.p.*, (V) with CBD and nano-Se infected with *C.p.* On days 15, 16, 17 and 18 of rearing, chickens in group II-V were infected per os 1 ml with *C.p.*. bacteria, while the other groups were given a saline solution. At 23 day of rearing, 9 birds from each group were slaughtered and a section was taken from the middle part of the *jejunum* for the expression of ZO-1, JAM2, GLP-2 genes by Real-Time PCR. ZO-1 gene expression was higher in the experimental groups compared to the control groups ($P<0.001$). Addition of nano-Se and nano-Se and CBD increased JAM2 and GLP-2 gene expression ($P<0.001$). Both CBD and nano-Se affected the response of chickens to C. p. infection. No opposing effect of CBD and nano-Se was observed in mediating the host response to the challenge, while an additive effect affected the up-regulation of genes determining intestinal integrity. These results indicate that understanding the mechanisms of action of CBD and nano-Se is of great interest for developing strategies to prevent *C.p.* infection in broilers.

Research funded by the National Science Center Project No. 2018/29/B/NZ9/01351

Consumer Demand for Alternative Poultry and Eggs Production Systems: What do we Know?

Daniele Asioli

University of Reading, United Kingdom.

Over the last decade, there has been an increasing controversial discussion and debate surrounding alternative poultry and egg production systems (e.g. free-range, cage-free, etc.). The demand for these alternative systems has grown considerably due to consumers' increasing desire for more sustainable animal food products. Furthermore, there are pressures from various food businesses, such as for example retailers and restaurant chains, as well as governmental and non-governmental institutions, advocating for more sustainable poultry and egg production systems. In this context, it is crucial to understand consumer demand for poultry and egg products produced using these alternative production systems. This information will help to evaluate the financial feasibility adoption of these alternative systems, provide useful insights for product development and marketing from the producers' and sellers perspectives, as well as to provide useful information for policy makers.

This presentation aims to provide an overview and stimulate a discussion about consumer demand for poultry and egg products produced using alternative production methods. Finally, implications and recommendations for poultry and eggs producers and policy makers, as well as future research avenues will be identified and discussed.

Posters

P-1 Egg internal quality for laying hens fed diets with functional fibers and xylanase

Deibity Alves Cordeiro[1], Natiele Ferraz De Oliveira[1], Imar Crisogno Fernandes Filho[1], Laura Alves Duarte[1], Alexandre Barbosa De Brito[2], José Henrique Stringhini[1]

[1] *Universidade Federal de Goias, Brasil*
[2] *ABVista LATAM, Brasil*

In this study we evaluated the effects of diets with xylanase and fermentable oligosaccharides for 33- to 48-weeks-old laying hens on the internal quality of eggs. A total of 320 Hy-Line W-80 laying hens were used. The treatments were: positive control diet (PC); negative control diet (NC), with reduced nutritional density related to the xylanase enzyme nutritional matrix; NC + xylanase; NC + xylanase and fermentable oligosaccharides. For analysis of egg internal quality, the following variables were measured: egg weight (g), yolk color, yolk index, yolk percentage, albumen index, albumen percentage and Haugh unit. Data were collected for four days in the 36th, 40th, 44th and 48th weeks of age, representing four experimental laying periods. The experiment was designed as a completely randomized design with four treatments and ten replicates of eight birds each. The F and Scott-Knott test ($p<0.05$) was used to compare results, with free software R-Project. During all four periods, egg weight (g), yolk percentage (%) and albumen percentage (%) showed no significant differences. Among the Haugh unit results, it was noted better results for birds fed NC + xylanase, which was also similar like the PC only in the second laying period, yolk color showed better results among birds fed NC + xylanase and NC + xylanase and oligosaccharides. The yolk and albumen indices showed significantly different results between the PC compared to the other treatments for the 4 laying periods evaluated, for the yolk index, and likewise for the albumen index. These results make clear that the influence of enzyme supplementation on yolk color, Haugh unit, yolk and albumen index can be associated to the better use of cellular components of the plant origin ingredients used in the layer' diets.

P-2 Egg external quality for laying hens fed diets with functional fibers and xylanase

Deibity Alves Cordeiro[1], Natiele Ferraz De Oliveira[1], Imar Crisogno Fernandes Filho[1], Laura Alves Duarte[1], Alexandre Barbosa De Brito[2], José Henrique Stringhini[1]

[1] *Universidade Federal de Goias, Brasil*
[2] *ABVista LATAM, Brasil*

This study was designed to evaluate the effects of supplementation of a xylanase associated or not with fermentable oligosaccharides in diets of 33- to 48-week-old laying hens on the internal and external quality of eggs. The treatments were: positive control diet (PC); negative control diet (NC), with reduced nutritional density related to the xylanase enzyme nutritional matrix; NC + xylanase; NC + xylanase and fermentable oligosaccharides.For analysis of egg external quality, the following variables were evaluated: egg weight (g), eggshell weight (g), egg shape index, eggshell thickness (mm), specific gravity and eggshell breaking resistance (N). Data were obtained for four days in the 40th, 44th and 48th weeks of age, representing three experimental laying periods. The experiment was designed as a completely randomized design with four treatments and ten replicates of eight birds each. The F and Scott-Knott test ($p<0.05$) was used to evaluate the results, using the free software R-Project. The egg weight did not differ during the evaluation periods, but the egg shape index was affected by the nutritional treatments, in which, PC and NC + xylanase and soluble oligosaccharides showed the lowest indexes. Eggshell weight, eggshell thickness and specific gravity were not affected by the nutritional treatments in the three periods evaluated. The eggshell breaking resistance (N) was not different at the 40th week of age, but the treatments NC + xylanase and NC + xylanase and fermentable oligosaccharides resulted in higher eggshell resistance, which was not observed in the 48th week of age. The use of xylanase and fermentable oligosaccharides can affect eggshell quality.

P-3 The effects of diet based on legume seeds on broiler performance and meat fatty acids

Ciurescu Georgeta, Panaite Tatiana, Ropotă Mariana

National Research-Development Institute for Biology and Animal Nutrition, Balotesti, Rumunia

The price and availability of extracted soybean meal (SBM) on global markets may change rapidly, thereby stimulating the interest to maximize the use of locally produced protein sources, like legumes. The aim of this study was to compare the growth performance (GP), blood and breast meat fatty acids (FAs) profile in broilers fed on diets containing unprocessed legumes (chickpea [CKP; Cicer arietinum L.] and cowpea [CWP; Vigna unguiculata [L] Walp]) as an alternative to SBM. A total of 780 one-d-old chicks (Ross 308) were allocated, over two growth phases (starter, 0-24 d; finisher, 25-42 d), to 5 treatments as follow: 1)corn-SBM diet as control; 2)10%CKP; 3)20%CKP; 4)10%CWP; 5)20%CWP. Diets were formulated to be isocaloric, isonitrogenous and with similar content of total lysine, and sulphur amino acids, Ca and av. phosphorous. At 42 d of age, 8 birds from each treatment were slaughtered. All the analyses were performed in accordance with the applicable methodologies. The substitution of SBM with CKP or CWP as the main source of protein in the diets yielded similar GP results (BW, FI, FCR). The carcass, breast and legs' yield, and organ size were not affected by the legume diets. However, it induced changes in the blood parameters. Glucose and total cholesterol decreased in birds fed CKP and CWP diets ($p<0.0001$). Also, the use of CKP and CWP had a significant effect on the content of breast muscle FAs, especially for alfa-linolenic ($p<0.0001$), eicosapentaenoic ($p<0.0001$), docosapentaenoic ($p=0.032$) and docosahexaenoic ($p=0.004$), which were higher than those fed SBM. Based on the results it can be concluded that CWP and CKP represent an interesting alternative protein source, which can improve broiler performance, health status and breast FAs composition.

P-4 Effect of Biostrong® 510 on meat quality of older broilers

Megan Koppen[1], Caroline Donaldson[2], Roberto Montanhini Neto[3], Manu Montanhini Neto[2], Jorge Urrutia[4], Kelley Wamsley[4], Dalton Dennehy[4], Li Zheng[4]

[1] *Delacon USA, Inc., Carlisle, United States*
[2] *Delacon Biotechnik GmbH, Engerwitzdorf, Austria*
[3] *Delacon France SAS, Toulouse, France*
[4] *Mississippi State University, United States (USA, Austria, France)*

Feed ingredient costs and meat prices continue to increase and vary dramatically versus historical norms. Thus, focusing on value-add feed additive selection is critical, especially with birds reared longer. Phytogenic feed additives can improve nutrient digestion and utilization as well as meat quality properties. Based on several digestibility studies, Delacon developed nutritional matrix values for Biostrong® 510 (BSG), the Performizer® solution (PS). The effect of BSG applied without formulation changes (on-top) and with reduction of the nutritional density of feed (PS) was evaluated by measuring the production performance of Ross 708 male broilers, 16 replicates with 25 birds/replicate from 0 to 56 days of age. The objective of this trial was to improve (on-top) or maintain (PS) production performance with a reduced feed cost. Four dietary treatments were tested: 1) control, 2) 150 g/MT BSG 0-42 days, 3) 150 g/MT BSG 0-56 days, and 4) 150 g/MT BSG 0-56 days (PS from 42 to 56 days). At 56 days, birds were slaughtered and processed. Live body weight, carcass, breast meat (fillet, tender & total), leg weight yield (drumstick, thigh & total), and wing processing metrics were measured. The total antioxidant capacity (TAC) was also measured at 55 days. Across all metrics excluding leg yields, treatments 3 and 4 were heavier than 1 and 2 ($P<0.05$). Treatment 2 had significantly lower total leg yields than 1 and 3 ($P<0.05$). Higher TAC levels were observed in treatments 3 and 4 compared to 1 and 2 ($P<0.05$). BSG and PS yielded the most profitable results in this experiment based on current US meat prices. Based on the trial results, the dietary addition of BSG on-top or PS may improve meat yield and quality metrics of older broilers while optimizing production costs.

P-5 Commercial Lemon balm (Melissa officinalis) extract in association with magnesium to improve meat quality: an in-field trial

Sekhou Cisse, Julia Laurain, Mohamed El Amine Benarbia

FeedInTech Labcom/Nor-Feed SAS, Beaucouzé, France

Carcass and meat quality traits are important factors in poultry production, which can lead to important economic losses when they are degraded. One of the main reasons for this degradation is the stress generated during poultry farming. Indeed, stress is documented to increase aggressiveness leading to negative effects on carcass and meat quality traits. This phenomenon is increased in some stressful events for birds such as transportation and catching. Therefore, calming animals could be a solution to reduce the economic losses linked to the carcass and meat quality traits. As lemon balm (Melissa officinalis) and magnesium are well known for their calming properties, this study aimed to evaluate their efficacy in combination, to improve carcass and meat quality after catching and transportation.

60 000 broilers chicken (Ross 308) were randomly assigned to two groups:

The control group (CTL, n=30 000) fed with a standard diet.

The Lemon balm/Magnesium group (LbM, n=30 000) fed with a standard diet and supplemented with a liquid combination of Lemon balm extract and Magnesium in the drinking water of broilers chicken (1 liter of LbM for 1.000 liters of drinking water), 3 days before catching and transportation to the slaughterhouse.

Carcass characteristics (skin aspect, hematomas on the wings, hematomas on the breast area, hematomas on the thighs, and injuries on the legs) were evaluated after slaughter. The quantity of grade A of meat (highest quality) was also monitored.

Results showed that LbM supplementation minimized injuries and reduced marks on chickens compared to the control group. As a result, grade A of meat was 10,4 % higher in the lbM group compared to the CTL group.

These results showed that LbM supplementation can be effective to improve carcass and meat quality after catching and transportation, probably due to the calming effect of its active compounds.

P-6 Soybean meal substitution by fodder pea seeds and flaxseed meal and their effects on fatty acid composition and egg yolk lipid peroxidation

Panaite Tatiana Dumitra[1], Cornescu Maria Gabriela[1], Turcu Paula Raluca[2], Untea Elena Arabela[2], Matache Cristina Camelia[1], Ciurescu Georgeta[3]

[1] *Nutrition Physiology Department, National Research and Development Institute for Biology and Animal Nutrition, Balotesti, Romania*
[2] *Food and Feed Quality Department, National Research and Development Institute for Biology and Animal Nutrition, Balotesti, Romania*
[3] *Animal Nutrition Department, National Research and Development Institute for Biology and Animal Nutrition, Balotesti, Romania*

Nowadays, finding alternative protein sources represents a priority in animal nutrition to substitute soybean meal (SBM), the dominant source of protein in poultry diets. In the current study was investigated the effects of soybean meal (SBM) substitution by fodder pea seeds (FPS) and flaxseed meal (FSM) on quality eggs. A 6-week feeding trial on 168 Tetra SL laying hens (37 weeks of age), divided into 3 groups (C, E1 and E2) with 28 replicates/group (2 hens per replicate) was done. Hens were fed corn-soybean meal-based (2750 kcal metabolizable energy and 17% crude protein) diet containing 0% FPS+0% FSM (Control), 10% FPS+5% FSM which replaced 3.5% of soybean meal protein (Exp.1), and 20% FPS+5% FSM replacing 5.75% of soybean meal protein (Exp.2). Egg samples (18 eggs/group for each period) were collected the beginning of the experiment and during the entire trial period, on the 2nd, 4th and the 6th weeks in order to determine the PUFA concentrations of eggs' yolk. At the end of the study, 18 eggs/group were collected and analysed, after 28 storage days at room temperature (20±0.4°C), to assess the oxidative stability of the yolk fat. After two experimental weeks, the PUFA Ω3 concentration increased gradually and significantly ($P<0.05$) on the E1 (3.62; 3.73 or 3.73 g% total fatty acids) and E2 (3.67; 3.53 and 4.20 g% total fatty acids) eggs compared to C eggs (1.12; 1.16 or 1.43g% total fatty acids). The antioxidant potential of fodder pea seeds and flaxseed meal supplements was observed by reducing the oxidative processes at the yolk level. In conclusion, using dietary raw materials rich in PUFA n-3 had a positive influence on laying hens' egg quality and improved the nutritional quality indices of the lipids in egg yolks.

P-7 Effects of dietary Rumex patientia on laying hens' egg quality

Cristina-Camelia Matache, Tatiana Dumitra Panaite, Gabriela Maria Cornescu, Mara-Ioana Munțiu-Rusu, Mariana Ropotă

National Research Development Institute for Animal Biology and Nutrition (IBNA), Balotesti, Rumunia

The study evaluated different levels of Rumex patientia, dried leaves on laying hens' egg quality. The five weeks trial was conducted on 168 laying hens HyLine (30 weeks of age), divided in 3 groups (C, E1, E2) and housed in 28 cages/group, 2 laying hens/cage, 56 laying hens/group, in Big Dutchman battery system. The basal diets on corn and soybean meal were formulated to be isocaloric and isonitrogenous (2800 kcal/kg metabolizable energy and 16.39 % crude protein). Compared to control group diet, E1 included 1.5% and E2 included 3% Rumex patientia. The entire trial we monitored the productive performances and, at the end of the study we analyzed the internal and external eggs' quality parameters. At 2 and 4 experimental weeks, 18 eggs/group/period were collected to assess the eggs' quality and the nutritional parameters, especially the concentration of α-linolenic acid (ALA). At 4 weeks, eggshell breaking strength registered highly significant differences ($p<0.0001$) on E2 group compared to E1 group and, also significant differences ($p<0.001$) were noticed on eggshell thickness on E2 group compared to E1 and C groups. At the end of the experimental period (4 weeks), for both experimental groups, the PUFA content was significantly ($p < 0.001$) increased (28.22% and 28.14%) comparative to C group (25.08%). The same trend was noticed for ALA (0.25g and 0.24 g ALA/100 g fatty acid, respectively) for both experimental groups. The utilization of the two dietary inclusion rates of Rumex patientia had beneficial effects on egg nutritional quality, especially on PUFA n3 concentration, as well as on eggshell breaking strength and thickness parameters.

P-8 The effect of selenium sources on the antioxidant status and performance of aging laying hens

Pinar Sacakli[1], Sarper Ozbek[2], Omer Bayir[1], Denise Cardoso[2], Ali Calik[1]

[1] *Ankara University Faculty of Veterinary Medicine Department of Animal Nutrition and Nutritional Diseases, Ankara, Turkey*
[2] *Adisseo France S.A.S. Antony, France*

Selenium (Se) is an essential trace mineral with a key role on the antioxidant sytem of animals. Its supplementation is a standard practice in laying hens, using either inorganic form such as sodium selenite (SS) or organic forms like SeYeasts (SY) or pure selenomethionine (SeMet; or hydroxy-selenomethionine; OH-SeMet). 270, 63-week-old laying hens (Lohmann Brown Classic) were set in 1 of 3 dietary treatments with 15 replicates with 6 birds each, in a randomized block design for 28 weeks: a 4-week adaptation period followed by a 24-week experimental period. A corn-soybean-based basal diet was formulated with the supplementation of different selenium sources: (T1) 0.3 ppm of Se from SS, (T2) 0.3 ppm Se from SY or (T3) 0.3 ppm of Se from OH-SeMet. No differences were observed between treatments for the mortality, feed intake or egg weight. OH-SeMet fed birds better mitigate the decrease on egg production as layers age, thereby resulting in a significant improvement in their performance for the overall period. OH-SeMet resulted in a 9% higher laying rate than SS ($p = 0.05$), and 4.5% higher than SY. The percentage of cracked and broken eggs and dirty eggs was significantly reduced when using OH-SeMet, compared to SS and SY ($p < 0.001$). The malondialdehyde (MDA) in the blood and liver decreased for the use of organic sources ($p = 0.02$), and a numerical decrease was also observed for OH-SeMet, compared to SY. A reduction in the liver fat content is also evidenced for when organic sources were used compared to SS ($p< 0.001$). Feeding organic Se, especially OH-SeMet, to aged laying hens improved their production performances, and decreased the incidence of cracked, broken and dirty eggs. Organic Se improved antioxidant capacity and reduced the liver fat content of layers.

P-9 The effect of full fat insect meal supplementation on chicken meat quality

Darina Chodová[1], Eva Tůmová[1], Jan Tyl[2], Mohamed Ketta[1]

[1] *Department of Animal Science, Czech University of Life Sciences Prague, Prague, Czech Republic*
[2] *International Testing Station Ústrašice, Tábor, Czech Republic*

Insect meal is an appropriate alternative protein source for soybean meal in poultry diet due to high protein content. The aim of the study was to evaluate the effect of 3 % insect meal supplementation on chicken breast meat quality characteristics. In the experiment, total of 840 one-day cockerels of Ross 308 were randomly divided into 2 groups: control group was fed using commercial feed mixture and the experimental group fed with feed mixture with 3% full fat insect meal from Hermetia illucens larvae. The cockerels were fattened under standard microclimate conditions, feed and water were available ad libitum for whole experiment. At 35 days of age ten chickens per each group for carcass value and breast meat quality were randomly selected for slaughter. The basic carcass parameters (dressing out, breast, thigh and abdominal fat percentage) were not significantly affected by the inclusion of insect meal. From the meat quality parameters, the full fat larvae meal reduced the pH value (P=0.004), but there was not PSE like meat detected. Meat colour parameters were similar for both groups as well as tenderness measured by shear force value. On the other hand, chickens fed with the alternative protein source had better (P=0.031) drip loss (0.28 %) compared to the control group (0.40 %). The basic chemical composition of meat was not significantly affected by insect meal inclusion. It can be summarized that insect meal supplement of 3 % did not affect carcass characteristics and most of the chicken breast meat quality parameters and it could be suitable alternative protein source to soybean meal in fast growing chicken's nutrition.

The study was supported by the Project NAAR No. QK1910387.

P-10 The effect of feed restriction and pasture on carcass composition and breast meat quality of fast-growing chickens

Eva Tůmová[1], Darina Chodová[1], Monika Okrouhlá[1], Mohamed Ketta[1], Jan Tyl[2]

[1] *Czech University of Life Sciences Prague, Prague, Czech Republic*
[2] *International Poultry Testing Station Ústrašice, Tábor, Czech Republic*

The aim of the study was to evaluate the effect of feed restriction and combination of feed restriction and pasture on carcass composition, physical and chemical meat quality parameters. Group 1 was fed ad libitum, group 2 and 3 were restricted. Feed restriction was applied on 70% of ad libitum from 8 to 14 days of age, in group 3 after restriction at the age 21 days chickens were on pasture until the end of the experiment at 35 days of age. Chickens were fed ad libitum prior to and following restriction. All chickens were fed by commercial feed mixtures and kept in indooor pens with access to pasture for group 3. Feed restriction and combination of restriction and pasture significantly reduced final body weight and carcass weight but dressing out percentage was not affected. The breast percentage was the highest (P=0.006) in the ad libitum group (30.5 %) followed by restricted group (28.2 %) and the lowest in the group with combination of restriction and pasture (27.4 %). Breast pH and colour measured 24 h post mortem were not affected, whereas texture expressed as Fmax was the lowest in the group with combination of restriction and pasture (P=0.05). There was no effect of the group on meat dry matter, crude protein and cholesterol content but ether extract was the significantly highest in the ad libitum fed group. The concentration of PUFA was significantly highest in the group with restriction and pasture combination and ad libitum and restricted groups did not differ. The feeding regime did not affect SFA, MUFA, PUFA n3 and n6 content. To sum up, the feed restriction and combination of restriction and pasture negatively affected final body weight and carcass composition, which might be related to a short realimentation period for compensatory growth; however, reduced meat fat content and combination of restriction and pasture improved fatty acid composition.

P-11 The effect of feeding regime and insect meal on chicken breast meat quality

Jan Tyl[1], Eva Tůmová[2], Darina Chodová[2]

[1] *International Poultry Testing Station Ústrašice, Tábor, Czech Republic*
[2] *Department of Animal Science, Czech University of Life Sciences Prague, Prague, Czech Republic*

The present experiment was focused on the effect of feed restriction and insect meal (Hermetia illucens) on carcass composition and meat quality of broiler chicken. In the experiment, 1680 one day old cockerels of Ross 308 were divided into four groups, group 1 was fed ad libitum, group 2 was fed ad libitum by feed mixture which included 3 % of insect meal, group 3 was restricted at a rate of 70% ad libitum from 8 to 14 days of age and group 4 was restricted on 70% ad libitum from 8 to 14 days of age and received the same feed as group 2 with 3 % insect meal. Restricted groups were fed ad libitum prior to and following restriction. At the end of the experiment at 35 days of age, ten males from each group were randomly selected for carcass analysis, physical and chemical meat quality determination. None of the evaluated parameters was affected by interaction of feeding regime and feed mixture. The significant effect of feeding regime was observed in physical meat quality measurements. Feed restriction decreased breast pH measured 24 h post mortem ($P \leq 0.001$) and increased drip loss ($P \leq 0.001$). The inclusion of insect meal to feed mixture on the level of 3 % significantly decreased dressing out percentage and increased breast meat colour parameter L^*. The results of the experiment show a minor effect of feed restriction and inclusion of insect meal on chicken carcass meat composition and meat quality parameters.

P-12 Effect of genetic and rearing system of laying hens on indicators of egg quality and eggshell microbial contamination

Amélie Chastagner[1], Pascal Galliot[1], Christophe Souchet[2], Séverine Chevalier[3], Tino Jamme[3], Sophie Jan[3], Valérie Lechevalier[4], Guillaume Gillot[4], Julie Evrard[4], Véronique Huchet[4], Maylis Dop[5], Eve-Anne Norwood[5], Carole Debregeas[6], Angélique Travel[1]

[1] *ITAVI, Ploufragan, France*
[2] *ITAVI, Nouzilly, France*
[3] *STLO, INRAE, INSTITUT AGRO RENNES-ANGERS, Rennes, France*
[4] *ADRIA Food Technology Institute, UMT ACTIA 19.03-ALTER'iX, Quimper, France*
[5] *ONIRIS-GEPEA, Nantes, France*
[6] *ADRO Ouest, Rennes, France*

The rearing of laying hens is in the process of transitioning to alternative systems to cage. The objective of the ELEV'OP project is to assess the impact of different rearing systems (cage, barn system and free-range) on microbiological contamination and on the macrostructure of eggs. Two strains of hens were studied at an average age of 58 weeks: 13 Lohmann Brown Classic (LB) flocks and 13 Lohmann LSL Classic (LW) flocks evenly distributed in the 3 different rearing systems. Quality of eggs was compared with a Digital Egg Tester (DET6000). The weight of eggs and yolks showed a strong inter-farms variability with a significant difference between the 2 strains. LW eggs and yolks are on average heavier ($p < 0.01$) in agreement with the reference data. We did not observe any effect of rearing system in LW whereas in LB egg and yolk weights are lower in free-range than in cage (-2.21g for egg and -0.9g for yolk). Shell resistance was stronger in LB than LW and it was also impacted by the rearing system for both strains (cage > barn & free-range). The yolk index was impacted by hen's age and strain but not by the rearing system. A strong difference in Haugh units was shown between strains (LB < LW) in addition to the rearing system (+2.18 for free-range and +2.31 for barn compared to cage farms). The microbial contamination of egg surface was evaluated by counting the total aerobic mesophilic flora, enterococci and presumed enterobacteria. There was a high variability between farms unrelated to the rearing system, which can be attributed to the management of the farm.

P-13 Effects of low doses of antibiotics in feed mixtures on carcass yield and meat quality of broiler chickens

Katarzyna Połtowicz[1], Anna Arczewska-Włosek[2], Joanna Nowak[1], Monika Olszewska-Tomczyk[3], Patrycja Adamczyk[1], Przemysław Podstawski[1], Patrycja Zawisza[2], Łukasz Gala[2], Kinga Szczepanik[2], Małgorzata Olejnik[3]

[1] *Department of Poultry Breeding, National Research Institute of Animal Production, Balice, Poland*

[2] *Department of Animal Nutrition and Feed Science, National Research Institute of Animal Production, Balice, Poland*

[3] *Institute of Veterinary Medicine, Faculty of Biological and Veterinary Science, Nicolaus Copernicus University in Toruń, Poland*

The aim of the study was to determine the impact of the diets with low doses of antibiotics that mimic the cross-contamination of non-medicated feed, given to chickens during the whole rearing period on slaughter performance and meat quality. One-day old broiler chickens were randomly divided into seven groups and fed with the basal complete starter (1–21 d) and grower/finisher (22–35 d) diets containing colistin (group I), doxycycline (II), flumequine (III), thiamphenicol (IV), tiamulin (V) or tilmicosin (VI) at the doses of 1% of the recommended concentration in the medicated feed, while the control group (VII) received antibiotic-free diets. At the end of the experiment chickens were slaughtered to determine carcass yield and meat quality. Breast and thigh muscles were analysed for selected physicochemical parameters: pH, electrical conductivity, Lab colour, drip loss, thawing loss, cooking loss, Warner-Bratzler shear force and texture parameters (hardness, springiness, cohesiveness, gumminess, chewiness, resilience). There was no significant effect of feed contamination with low doses of antibiotics on slaughter performance and percentage of basic carcass elements, however, chickens from group III tended to achieve the lowest muscle weight and slaughter performance. Within the assessed physicochemical parameters, the breast muscles of chickens did not differ, while the leg muscles differed depending on the tested antibiotic in the diet in terms of cooking losses, and texture parameters, with the most favorable values obtained in the control group, and the least favorable in group III. In conclusion, the antibiotic contamination did not affect the carcass and breast meat quality negatively, but altered some physicochemical properties of the leg meat.

This research was funded in whole by the National Science Centre, Poland, under project no 2021/41/B/NZ9/04114.

P-14 Effect of antibiotic contamination of feed mixtures on chemical composition and storage ability of broiler chickens breast and thigh muscles

Katarzyna Połtowicz[1], Anna Arczewska-Włosek[2], Joanna Nowak[1], Monika Olszewska-Tomczyk[3], Patrycja Adamczyk[1], Przemysław Podstawski[1], Patrycja Zawisza[2], Łukasz Gala[2], Kinga Szczepanik[2], Małgorzata Olejnik[3]

[1] *Department of Poultry Breeding, National Research Institute of Animal Production, Balice, Poland*

[2] *Department of Animal Nutrition and Feed Science, National Research Institute of Animal Production, Balice, Poland*

[3] *Institute of Veterinary Medicine, Faculty of Biological and Veterinary Science, Nicolaus Copernicus University in Toruń, Poland*

The aim of the study was to determine the effects of diets with low doses of antibiotics that mimic the cross-contamination of non-medicated feed, on the chemical composition and oxidative stability of broiler chicken breast and thigh muscles. One-day-old Ross 308 broilers were randomly assigned to 7 groups and were fed throughout the rearing period with iso-protein and isoenergetic diets differing in the content of various antibiotics: colistin, doxycycline, flumequine, thiamphenicol, thiamulin or tilmicosin administered at the doses of 1% of the recommended concentration in the medicated feed (group I, II, III, IV, V or VI, respectively), or antibiotic-free diets (group VII). After slaughter on day 35 of the experiment, breast and thigh muscles were collected from chickens to determine the basic chemical composition (dry matter, crude protein, crude fat, crude ash), cholesterol content, fatty acid (FA) profile and fat oxidative stability (TBARS, on the day of slaughter and after 3 months of storage at -18oC). There was no significant effect of low-dose antibiotic feed contamination on the TBARS value and basic chemical composition of breast and thigh muscles when compared to the control group. However, the differences in the FA profile were indicated. Compared to the control, the decrease in monounsaturated FA (including oleic acid), and an increase in eicosapentaenoic and arachidonic acid contents in breast muscles from group III were observed. In the leg muscles, the decrease in lauric acid contents in groups II, III, IV and VI was noted, and an increase in unsaturated FA along with a decrease in saturated FA was recorded in groups I and II. In conclusion, antibiotic contamination did not affect the meat quality negatively.

This research was funded in whole by the National Science Centre, Poland, under project no 2021/41/B/NZ9/04114.

P-15 Proximate composition and fatty acids profile of egg yolk of three hen genotypes fed with local cereals and forages

Sherezade Sigut[1], Sergio Alvarez[1], Noemi Castro[2], Pilar Mendez[1], Maria Fresno[1], Carolina Gonzalo[1], Alexandr Torres[1]

[1] *Canary Islands Institute for Agricultural Research, Tenerife, Spain*
[2] *Universidad de Las Palmas de Gran Canaria, Arucas, Spain*

A significant number of small and medium-sized poultry farmers produce and market chicken eggs under free-range production system in the Canary Islands. This sector is especially sensitive to variation of prices of feedstock in international markets, due to its strong dependence of importation considering its outermost region status. Thus, the commercial feed for poultry has increased around of 50% respect to the last year. Therefore, priority should be given to look for alternative feeding resources in order to alleviate the current crisis that the poultry sector is going through. The objective of this study was to evaluate the proximate composition and fatty acids profile of egg yolk of three hen genotypes (Lohmann White, Franciscana and Canaria). One group of 20 animals of each genotype was fed with commercial feed for laying hens and another group with a mixture of local cereals and forages (40% wheat, 22% barley, 15% corn, 10% barley, 5% tedera) during 4 months under free-range conditions. For the analysis, 120 egg yolks were collected the wk 12 and 16 of experimental period. One-way ANOVA was used to analyze the statistical differences due to diet factor. The results showed that there were no significant differences for proximate composition due to diet and breed factor. Thus, the moisture varied between 52.80 and 56.75%, and the ashes between 1.55 and 2.00% for the different experimental groups. Furthermore, the fat and protein percentages of egg yolk for control diet was 24.98 and 15.32%, and for the experimental diet was 24.93% and 14.78%, respectively. Regarding the fatty acids profile of the egg yolks, there were also no significant differences for the fraction of saturated, monounsaturated and polyunsaturated fatty acids between both groups. Finally, further studies are necessary to evaluate the use of alternative diet in long-term periods.

P-16 Characteristic identification of grilled Korat chicken compared with grilled commercial chicken using FTIR spectroscopy

Boonyarit Kamkrathok[1], Kanjana Thumanu[2], Wittawat Molee[1], Jirawat Yongsawatdigul[1], Amonrat Molee[1]

[1] *School of Animal Technology and Innovation, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, Thailand*
[2] *Research and Facility Department, Synchrotron Light Research Institute (Public Organization), Nakhon Ratchasima, Thailand*

The chicken breed is a factor that influences meat quality. In Thailand, Korat (KR) chicken was developed as an alternative meat-type chicken for producers and consumers. To date, consumers are more concerned with their health, which raises the importance of meat quality. Thus, the objective of this study was to compare the differences in biomolecules in the breast, thigh, and skin of grilled KR chickens, broiler (Br) chickens, and male brown laying (ML) chickens. Three breeds of chicken (n=3/group) were grilled by vertical electric chicken rotisserie. Breast, thigh, and skin samples were collected, and the Fourier transform infrared spectroscopy (FTIR) technique was used to identify the differential biomolecules in chicken tissues at wavenumbers range of 900–1700 cm^{-1} (protein amide groups) and 2800–3000 cm^{-1} (lipid groups), and principal component analysis (PCA) was used to classify tissue samples among breeds. The results revealed that changes in the absorption band of amide band shapes and the absorption band of CH-stretching from lipid were detected in all breeds. Comparing among groups reveals that changes in the lipid absorption peaks in the meat and skin of Br chickens were higher than those of KR and ML chickens, respectively, while amide bands were not different in any group. However, PCA revealed that the FTIR spectra of biomasses in the breast, thigh, and skin were not separated among groups. These results indicated that the biomolecules of KR chickens after grilling were the same as those of commercial chickens, but the low variation in the range of lipids of KR chickens may be indicative of improved meat quality such as tenderness, juiciness, and water holding capacity. As a result, KR chickens are a good choice for consumers.

P-17 Evaluation of echogenicity and breast thickness of broilers by ultrasound

Marianne De Jesus Silva Patriarca, Pedro Moraes Rezende, Carla Daniela Suguimoto Leite, Renata Gomes, Jose Henrique Stringhini

Universidade Federal de Goias, Goiania, Brasil

Ultrasound examination can be an effective tool for evaluating carcass quality in vivo and has recently been used to detect muscle degeneration such as Wooden Breast (WB) in broilers. This study evaluated the incidence, echogenicity and thickness in breasts of broilers supplemented with the combination of xylanase, protease and two phytase doses. A total of 1536 Ross 308 AP95 male chicks were distributed in a completely randomized design (2x2x2 factorial arrangement), two levels of phytase (750 FTU and 1500 FTU), xylanase (with and without) and protease (with and without), with six replicates each. At 42 days, four birds with average weight of 3311 grams, of each treatment were analyzed by means of the ultrasound device to collect images of the pectoral muscles. The echogenicity and thickness of the musculature were analyzed using the ImageJ software. A total of 296 birds were slaughtered and the breast was visually evaluated for WB scores (0 – normal, 1 – moderate, 2 – severe). The incidence of WB scores was submitted to the Kruskal-Wallis test and the echogenicity and thickness were analyzed by generalized linear models, and the means were compared by the Tukey test ($p<0.05$). The average results for WB were 75.9% for score 1; 17.0% for score 2 and 7.2% for score 3. The echogenicity was lower in the addition of 1500 FTU of phytase and without the additions of xylanase and protease ($p<0.05$). The thickness was lower in the treatment without the use of protease ($p<0.05$). There was no significant difference for the other treatments tested for WB scores. Breasts affected by WB have higher echogenicity values and greater thickness. In this study, the use of 1500 FTU of phytase obtained a lower incidence of the severe WB score and a lower echogenicity value, corroborating the literature. The use of higher phytase dosage showed less presence of WB lesion in chicken breasts.

P-18 Impact of frozen storage on fatty acid profile and healthy indices in goose meat

Wereńska Monika, Okruszek Andrzej, Haraf Gabriela

Wroclaw University of Economics and Business, Wrocław, Poland

The goose meat lipids due to the high content of unsaturated fatty acids are susceptibility to oxidation processes during frozen storage. The composition of the lipids fraction is one of the main dietary aspects to be considered in relation to the risk of civilization diseases. The factors which implicated in the development of these diseases these related to the lipid fraction are among others: cholesterol-raising saturated fatty acids (SFA), thrombogenic SFA, or n-6 polyunsaturated fatty acids. Additionally, the changes in the fatty acids composition of foods are reflected too in the values of such indicators as: nutritive value index, hypocholesterolemic/hypercholesterolemic index, health-promoting index, atherogenic, and thrombogenic indices.

The experimental material covered breast and leg muscles cut from carcasses of 17-week old "Polish oat geese". The samples were vacuum packaged, refrigerated and storage at -20°C±1°C. The samples were examined 24h after slaughter and on the 30th, 90th, 180th, 270th, and 365th day of storage. The fatty acid profile of meat was determined by gas chromatography and health lipid indices were calculated.

Storage time had a significant effect on the fatty acid profile of intramuscular goose fat and also on the healthy indices. The total share of SFA, MUFA and PUFA in breast & leg muscles did not change significantly only until the 90th day of storage. The healthy indices were higher as recommended.

Based on the results, it was found that all groups of fatty acids in goose muscles decreased, the proportion of n-6 and n-3 increased with prolonged frozen storage time. Moreover the healthy indices increased during frozen storage and were more favorable in breast than in leg muscles.

P-19 Frozen Storage Effects on Goose Meat: Assessing Functional Properties and Sensory Evaluation

Wereńska Monika, Okruszek Andrzej, Haraf Gabriela

Wroclaw University of Economics and Business, Wrocław, Poland

The quality of meat obtained from slaughtered animals, including waterfowl, is determined primarily by its nutritional value, health safety, consumer acceptance, and technological suitability determined by functional properties. Muscle proteins, mainly myofibrillar proteins, play an important role in shaping the functional properties of raw meat. The results of the tests on poultry meat indicate that the functional properties deteriorate with the extension of the frozen storage time.

The objective of this study was to investigate the changes in the functional properties (pH, water holding capacity - WHC, water binding capacity - WBC, cooking loos - CL, defrosting loos - DL), color parameters (L*, a*, b*, C, h°) and sensory evaluation of breast (BM, n=18) and leg (LM, n=18) muscles from White Kołuda geese® packaged in a vacuum and stored in frozen conditions for 30, 90, 80, 270, and 365 days at -20°C. The changes in functional properties were established using a standard method used in food technology. The data were analyzed using a two-way ANOVA (Statistica®13.3 software).

The frozen storage time affected (P≤0.05) the decrease in WHC & WBC of BM & LM. The LM can be characterized by a higher (P≤0.05) WHC & WBC than the BM values. It was established that CL & DL negatively increased in BM & LM during frozen storage. Considering the sensory evaluation and L*, a*, b*, C, it was established that changes in BM & LM were unfavorable. The scores are given for smell, taste, consistency, and general appearance, as also L*, a*, and b* parameters decreased significantly (P≤0.05) during frozen storage. BM & LM characterized the parameter ΔE in the range of 0.44-1.45; we can conclude that slight color differences were visible in these muscles (<2).

Based on the study, it can be suggested that the optimal frozen storage time for BM & LM should not be longer than 180 days.

P-20 Laying performance and egg quality of hens fed diets with defatted black soldier fly (Hermetia illucens) meal as a partial replacement of soybean meal

Anna Arczewska-Włosek[1], Patrycja Zawisza[1], Beata Szymczyk[1], Kinga Szczepanik[1], Łukasz Gala[1], Sylwester Świątkiewicz[1], Jolanta Calik[2]

[1] *Department of Animal Nutrition and Feed Science, National Research Institute of Animal Production, Balice, Poland*

[2] *Department of Poultry Breeding, National Research Institute of Animal Production, Balice, Poland*

The effects of defatted Hermetia illucens larvae meal (HIM) incorporated into the diet of laying hens as a partial replacement of soybean meal (SBM) on performance indices, egg quality, and serum biochemical parameters were determined during the 12-week experiment. A total of 96 caged Bovans Brown laying hens, 25 wk of age, were randomly assigned to 4 experimental groups of 12 replicates (cages) of 2 hens per cage. The hens were fed a diet containing 20 % of SBM in the control group, or a diet containing a defatted HIM at a level of 5, 10, or 15 % (HIM5, HIM10, HIM15, respectively). The laying performance parameters were not affected by the inclusion of any HIM level in the diet ($P>0.05$). The internal egg and eggshell quality parameters were unaffected ($P>0.05$) after 4 weeks of HIM administration, while after 8 weeks, lower albumen height and Haugh unit were observed in HIM15, and after 12 weeks, more intense egg yolk colour was noted in HIM10 and HIM15 groups when compared to the control group ($P\leq0.05$). The increased serum Ca, and lower yolk cholesterol contents were obtained in all HIM groups. Summing up, the inclusion of HIM in the diet of laying hens for 12 weeks did not deteriorate the laying performance, did not permanently negatively affect the quality of eggs and eggshells, or altered liver and pancreas function. HIM did not significantly change most serum biochemical indices, but increased serum Ca content and decreased yolk cholesterol content. Thus, HIM can be considered an effective alternative source of protein for laying hens.

This study was financed under Multiannual Project No. 03-18-16-09 funded by the Polish Ministry of Agriculture and Rural Development.

P-21 Yolk colour of eggs from hens fed diets differing in maize hybrid, rapeseed oil level and addition of emulsifier

Kristina Kljak[1], Dora Zurak[1], Veronika Gunjević[1], Goran Kiš[1], Dalibor Bedeković[1], Zlatko Janječić[1], Marija Duvnjak[1], Vasil Prirgozliev[2], Darko Grbeša[1]

[1] *University of Zagreb Faculty of Agriculture, Zagreb, Croatia*
[2] *Harper Adams University, Shropshire, United Kingdom*

This study was conducted to investigate the effect of the rapeseed oil level (RO; 2, 3, 4%) and the emulsifier addition (Lysoforte®, Kemin, USA; 0.5% or no addition) in diets differing in maize hybrid (H1 and H2; carotenoid source in the diet) on yolk colour. A total of 12 treatments (2x3x2 factorial design) were randomly allocated to 72 cages each containing 3 Lohmann Brown hens. The hens were fed the treatment diets for eight weeks and eggs for analysis were collected at week six. Yolk colour was determined according to CIE L*(brightness), a*(redness), b*(yellowness) and with the Yolk Colour Fan (YCF). Diets were analysed for the carotenoid profile using HPLC method. Yolk colour (L*, a* and YCF) was affected by the hybrid, while RO level and emulsifier addition affected only a*. Higher RO levels improved while the emulsifier addition decreased a* ($p<0.05$). However, this effect was hybrid-dependent; in the H1-based diet, RO level also affected L*, b* and YCF, with L* and b* highest in the 3% RO diets. Consistent with the most prominent effect of maize hybrid, dietary β-branched and total carotenoid content correlated positively (r from 0.35 to 0.57), while α-branched correlated negatively (r from -0.24 to -0.54) with a* and YCF ($p<0.05$). These results suggest that the investigated RO levels and emulsifier addition cause small changes in yolk colour compared to maize hybrid alone, detectable only with a*, although their effect may be more pronounced in certain hybrids.

Funding: This work has been fully supported by Croatian Science Foundation under the project “Bioavailability of maize carotenoids in laying hens: effect of grain microstructure and diet composition” (IP-2019-04-9063). The work of doctoral student Dora Zurak has been fully supported by the “Young researchers’ career development project – training of doctoral students” of the Croatian Science Foundation.

P-22 Assessment of the sustainability of male and female lines of a dual-purpose chicken breed using comparative Life Cycle Assessment

Maryam Mehri, Simone Pauling

Faculty of Life Sciences, Rhine-Waal University of Applied Sciences, Kleve, Germany

Since January 2022, culling of male day-old chicks of the layer line has been banned in Germany. Among different alternatives, using a dual-purpose chicken breed has been considered an option, where the males are raised for meat production, while the females are kept for egg production. Although recent studies imply ethical advantages, social acceptance and a potential niche market for this breed, research on the performance of both its layer and broiler lines shows a significantly lower feed efficiency both in egg and meat production. Male birds moreover have a lower yield of valuable breast meat in comparison with conventional broilers. While there is a general understanding that these breeds have a higher demand for natural resources, the environmental impacts of the complete system including both the layer and the broiler side have not been studied so far. It is therefore the aim of this study is to explore the environmental impacts of each production system including acidification, eutrophication and global warming potential under similar housing conditions in comparison to conventional systems using comparative Life Cycle Assessment. The study has been carried out by OpenSourceLCA software and database, using Lohmann Dual (layer and broiler), Lohmann Brown, and Ross 308 data of performance, feed & resources use, and waste products for a cradle-to-farm-gate life cycle assessment. The functional unit for layer and broiler lines are considered as Egg Mass per starting hen (EM) and kg Breast Meat (BM), respectively. The environmental impacts of both conventional and dual-purpose chickens can be positively influenced by using regional feed sources.

P-23 Effect of replacing soybean with alternative feedstuffs on meat quality of a local broiler line

Servet Yalcin, Muazzez Comert Acar, Sezen Ozkan

Ege University, İzmir, Turkey

The concern about its price and the environmental impact of soybean production pushes researchers to seek alternative feedstuffs. The present study, a part of the SUSTAvianFEED* project, aims to investigate the effect of partial replacement of soybean with alternative feedstuffs on breast meat quality in a local broiler line. A total of 168 one-day-old chicks from the Anadolu-T pure dam line (slow-growing) were distributed into 12-floor pens with 14 chicks each. The birds were divided into two groups and fed either a basal control diet consisting of corn and soybean meal or an alternative diet (ALT) that partially reduced soybean content using sunflower meal, dried brewer's grain, and wheat middlings from d 0 to 55. The ALT contained 3.58, 6.3, and 8 % sunflower meal, 2.58, 3.08, and 4 brewer's dried grain, and 2.58, 3.08, and 4% wheat middlings in the started, grower, and finisher diets, respectively. The starter, grower, and finisher diets were formulated to contain 20.8 % protein 2990 ME/kg, 18.8 % protein 2900 ME, and 17% protein 2900 ME, respectively. On d 55, 18 birds from each group were randomly selected after 8-h of feed withdrawal and slaughtered. The left and right p.major were sampled for meat quality analysis and sensory test, respectively. The ALT increased the relative breast weight and did not affect pH, color (L*, a*, b*), or drip loss in breast meat. Sensory scores were not affected by diet. ALT-fed chickens had a reduction in monounsaturated fatty acid content in the breast meat compared to those fed the control diet. The polyunsaturated fatty acid content of breast meat increased with ALT. It was concluded that partial replacement of soybean with sunflower meal, dried brewer's grain, and wheat middlings had no negative effect on breast meat quality.

* This project was supported by PRIMA Foundation (Grand agreement number 2015).

P-24 Effect of goose breed on carcass and meat characteristics

Katarzyna Połtowicz[1], Anna Koseniuk[2], Joanna Nowak[1], Grzegorz Smołucha[2], Joanna Obrzut[1], Bogumiła Kłeczek[2], Paulina Potocka[3], Kamila Kłos[3], Halina Bielińska[3]

[1] *Department of Poultry Breeding, National Research Institute of Animal Production, Balice, Poland*
[2] *Department of Animal Molecular Biology, National Research Institute of Animal Production, Balice Poland*
[3] *National Research Institute of Animal Production, Experimental Station Kołuda Wielka, Janikowo, Poland*

The aim of the study was to determine the effect of goose breed on slaughter performance and meat quality. One-day-old goslings (males) of Pomeranian geese and White Kołuda® geese were reared until 115 days of age under the same optimal environmental conditions and fed according to oat fattening technology. At the end of the experiment 6 geese of average body weight were selected for slaughter from each group to determine slaughter performance and the quality of breast and leg muscles (pH, Lab color, drip loss, thawing loss, thermal loss, shear force and texture parameters (hardness, springiness, cohesiveness, gumminess, chewiness). The results obtained were analysed by one-way analysis of variance and Duncan's test. The study showed a significant effect of goose breed on body weight and carcass weight, as well as on slaughter yield and carcass muscling. The average slaughter body weight of Pomeranian geese was lower compared to White Kołuda® geese. Therefore, Pomeranian geese had a lower carcass weight, as well as a lower slaughter yield. White Kołuda® geese were also characterized by a higher weight of breast and leg muscles but the proportion of breast muscles in the carcass was higher in Pomeranian geese. There was no significant effect of goose breed on most of the meat quality parameters evaluated. The only significant differences were the hardness of the raw leg muscles greather in White Kołuda® geese, and the cohesiveness of the breast muscles and the redness of the thigh muscles higher in Pomeranian geese. In conclusion, White Kołuda geese achieve significantly higher body weight and slaughter performance compared to Pomeranian geese, with no negative impact on meat quality.

This research was funded in whole by the National Research Institute of Animal Production, Poland, under project no 501-181-621.

P-25 Metabolite profile of Wooden Breast in broilers fed guanidine acetic acid assessed by H1-NMR spectroscopy

Carla Daniela Suguimoto Leite[1], Renata Gomes[1], Laura Alves Duarte[1], Fernanda Alves Duarte[1], Ingrid Carneiro De Olivei Falcao[1], Thaciane Lorenzo Amaral[2], Jose Henrique Stringhini[1]

[1] *Universidade Federal de Goias, Goiania, Brasil*
[2] *North Carolina State University, Raleigh, United States*

Wooden breast (WB) lesion is observed as a hardening of the pectoral muscle (Pectoralis major), that could be classified in degrees of severity. Nuclear magnetic resonance (NMR) is a recent technology applied for metabolism studies in animal production. This study aimed to compare metabolites changes among WB scores of severities. 720 birds were distributed in a complete random design of three treatments and eight replications: a standard diet; a diet containing 0.06% guanidine acetic acid (GAA), considering its nutritional matrix; and a basal diet with the addition of 0.06% GAA in a 'on top' form. At 41 days old, 16 birds per treatment were slaughtered, and breast samples were handling scored in a 4-point scale: 0- normal, 1-mild, 2- moderate, and 31- severe. From 27 samples, metabolites were extracted and quantified by Topspin 3.1 software. Statistical analyses were performed by MetaboAnalyst. As result, 19 different metabolites were found and quantified (Niacinamide, AMP, Carnosine, Hypoxanthine, Fumarate, IMP, Glucose, Ribose, Lactate, N-Methylhyantoin, o-Acetylcarnitine, Anserine, Creatine, Carnitine, Methionine, Acetate, Alanine, Valine and Isoleucine). No difference among diets treatments were found for incidence of WB scores ($p<0.05$). By Principal Component Analysis, considering WB scores, no difference of metabolites was found. Carnitine was the most important metabolite in the WB severity, and it was in a higher concentration in meat of severe WB scores. Carnitine is a branched amino acid that, plays a critical role in energy metabolism, especially in cardiac and skeletal muscle. For WB abnormality, GAA does not ameliorate severity of lesions and could not affect metabolite profile from breast muscle.

P-26 The role of networking in farm biosecurity and in food safety issues in table egg and poultry meat production in Hungary

László Kovács[1], Ákos Józwiak[2], Rubina Tünde Szabó[3], Miklós Süth[2], László Könyves[1], Levente Kovács[3], Dávid Mezőszentgyörgyi[3], András Székács[4], Eszter Takács[4], Mária Kovács-Weber[3]

[1] *Department of Animal Hygiene, Herd Health and Mobile Clinic, University of Veterinary Medicine, Budapest, Hungary*
[2] *Digital Food Chain Education, Research, Development and Innovation Institute, Institute of Environmental Sciences, University of Veterinary Medicine, Budapest, Hungary*
[3] *Institute of Animal Sciences, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary*
[4] *Agro-Environmental Research Centre, Institute of Environmental Sciences, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary*

The most prominent task for the poultry sector is the proper implementation of biosecurity practices and the promotion of the prudent use of antimicrobial agents. Both areas affect consumers through the food safety. It can be rightly stated that biosecurity is a key issue in the table egg and meat production.

Recurrent outbreaks of avian influenza have demonstrated that addressing this problem solely at the local level is not sufficient. Instead, uniform regulations and network operations at regional, national, and even international levels as a means of a preventive process regulation procedure are essential. In addition to avian influenza, it is important to mention other diseases with public health relevance.

The **NetPoulSafe** project is a network of European poultry industry players that was established by the European Union to enhance epidemic prevention and ensure production sustainability. The goal is to **create a European knowledge base reservoir for the development of on-farm biosecurity**.

During our work, it became evident from the results that most producers are quite familiar with the elements of on-farm disease prevention measures. However, the operational practices related to biosecurity are not necessarily uniform or appropriate in the poultry production chain at the national level. It is evident, however, that there are additional barriers beyond financial (main obstacle) ones to implementing certain biosecurity measures.

The final outcome of our work, in collaboration with our international partners, will be the establishment of a professional biosecurity knowledge platform which will ultimately benefit public health and food safety as well. The harmonized knowledge base will contain all necessary information on non-specific disease prevention protocols.

P-27 Effect of the competitive exclusion product BROILACT® on the growth performance and breast muscle quality of broiler chickens

Damian Bień[1], Michał Gagucki[2], Artur Żbikowski[3], Monika Łukasiewicz-Mierzejewska[1], Monika Michalczuk[1]

[1] *Department of Animal Breeding, Institute of Animal Sciences, Warsaw University of Life Sciences – SGGW, Warsaw, Poland*
[2] *Orion Pharma Sp. z o.o., Warsaw, Poland*
[3] *Department of Pathology and Veterinary Diagnostics, Institute of Veterinary Medicine, Warsaw University of Life Sciences - SGGW, Warsaw, Poland*

We evaluated the influence of the commercial, competitive exclusion (CE) product, Broilact® (Orion Pharma, Finland) on the growth performance and breast muscle quality in broiler chickens raised for 42 days. A floor pen trial was carried out in the experimental broiler house at RZD Wilanow-Obory, Warsaw University of Life Sciences–SGGW. In total, 1044 one-day-old ROSS-308 male chicks were randomly divided into two groups: the experimental group treated with Broilact® and the non-treated control group. Each group consisted of 9 replicated pens. A dose of 1 mg Broilact® per bird (≥107 CFU/0.3 mL) was diluted in 0.3 ml of regenerate agent solution and administered into the crop of one-day chicks at the hatchery. The lighting and temperature in the building were adjusted according to the ROSS management guide. Chickens were fed commercial diets. Final production parameters were calculated as the body weight of chickens, mortality, feed conversion ratio, and EPEF. At 42 days of life,10 birds were selected from each group and dissected to obtain samples of breast muscle for analysis. The results for the determination of production parameters, and breast muscle quality, were processed using the PS IMAGO PRO 8.0. We observed lower mortality in the Broilact® treated group (0.96%) in comparison to the non-treated group (2.30%) ($p \leq 0.01$). There were no statistically significant differences in body weight, FCR and EPEF points between the chickens from the Broilact® treated group and the control group on the 42nd day ($p > 0.05$). The significant differences between the experimental groups were observed for the pH24 and shear force ($p \leq 0.01$). Treatment with one dose of the Broilact® product on day one of a chicks' life reduces mortality and does not adversely affect the quality parameters of the breast muscle.

P-28 Microalgae as health-promotors for chickens: effect of Chlorella vulgaris supplementation on digestibility of broiler feed

Sofie Van Nerom[1], Filip Van Immerseel[2], Johan Robbens[3], Evelyne Delezie[1]

[1] *ILVO, Melle, Belgium*
[2] *UGhent, Merelbeke, Belgium*
[3] *ILVO, Ostend, Belgium*

Microalgae can produce high-quality endproducts. After extraction, residual biomass can be repurposed in poultry feed. Microalgae contain compounds that might have health-promoting effects on chickens. 2 groups of microalgae cultivation exist: hetero- and autotrophic: former grows on organic C sources, latter use light and CO_2. *Chlorella vulgaris* (CV) in this study is mixotrophic: grows both ways. A first step is checking digestibility and determining if algae need processing for breaking the cellwalls. Digestibility trials with broilers were performed: effect of auto- and heterotrophic, non-processed and PEF (Pulse Electric Field) CV on digestibility was determined with following treatments: heterotrophic CV: 1, 2, 5%, autotrophic CV: 1, 2, 5%, PEF heterotrophic CV: 5% and PEF autotrophic CV: 1, 5%. Broilers were fed the algae during 10 days, feces were collected. Protein, fat, gross energy, ash and fiber of feed and feces were analysed. Inclusion of 5% CV showed a significant decrease in metabolisable energy. For ash, increasing inclusion levels of CV in the feed showed increasing digestibility, but only 5% heterotrophic CV was significantly higher than the control feed. Digestibility of ash of PEF heterotrophic 5% CV feed was significantly higher than the non-processed CV. Fiber wasn't digested in any of the treatments. 5% CV feed showed significantly lower fat digestibility than the 1 and 2% and control feed, however the 5% feed had a lower fat content. Protein digestibility was significantly lower for all treatments compared to the control feed. The effect of the PEF will be further studied using microscopy and protein solubility, since the digestibility above considers the complete feed which includes max 5% algae. Different inclusion levels and (non)-processed CV will be evaluated in performance trials to study effects on gut health, welfare and meat quality.

P-29 Effect of slaughter body weight on the nutritional value of intensively reared goose meat.

Paulina Potocka[1], Joanna Nowak[2], Katarzyna Połtowicz[2]

[1] *National Research Institute of Animal Production, Experimental Station Kołuda Wielka, Janikowo, Poland*

[2] *Department of Poultry Breeding, National Research Institute of Animal Production, Balice, Poland*

The aim of the study was to determine the effects of slaughter body weight of 10.5 week-old intensively reared White Kołuda® geese on the chemical composition and fatty acid profile of breast and thigh muscles. One hundred and twenty White Kołuda® geese (W33, male and female) were managed with an intensive rearing system and were feed with the same complete KB-1 (0-4 week-of-age), KB-2 (5-9 week-of-age) and KB-3 (10-10,5 week-of-age) feed mixtures containing 20.0%, 18.5% and 14.5% of crude protein and 3.0%, 2.3% and 2.3% crude fat, respectively, and, in addition, with cut green fodder. At 10.5 weeks of age, thirty two animals were selected and divided into average (I) and high (II) groups depending on final body weight. After slaughter, breast and thigh muscles were collected from each goose to determine the basic chemical composition (dry matter, crude protein, crude fat, crude ash), cholesterol content and fatty acid (FA) profile. There was no significant effect of geese body weight on basic chemical composition of breast muscles, however the cholesterol content was higher in group I. In thigh muscles, group I was also characterized by higher cholesterol level, and in addition, by lower dry matter and protein content. Moreover, some differences in the FA profile were indicated. Compared to group I, the decrease in C18:3, EPA, n-3 PUFAs and increase in C14:0 and C16:1 contents in breast muscles from group II were observed. In the leg muscles, the decrease in C18:0, C12:2, PUFA and n-6 PUFAs contents in group II were noted, along with increase in MUFA (including C16:1). In conclusion, the higher slaughter body weight of intensively reared geese may affect the meat nutritional value negatively.

This research was funded by the statutory activity of NRIAP, project no 08-12-01-12.

P-30 Quality characteristics of chicken meat belonging to the different market categories available in Italy

Francesca Soglia[1], Mara Antonia Gagliano[1], Alice Cartoni Mancinelli[2], Massimiliano Petracci[1]

[1] *Department of Agricultural and Food Sciences, Alma Mater Studiorum - University of Bologna, Cesena, Italy*

[2] *Department of Agricultural, Environmental and Food Science, University of Perugia, Perugia, Italy*

The present study aims at evaluating the quality traits and technological properties of chicken breast meat belonging to the different market categories available in Italy: light reared under conventional indoor (LC, 35d) or outdoor (LO, 56d) conditions, medium (M,42d), organic (O, 81d), and heavy (H, 45d) broiler chickens. A total of 625 breast fillets (N=25/flock) and 500 thighs (N=20/flock) belonging to 25 flocks of broiler chickens (5 flocks/market category) were used to evaluate the main quality traits (pH, color) and technological properties (drip and cooking losses, shear force). Data were analyzed by one-way ANOVA by considering the market category as main effect. When significant, means were separated by Tukey-HSD test ($p<.05$). The market category remarkably affected all the parameters describing meat quality. As for pHu, birds reared under conventional intensive systems (LC, M, and H) exhibited higher ($p<.001$) values if compared to O and LO. As for color, the lowest L^* and a^* values observed in LO along with the highest yellowness may be directly ascribed the rearing system and to the genotype from which these animals belong to which likely results in a different conformation of the pectoral muscles themselves. In this regard, the lower water holding capacity observed in LC (as depicted by drip and cooking losses, $p<.001$ and $p<.001$, respectively) may be ascribed to a higher proportion of soluble collagen within these muscles that may also contribute to explain their higher tenderness after the cooking process. In agreement with that, the highest shear force values were recorded in LO ($p<.001$) that requiring more time to achieve the slaughter weight likely have a higher cross-linking of the collagen fibrils.

P-31 Supporting measures to improve the biosecurity of Polish poultry farms

Artur Żbikowski, Karol Pawłowski, Krzysztof Adamczyk, Piotr Szeleszczuk

Department of Pathology and Veterinary Diagnostics, Institute of Veterinary Medicine, Warsaw University of Life Sciences, Warsaw, Poland

Biosecurity is acknowledged as the appropriate answer for preventing diseases spread and safeguarding competitive and sustainable poultry farms. The H2020 Netpoulsafe project aims to improve biosecurity compliance on poultry farms through the compilation, validation and sharing of supporting measures (practices that support the implementation of biosecurity - SM) in Belgium, France, Hungary, Italy, The Netherlands, Poland, and Spain. To qualitatively assess these measures in Poland 26 farmers and 23 advisors (enclosed breeders, broilers, layers, turkeys) were interviewed with a semi-closed questionnaire (9 items with 23 SM's). For each SM option, two questions were asked to assess which SM has already helped to implement biosecurity practices (BP's) on the farm (successful SM) and which SM's they would need to improve the implementation of the BP's (required SM). The most required SM's were: financial support for biosecurity implementation; biosecurity training (exposure visit at a well-organized farm, group discussion, live workshops); contact support or distance support by a biosecurity advisor; conferences, webinars, advisors meetings; educational materials (books, guides, manuals, research papers, journals, farming press); biosecurity checks by stakeholders (local integration companies, etc.). The "successful" SM's were: biosecurity checks by the government and stakeholders, conferences, webinars, advisors meetings; contact support or distance support by a biosecurity advisor, and educational materials. To improve biosecurity on farms, Polish farmers require more individualized (and preferably on-site) practical training (which helps to identify the specific risk factors and to find practical solutions) and financial support. The correct application of biosecurity measures will have an impact on the quality of final products (meat or egg) and the farm economy.

P-32 The effect of in ovo injection of bee pollen extract or some carbohydrates on selected carcass attributes and meat quality of broiler chickens

Joanna Pawłowska, Ewa Sosnówka-Czajka, Iwona Skomorucha, Katarzyna Połtowicz

National Research Institute of Animal Production, Cracow, Poland

The study was designed to investigate the *in ovo* effect of bee pollen extract or a combination of carbohydrates solution on selected carcass attributes and meat quality of Ross 308 broiler chickens. A total of 360 hatching eggs were randomly divided into three treatment groups (12 replicate trays/group of 10 eggs/each): control – not injected (group I); injected with 500µL of 0.9% saline solution + 1.5% bee pollen extract (group II) and injected with 500µL of 0.9% saline solution + carbohydrates solution with the analogous content of simple and complex sugars (group III). After hatching, 210 broiler chicks (5 replicates of 14 chicks/replicate) were placed in pens on litter and fed *ad libitum* the same standard diet. Weekly measurements of body weight (BW), average daily gain (ADG), feed intake (FI), and feed conversion ratio (FCR) were performed. At the end of the experiment (42nd day), 30 birds (15 hens and 15 roosters) were selected from each group to evaluate carcass quality, physicochemical traits of breast and leg muscles: ultimate pH (pHu), drip loss (DL), water holding capacity (WHC), and chemical composition of the meat. All data were subjected to an ANOVA. There were no significant differences in production results between groups. However, the chickens from the experimental group (II) were characterized by significantly higher carcass yield and higher pH values of leg muscles when compared to the control group (I). There were no differences between the experimental groups with regard to pHu, DL, WHC, and the chemical composition of meat. To conclude, the supplementation of chickens with bee pollen at the embryogenesis stage did not affect the carcass and meat quality negatively, but altered slaughter yield of the birds. This study requires further research, but supplementing chickens with bee pollen at the embryogenesis stage seems promising.

P-33 How about insects?

Agnieszka Orkusz, Joanna Harasym

Wroclaw University of Economics and Business, Wrocław, Poland

In the interest of the planet and future generations, a lifestyle redesign is necessary, with the pillar being food produced based on ecological production systems that consider animal welfare. Edible insects are a valuable food product and a valuable meat substitute. Their widespread use in the human diet can help solve the problem of global malnutrition. Insect production entails lower water consumption, surface area, electricity usage, and lower greenhouse gas emissions than livestock production. Introducing insects into the diet requires a change in a consumer mentality and cultural beliefs, not only in Poland but also in Europe, as a Western culture generally perceives insects very negatively.

The study aimed to compare and determine the type of emotions ("happy", "sad", "angry", "surprised", "disgusted", "contempt") experienced by respondents in real time while watching a 1-minute and 26-second film. The film consisted of 5 segments depicting livestock farming: turkeys, cows, pigs, and edible insects: mealworms and house crickets. FaceReader software (Noldus) evaluated which parts of the film evoked more robust responses from the respondents. Participation in the study was voluntary, and the participants were students from Wrocław universities belonging to Generation Z. The study group consisted of 227 individuals.

The research found that the respondents' emotions, such as „happy", "angry", "surprised", "disgusted", and "contempt", did not differ significantly when watching scenes depicting livestock farming and edible insects. Statistically significant differences were observed in the case of „sad" for turkey farming and edible insects* and turkey farming and pigs*, as well as cows and mealworms* (*higher level of "sad").

The research results are quite surprising because it was assumed that the respondents would show a higher level of emotions in the case of livestock farming compared to insect farming. However, the research results seem to confirm the regularity that respondents belonging to Generation Z, the first generation born in the era of the Internet and digital technology, are exposed to an abundance of stimuli due to access to a vast amount of information, films, and video games, often with a brutal, bloody, and shocking content, undergo desensitization.

The project is financed by the Ministry of Science and Higher Education in Poland under the programme „Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN".

P-34 Analyzing the Risk of Short-Term Production Losses in Free-Range Hens Using Weather and Production System Data

Yusuf Adewale Adejola, Terence Sibanda, Tellisa Kearton, Johan Boshoff, Isabelle Ruhnke, Mitchell Welch

University of New England, Armidale, Australia

The purpose of this study is to investigate the relationship between the risk of short-term egg production losses, weather, and flock production performance data. A data set was collected from 7 flocks of 20,000 to 40,000 laying hens per flock. The data used for modelling included the age of hens, laying rate, mortality, feed and water intake, and historical weather data. This raw data was processed using a moving average to calculate a series of aggregate features including mean and standard deviation. Short-term reductions in egg production rate were detected through a peak-detection technique on inverted production curves. Generalised linear models were created to model the probability of a short-term drop in egg production 5 days after the end of the data window. The values across each variable were binned into low, high, and medium ranges, and odds ratios were calculated to identify significant relationships between the variables and production drop outcome. The results show that a lower standard deviation of the laying rate (<1.7%) was linked to a lower risk, while a higher standard deviation of the laying rate (> 3.4%) was linked with higher risk of sudden egg loss. This indicates that consistent laying performance is linked with a lower probability of a production issue. Lower mean feed and water intake are similarly linked with a higher risk of a sudden production drop. Higher mean mortality is linked with a lower risk, which is counterintuitive as high flock mortality would normally indicate a production issue. This suggests that mortality is likely a poor indicator of future risk. This study provides a good insight into the viability of using readily available production data within a decision support tool to aid in free-range egg production.

P-35 The effects of castration and age on the content of edible and non-edible components and the distribution of tissue components in the carcasses of Rhode Island Red cockerels and capons

Daria Murawska[1], Michał Gesek[2], Korina Michalska[2], Justyna Błażejak-Grabowska[1]

[1] *Department of Commodity Science and Animal Improvement, University of Warmia and Mazury in Olsztyn, Poland*
[2] *Department of Pathological Anatomy, Faculty of Veterinary Medicine, University of Warmia and Mazury in Olsztyn, Poland*

Changes in the content of edible (muscle tissue, skin with subcutaneous fat and giblets) and non-edible components (bones and slaughter offal) and the distribution of tissue components in the carcasses of intact and castrated birds of Rhode Island Red breeds remain insufficiently investigated. A better understanding of those changes could support the determination of optimal slaughter age in capons. The experimental material comprised 200 RIR male raised to 28 weeks of age. At 8 weeks of age, 100 birds were surgically castrated by a qualified veterinarian. Between weeks 12 and 28, at four-week intervals, 8 intact cockerels and 8 capons were selected randomly and slaughtered. The data obtained from carcass dissection were analyzed statistically. RIR cockerels, compared with capons, were characterized by a higher proportion of edible components, at 12-16 weeks of age ($P \leq 0.05$) and a more desirable carcass tissue composition due to a higher content of lean meat in total body weight (BW) (at 14 -28 weeks of age, $P \leq 0.05$). Capons had higher abdominal fat content than cockerels ($P \leq 0.05$), which resulted in a higher percentage of non-edible components in their BW (at 20-28 weeks, $P \leq 0.05$). Differences in the distribution of lean meat in the carcass were noted from 16 weeks of age in both castrated and intact birds. The content of breast muscles increased in capons to 20 wk ($P \leq 0.05$), and the content of leg muscles increased in cockerels to 20 wk ($P \leq 0.05$). The results of this study indicate that in view of the optimal proportions of edible and non-edible components and the optimal distribution of major tissue components, RIR capons should be slaughtered at 20 - 24 weeks of age.

P-36 Effects of different tannin-based extracts on gut chicken spontaneous contractility

Laura Mattioli[1], Ivan Corazza[2], Matteo Micucci[3], Marco Pallavicini[4], Roberta Budriesi[1], Mojca Osredkar Mergole[5]

[1] *Food Chemistry and Nutraceutical Lab, Department of Pharmacy and Biotechnology, Alma Mater Studiorum-University of Bologna, Bologna, Italy*
[2] *Department of Specialistic, Diagnostic and Experimental Medicine (DIMES), University of Bologna, S. Orsola-Malpighi University Hospital, Alma Mater Studiorum-University of Bologna, Bologna, Italy*
[3] *Department of Biomolecular Sciences, University of Urbino "Carlo Bo", Urbino, Italy*
[4] *Department of Pharmaceutical Sciences, University of Milano, Milano, Italy*
[5] *Silvateam S.p.A., San Michele di Mondovi (CN), San Michele di Mondovi, Italy*

Background: Transmission of gastrointestinal disease is favoured by liquid excrements, because by stagnating in the litter, they can greatly facilitate the passage of bacteria and viruses through lesions of the legs, which often occur in meat and breeding chickens. Adequate smooth muscle contractility in the gastrointestinal tract is therefore essential to maintain the better consistency formation of stools as well as better digestion and absorption of nutrients. Silvafeed ENC and Silvafeed Q represents an important source of bioactive molecules, such as tannins. These phytocomplexes obtained from natural matrices have several health biological effects, of which the main ones are astringent, antispasmodic and spasmolytic properties. The aim of presented trial was to study the in vitro effects of a hydrolysable tannin-rich extract (Silvafeed ENC) and a condensed tannin-rich extract (Silvafeed Q) on the intestinal tracts and the gallbladder basal spontaneous contractility of healthy chickens. The results showed that the two phytocomplexes influenced the spontaneous intestinal contractility in different ways by regulating the tone and consequent progression of the food bolus. A reduction in the contractility of intestinal smooth muscle promotes absorption and causes an increase in fecal consistency. Thus, improving the quality of life and welfare of poultry are objectives that benefit the producer and public health.

Materials and Methods: Fresh gastrointestinal tracts of healthy chicks Ross 308 (2.65–2.85 Kg) were obtained from a local slaughterhouse. The tissues (duodenum, caecum, ileum, proximal colon and gallbladder) were rapidly set up under a suitable resting tension in 15 mL organ bath, containing appropriate physiological salt solution (PSS), consistently warmed (37°C) and buffered to pH 7.4 by saturation with 95% O_2–5% CO_2 gas. Tissues were allowed to equilibrate for at least 30 min. For the evaluated tissues the tracing graphs of spontaneous contractions were continuously recorded as tension changes in longitudinal muscle length. The following parameters were evaluated: mean contraction amplitude (MCA)(g); index of the spontaneous contraction variability (SCV); and basal spontaneous motor activity (BSMA). The spontaneous contraction rates were investigated through a standard FFT analysis. Three frequency bands were made (LF, MF and HF) for the evaluation of the absolute powers to simplify the analysis.

Results: The two phytocomplexes showed different effects towards gastrointestinal smooth muscle contractility. In the duodenum, Silvafeed ENC relaxed the muscles without significantly influencing the peristalsis waves, Silvafeed Q clearly reduced them. Both extracts reduced the tone in ceacum, Silvafeed ENC reduced peristalsis frequencies blandly and in a concentration-dependent manner, while Silvafeed Q had an up-and-down pattern. In the ileum, Silvafeed ENC little affected spontaneous contraction and Silvafeed Q decreased it, but at the highest concentration. Silvafeed Q relaxed the colon and reduced the spontaneous variability at all frequencies of interest, Silvafeed ENC has no effects. Both Silvafeed ENC and Silvafeed Q increased spontaneous contractility of the gallbladder, but Silvafeed ENC in a concentration-dependent manner.

Conclusions: Results obtained in the presented study describing the different effects on different intestinal tracts confirm how a combined use of Silvafeed ENC and Silvafeed Q can improve spontaneous motility. The increase in contractility responsible for bolus mixing may favour the activity of pancreatic enzymes on proteins, lipids and carbohydrates, which would become more bioavailable for intestinal absorption. The reduction in the low-frequency of contraction in colon could be associated with a change in the transit velocity of the colon content, with a consequent increase in the absorption of electrolytes and an increase in the consistency of the stool. Silvafeed ENC and Silvafeed Q can beneficially support the life quality of the animal and, at the same time, the quality of the meat through action on different targets, including contractility.

P-37 Influence of storage time and conditions on the quality of eggs

Zofia Sokołowicz[1], Miroslava Kacániová[2], Anna Augustynska-Prejsnar[1]

[1] *Uniwersytet Rzeszowski, Rzeszów, Poland*
[2] *Slovak University of Agriculture, Nitra, Slovakia*

The wide availability, relatively low price, and high nutritional value of chicken eggs make them an integral part of human diet. Eggs are a good source of high-quality protein, the necessary unsaturated fatty acids and fat-soluble vitamins, vitamins of the B group, mineral compounds, and other biologically active compounds. In addition to their high nutritional value, table eggs must be microbiologically safe and have favourable sensory and functional qualities. Factors that shape egg quality can be storage time and conditions. Eggs may be packaged in plastic or cardboard egg packaging. The studies aimed to assess the impact of packaging, storage time, and temperature on the microbiological quality as well as on the sensory quality and functional properties of eggs.

The study material consisted of eggs from laying hens kept under free-range conditions. The eggs packed in cardboard and plastic cartons were stored at 5 °C and 22 °C, respectively. The eggs were examined on the day of laying and on days 14 and 28 of storage. The microbiological quality of the shell and contents of the eggs were examined on all evaluation dates. The identification of the bacteria was performed using the Maldi TOF-MS Biotyper. The foaming properties of the egg white stored in cardboard and plastic packaging as well as the sensory characteristics of the eggs stored in both types of packaging after hard-boiling were examined on all evaluation dates.

The type of packaging in which the eggs were stored was shown to influence the microbiological quality of the egg contents. Eggs stored in plastic packaging, on days 14 and 28 of storage, contained more bacteria in egg contents than eggs stored in cardboard packaging ($p < 0.05$). The total count of bacteria on the surface of the shell and in the contents of eggs stored in both types of packaging did not exceed acceptable levels, and non-pathogenic bacteria predominated among the bacteria isolated. In this study, 217 isolates were identified from 31 species, 11 genera, and 10 families.

The type of packaging in which the eggs were stored did not have an effect on the foaming properties of the egg white ($p > 0.05$) or on the sensory characteristics of the eggs after hard-boiling. Irrespective of the type of packaging, the foaming properties of the egg white and the sensory characteristics of the eggs after hard-boiling deteriorated with storage time. The effect of temperature on egg quality was found. Regardless of the type of packaging, eggs stored at 5 °C after hard-boiling had better yolk colour, smell, and texture than eggs stored at 22 °C ($p < 0.05$).

The results obtained may be of relevance for optimising the selection of egg packaging. However, further research is required for a full assessment of the impact of packaging type on the quality of stored eggs.

P-38 Impact of dietary nettle (Urtica dioica) and fibre degrading enzymes on laying hen egg production and egg quality

Vasil Pirgozliev[1], Isobel Margaret Whiting[1], Stephen Charles Mansbridge[1], Kristina Kljak[2], Stephen Paul Rose[1]

[1] *The National Institute of Poultry Husbandry, Harper Adams University, Newport, United Kingdom*
[2] *Faculty of Agriculture, University of Zagreb, Zagreb, Croatia*

The study aimed to examine the effects of graded levels of dried milled stinging nettle (Urtica dioica) leaves at 0, 25 and 50 g/kg dietary inclusion in wheat-soya based diet, with or without fibre degrading enzymes on egg production and egg quality variables when fed to HyLine Brown hens from 43 to 47 weeks of age. Lutein content in yolks was also determined. A basal diet was mixed and split into three parts. Part one was fed as is (control; C), and each of the other parts were supplemented with one of the graded nettle levels. The three diets were further split into two parts, with one of each part supplemented with a commercial preparation of beta glucanase and xylanase enzyme (Ronozyme Multigrain, DSM, Switzerland), resulting in six diets in total. Each diet was fed to six cages containing two layers, for four weeks, following randomization. Dietary feed intake, egg production and feed efficiency were determined for the study period. The egg quality variables were determined based on one egg per cage collected at the end of the study. Data were analysed by two-way ANOVA using a 2 X 3 factorial design (enzyme and nettle inclusion main effects and interaction) and polynomial contrasts were performed to test for linear relationships between nettle dose and the studied variables. Feeding nettle and enzyme did not change egg production ($P > 0.05$) or most of the egg quality variables. Dietary nettle linearly decreased albumen pH ($P < 0.05$) and increased yolk color and yolk lutein concentration ($P < 0.001$). There was no enzyme by nettle interactions observed ($P > 0.05$). The results suggest that feeding nettle to laying hens can improve the egg yolk antioxidant status. Further research involving various dietary levels of nettle and enzyme in laying hen diets is warranted.

P-39 Effect of partial or total replacement of soybean oil by Hermetia illucens larvae fat in layers diets on selected egg quality indices

Aleksandra Drażbo[1], Damian Józefiak[2], Paweł Konieczka[1], Eliza Włodarczyk[1], Aleksandra Ziemianowicz[1], Krzysztof Kozłowski[1]

[1] *Department of Poultry Science and Apiculture, University of Warmia and Mazury in Olsztyn, Olsztyn, Poland*
[2] *Department of Animal Nutrition, University of Life Sciences, Poznań, Poland*

Insect fats can be a source of many nutrients, including energy and essential fatty acids, but there is a lack of research into how they affect the quality of poultry products. Therefore, the aim of this study was to determine the effect of fat from *Hermetia illucens (HI)* larvae in substitution to the soybean oil on physico-chemical traits of eggs and fatty acid profile in laing hens. A total of 168 Hy-Line Brown layers at 56 weeks of age, kept in battery cages, were divided into 3 dietary treatments (28 replicates of 2 birds each). For 12 weeks, the birds were fed diets with ditterent type of fat as follows: group (C) - a diet with 5% addition of soybean oil; group T2 - a diet in which 50% of soybean oil was replaced with fat from *Hermetia illucens* larvae, group T3 - a diet in which 100% of soybean oil was replaced with fat from *Hermetia illucens* larvae. On the last day of the experiment, 12 eggs were collected from each group to determine the selected egg quality indicators and yolk fatty acid profile. The total replacement of soybean oil with fat from *HI* in the diets of laying hens significantly improved egg yolk colour (P=0.012), but significantly deteriorated shell quality parameters, i.e. thickness, strength and shell content, compared to the T1 group (P=0.030, P=0.008 and P=0.001, respectively). No change in the above-mentioned parameters was observed with 50% replacement of soybean oil with fat from *HI*. With an increased the inclusion of *HI* fat in the diet of laying hens, a significant increase in the concentration of SFA in the egg yolk (P<0.001), including lauric acid (C12:0, P<0.001) was noted. There was also a significant increase in MUFA and a decrease in PUFA (P<0.001, both), including C18:3 and C22:6 (P<0.001). Irrespective of the level of HI fat had no effect on the n6/n3 PUFA ratio. It can be concluded that the introduction of *Hermetia illucens* larvae fat can significantly affect egg quality indicators and changes in the fatty acid profile of egg yolks. A partial (50%) substitution of soybean oil for HI fat in laying diets is more recommended than a total substitution (100%), as it does not impaire shell quality indices and has a lower effect on the PUFA n-3 concentration in the egg yolk.

P-40 Effects of cannabidiol and nano-selenium on growth performance on broiler chickens infected with Clostridium perfringens

Dominika Szkopek[1], Misza Kinsner[1], Paweł Konieczka[2]

[1] *Department of Animal Nutrition, The Kielanowski Institute of Animal Physiology and Nutrition, Polish Academy of Sciences, Jablonna, Poland*

[2] *Department of Animal Nutrition, The Kielanowski Institute of Animal Physiology and Nutrition, Polish Academy of Sciences/ Department of Poultry Science, University of Warmia and Mazury in Olsztyn, Olsztyn, Poland*

Necrotic enteritis (NE) caused by the anaerobic bacterium Clostridium perfringens is responsible for significant economic losses in the poultry industry due to deteriorated bird performance and increased morbidity and mortality rates. Cannabidiol (CBD) from Cannabis sativa and nano-selenium (nano-Se) are substances of potential regulatory functions in the gastrointestinal tract. Determining the mechanisms affecting the interactions between Clostridium perfringens pathogenesis and the host response is an urgent need in the poultry industry. The aim of the experiment was to verify the effect of CBD and nano-Se on birds performance in the ileum of broiler chickens infected with Clostridium perfringens. Ross 308 broiler chickens were divided into 6 groups of 72 birds each and were fed from 8 to 23 days of life the following diets: (I, II) control, (III) CBD (5g/kg of feed), (IV) nano-Se (1,5mg/kg of feed), (V, VI) CBD + nano-Se. On 15, 16, 17 and 18 days of age, chickens from II, III, IV and VI were infected with C. perfringens (108 CFU/mL, per-os, sub-clinical dose). Feed intake and body weight were monitored during the experiment. On day 23 of age, 9 birds from each group were sacrificed and tissue samples were collected for futher analysis. The infection birds with C. perfringens compromised body weight in group II ($P < 0,05$), while it did not adversely affect the body weight gain of group VI. The results of the experiment indicate the beneficial effects of CBD and nano-selenium on the growth performance in C. perfringens challenger.

P-41 Application of Nanopore Sequencing in the Microbiological Environmental Control of Chicken Broiler Farms

Krzysztof Andres[1], Anita Molenda[2], Marcin Pękalski[3], Rafał Kędzia[2], Mateusz Adamski[2]

[1] *University of Agriculture in Krakow, Department of Animal Reproduction, Anatomy and Genomics, Cracow, Poland*
[2] *University of Oxford, Wellcome Trust Centre for Human Genetics, Roosevelt Drive Headington, Oxford, United Kingdom*
[3] *Spark-Tech sp. z o.o., Cracow, Poland*

Introduction: Nanopore sequencing is an innovative and powerful technology that enabling detailed view of the complete bacterial microbiome. It allows us to understand the dynamics of microbial communities in poultry farming. Here, we employed nanopore sequencing to examine the microbiological environment of a broiler chicken farm.

Methods: Samples were collected at 3 time points: (1) prior to chick introducing, (2) at 4 week of broiler rearing and (3) a week after the broilers were sent to slaughter. The DNA was isolated using silica columns. Sequencing was performed using Oxford Nanopore MinION device and chemistry and Epi2Me platform.:

Results: The bacterial microbiome composition varied in terms of the number of read sequences: (1) 730 sequences; (2) 20,077 sequences; (3) 22,449 sequences and number of identified bacterial species: (1) 143 sp.; (2) 381 sp.; (3) 484 sp. The dominant species diverged at each time point: (1) Kocuria carniphila (14.3%); (2) Lactobacillus gallinarum (14.3%); (3) Staphylococcus ureilyticus (18.2%).

Conclusion: These results reveal the diversity and dynamics of the microbiomes at different stages of broiler rearing. The application of this technological approach holds significant potential to enhance both the productivity and health outcomes within the poultry industry.

P-42 Triangulated epigenetic-spatio-temporal analysis of A/H5N1 spillover to cats in Poland in June/July 2023

Andrzej Jarynowski[1], Vitaly Belik[2]

[1] *Interdisciplinary Research Institute, Głogów/Aidmed, Gdańsk, Poland*
[2] *System Modeling Group, Institute for Veterinary Epidemiology and Biostatistics, Freie Universität Berlin, Berlin, Germany*

One Health topics such as transmission of zoonotic agents of domestic/wild birds and environmental residue problems, food and feed safety become increasingly important to modern society in the post pandemic times. We performed epigenetic-spatio-temporal analysis of A/H5N1 epizootic in cats in Poland in Spring-Summer 2023 based on: 1) 30 (positive) and 27 (negative) cases from WOAH reference lab, 2) 19 RNA sentences of viruses3) suspected 87 cases submitted by animal owners (participatory epidemiology), 4) daily time series of i) Google queries for Avian Influenza (AI), cat's disease and cats' deaths, as well as ii) mentions of cat/cats and AI in social and traditional media. Data triangulation suggests the most likely scenarios based on Google queries, news and social media analysis, reference lab results and participatory epidemiology reports: 1) The first A/H5N1 cases were probably in cats in late May near the south-eastern border (based on the evidence from the retrospective media analysis and participatory reports). 2) The highest disease burden was in Pomerania (particularly Gdansk) in mid-June. 3) The highest positivity ratio was in Western Poland, indicating outbreak clusters in late June/early July. 4) Positive cases formed clear chains, supporting the environmental source hypotheses (on the connection to bird migration paths and nearness of nesting sites of water birds). 5) There are at least 2 (eastern and western Poland) separate genetic clusters of viruses. We recommend performing active monitoring (PCR and serology) of water birds in Pomerania and selected sites in Western Poland (as maybe some low viral pressure of active virus is still present at the end of July 2023). Retrospective epigenetic investigation of the south-eastern border area should be done to prove Lublin cases as the origin of the outbreak. Even that hypothesis of poultry meat/eggs (being feed for cats) contamination, seems to be unlikely (i.e. our method indicated that suspected positive cases situated far from bird migratory paths were wrongly geocoded or the results came form not accredited lab), aviary disease surveillance system needs to be updated to handle new pandemic threats.

P-43 The effect of covering the eggshell with a silicone or chitosan layer on the physicochemical properties of Peking duck eggs during storage

Kamil Kustra[1], Magdalena Trela[1], Barbara Tombarkiewicz[1], Krzysztof Pawlak[1], Krzysztof Andres[2], Aleksandra Januszewska[3], Marcin Lis[1]

[1] *Department of Zoology and Animal Welfare; University Agriculture in Krakow Mickiewicza 21, 31-120 Kraków, Poland*
[2] *Department of Animal Reproduction, Anatomy and Genomics; University Agriculture in Krakow Mickiewicza 21, 31-120 Kraków, Poland*
[3] *E.G.G. Ltd. ul. Moniuszki 15, 42-672 Wieszowa, Poland,*

Duck egg incubation technology typically involves washing the eggs. However, this procedure removes the protective mucin layer from the eggshell's surface. Therefore, investigating the effects of artificial re-coating on maintaining egg quality during storage seemed to be interesting.

Pekin duck hatching eggs from two flocks (27 and 60 weeks old, 600 eggs per flock) were divided into three equal groups, washed, and disinfected by immersing them in 1% solutions of silicon or chitosan preparations (ICB Pharma Ltd, Poland). Control eggs weren't washed but dry dezinfected by ozonation (10 minutes). Subsequently, all eggs were stored at temperatures of 8, 12, 18, or 22°C. The selected physicochemical quality parameters of the eggs were measured using the Texture Analyzer (TA.XT Express) on days 0, 7, 14, 21, and 28 of storage.

It was found that chitosan coating appeared to strengthen the eggshell (52.3 ± 0.94 N) compared to the control (48.6 ± 0.94 N) and silicone coating groups (50.0 ± 0.92 N, $P = 0.019$). However, the artificial coating didn›t affect other quality parameters, which mainly decreased with prolonged storage time and temperature. For instance, Haugh units of egg white decreased from 86.1 ± 1.46 to 70.3 ± 1.45 between 7 and 28 days of storage ($P < 0.001$) and from 83.1 ± 1.46 to 66.2 ± 1.45 between 8 and 22°C ($P < 0.001$). Similarly, yolk color darkened with increased storage time ($P < 0.001$), temperature ($P = 0.006$), and parental flock age ($P < 0.001$). It should be noted that ozonation seems to inhibit the pace of these adverse changes.

In conclusion, storing duck eggs at 8-12°C helps maintain proper physicochemical quality parameters for up to 28 days; higher temperatures shorten this to a maximum of 14 days. Coating eggs with silicone or chitosan doesn›t reduce the physicochemical properties of duck eggs during storage.

Acknowledge: Supported by: The YOUNG RESEARCHRES Grant of World›s Poultry Science Association. The research funded by grant, no. POIR.01.01.01-00-1010/17 "Innovative solutions of duck incubation technology"

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