Table of Contents

SYMPOSIA AND ORAL SESSIONS

Monday, January 26, 2015
Milton Y Dendy Keynote Address................................................................. 189
Pathology ................................................................................................. 190
Physiology/SCAD I ................................................................................ 194
Processing & Products .......................................................................... 198
Environment Management I ................................................................. 203
Metabolism & Nutrition I ................................................................. 207
Metabolism & Nutrition II ................................................................. 212
SCAD II ................................................................................................. 215
Metabolism & Nutrition III ................................................................. 219
Environment Management II ............................................................ 222
Metabolism & Nutrition IV ................................................................. 224

Tuesday, January 27, 2015
Metabolism & Nutrition V ................................................................. 228
SCAD III ................................................................................................. 233
Metabolism & Nutrition VI ................................................................. 237
Environment & Management III ....................................................... 243
Metabolism & Nutrition VII ............................................................... 246

POSTER PRESENTATIONS ...................................................................... 252
Author Index ...................................................................................... 283
B-313 Can vaccines create hot viruses? Lessons from Marek's disease Andrew Read* Pennsylvania State University, State College, PA, USA

Could some vaccines drive the evolution of more virulent pathogens? Conventional wisdom is that natural selection will remove highly lethal pathogens if host death greatly reduces transmission. Vaccines that keep hosts alive but still allow transmission could thus allow very virulent strains to circulate in a population. I will describe experiments which show that immunization of chickens against Marek’s disease virus enhances the fitness of more virulent strains, making it possible for hyperpathogenic strains to transmit. Immunity elicited by direct vaccination or by maternal vaccination prolongs host survival but does not prevent infection, viral replication or transmission, thus extending the infectious periods of strains otherwise too lethal to persist. Our data show that anti-disease vaccines that do not prevent transmission can create conditions that promote the emergence of pathogen strains that cause more severe disease in unvaccinated hosts.

Key Words:
M1 Antibacterial Activity of Ethanol and Methanol Extracts of Date Pits Against Staphylococcus aureus and Escherichia coli Sherif Hassan*, Yousef Al-Yousef, & Sherif Date Pits Against Staphylococcus aureus and Escherichia coli

This study was undertaken to evaluate the antibacterial activity of ethanol and methanol extracts of date pits against Staphylococcus aureus and Escherichia coli by disc diffusion technique using six concentrations ranged from 300 to 9,375 μg/ml. The results obtained exhibited that methanol extract inhibited the growth of Staphylococcus aureus at the concentration level of 75 μg/ml with inhibition zone diameter of 10 mm. The growth of Equally, methanol extract concentration levels used in this experiment. This revealed that methanol extracts have antimicrobial activity on Staphylococcus aureus and Escherichia coli. While the ethanol extract showed antimicrobial activity on Staphylococcus aureus with no effect on Escherichia coli. Results obtained suggested that methanol and ethanol extracts of date pits probably might be used to control infections associated with these common poultry pathogenic organisms.

Key Words: Antibacterial activities, date pits, Staphylococcus aureus, Escherichia coli

M2 Control of complicated respiratory distress in broilers using a synergistic effect with Ma5 and 4/91 IB vaccine strains at different ages. Francisco Rios-Cambré1, Jesús Cabriales-Jimenez2, Alejandro Garcia-Cantu1, Francisco Zorrilla-Fierro1, 3MA DS Animal Health Mexico, Santiago Tianguistenco, Mexico; 3MSD Salud Animal Mexico, Santiago Tianguistenco, Mexico

Mortality due to respiratory disease in broilers in the Mexican poultry industry has been a common problem for several years. The most frequent lesion found is tracheal plugs, usually between 20 and 30 days of age. This pathology can cause an increase in mortality than may be up to 20% or more in broiler flocks that up until they reached such age, it had been within the normal parameters. This paper describes the sampling design, monitoring and results; followed by vaccination program adjustments, conducted according to a synergistic effect previously described, by using a combination of Ma5 and 4/91 IB vaccine strains; as well as subsequent sampling, lab monitoring and production results of such adjustments, monitored by a synergistic effect previously described. According to the available literature, both vaccines can be applied either at one day of age, or more in broiler flocks that up until they reached such age, it had been within the normal parameters. This paper describes the sampling design, monitoring and results; followed by vaccination program adjustments, conducted according to a synergistic effect previously described, by using a combination of Ma5 and 4/91 IB vaccine strains; as well as subsequent sampling, lab monitoring and production results of such adjustments, which can be attributable to a significant improvement from the previous conditions to the application of the aforementioned concept. According to the available literature, both vaccines can be applied either at one day of age, mixed together, or Ma5 strain applied at one day of age, whilst 4/91 strain is applied at farm level, in this case at 12 days of age. In this is a report a significant difference in body weight and uniformity was observed between both vaccination programs, being the flock vaccinated with both vaccine viruses simultaneously showing the most favorable results, with an average 100 g more in body weight and 1% less coefficient of variation.

Key Words: Respiratory, Infectious bronchitis, Ma5 strain, 4/91 strain, Synergistic effect

M3 Coccidiostat withdrawal from broiler diets containing refined functional carbohydrates (RFC) from enzymatically hydrolyzed yeast John Brake1, S. Attawong1, S. Jalukar2, J. Oppy2, 3North Carolina State University, Raleigh, NC, USA; 2VI-COR, Mason City, IA, USA

Appropriate enzymatic hydrolysis of yeast can produce RFCs that have protective activities against a range of bacterial and protozoal species. Specifically, Aviator (Aviator SCP, Vi-COR, Mason City, IA) possesses a complex sugar that reduces the ability of Eimeria sporozoites to attach to intestinal epithelial cells, which should provide an opportunity to modify usage of coccidiodists in broiler feed. To test this theory, three scenarios were developed that covered a range of commercial environments and involved growing Ross 708 male broilers from a 26- wk-old breeder flock to 49 d on either new litter with clean water and coccidiostat (Salinomycin), used litter with dirty water and coccidiostat, or used litter with dirty water and no coccidiostat after 16 d of age. These scenarios were termed Best, Intermediate, and Worst, respectively. Aviator was included in the starter, grower, and finisher feeds at either 0 or 50 g/Mt in each of the three scenarios. Feed consumption and BW were determined at 35 and 49 d of age. Average BW was 2332 and 4061 g at 35 and 49 d, respectively, which generally represented small and larger broilers at marketing. BW did not differ by scenario but feed intake was greatest (P<0.05) in the Intermediate, and Worst scenario, respectively, being significant (P<0.05) the difference C and V groups that received the same diet, nor between the two vaccinated groups fed different diets. BW differences were observed between Cox and V groups that received the same diet, nor between the two vaccinated groups fed different diets. Mean FCR were 1.97±0.07, 1.92±0.10, 1.90±0.08, 1.84±0.10, for C, Cox, V and VLE, respectively (ns).
The WS prevalence was above 90% in all groups. The prevalence of WS score 2 was 54.0, 81.2, 62.5 and 68.6%, whereas the mean WS scores were 1.50, 1.79, 1.58 and 1.63, for C, Cox, V and VLE, respectively, being significant (P<0.001) for the difference Cox vs C and V. The prevalence of WS grade 2 causes breast downgrade that results in economic losses, and the mean WS score was higher in birds treated with coccidiatostatin than in vaccinated ones, but no difference was observed due to the diet. These results could be explained by the different growing curves of the groups. This study provided a new perspective for the control of WS prevalence and a starting point for further studies.

References


Key Words: White striping, coccidiosis, broiler

M5 An evaluation of the anticoccidial efficacy of the feed additives Algamune™ AM or Algamune™ ZPC fed to commercial broiler chickens exposed to a mixed challenge of Eimeria acervulina, E. maxima, and E. tenella Robert Levine¹, B. Lumpkins², Greg Mathis² 'Algal Scientific Corporation, Northville, MI, USA; ²Southern Poultry Research, Athens, GA, USA

Coccidiosis can have significant adverse effects on performance in commercial broiler operations. The objective of the current study was to determine how dietary inclusion of a new feed additive made from microalgae containing beta-1,3-glucan impacts performance and gut health in birds challenged by Eimeria. This study was carried out in cages at Southern Poultry Research, with 4 cages per treatment group and 8 male birds (Cobb X Cobb) per cage (0.63 sq.ft/bird). The eight treatment groups included a non-infected, non-treated control and an infected, non-treated control, along with groups fed 50, 100, or 200 g/MT of Algamune™ AM or Algamune™ ZPC. Both products are similar in that they contain about 50 wt.% beta-1,3-glucan derived from the algae Euglena gracilis, but Algamune™ ZPC contains 2% zinc in the form of a zinc polysaccharide complex (ZPC). On day 14, all birds, except the non-infected control, were orally dosed with coccidia from a mixed inoculum containing Eimeria acervulina, E. maxima, and E. tenella. Fecal samples were collected 120-144 hours post infection to determine oocysts per gram (OPG). Performance (feed consumption, feed conversion efficiency (FCR), and weight gain) was measured on day 14 and day 20; all birds were lesion scored on day 20.

All birds fed Algamune™ AM and ZPC-2 and challenged with Eimeria acervulina demonstrated a trend towards improved D0-20 FCR compared to the infected control. Birds receiving 50 or 100 g/MT Algamune™ AM and 200 g/MT Algamune ZPC-2 demonstrated statistically significant FCR improvement of 16 to 19 points (cf. 1.856 FCR for infected control vs. 1.676, 1.692, and 1.660 for AM 50 g/MT, AM 100 g/MT, and ZPC-2 200 g/MT, respectively). Birds fed Algamune™ AM at 50 and 100 g/MT demonstrated a strong trend of improved D0-20 weight gain compared to the infected control, though no differences were statistically significant. Birds fed Algamune™ AM at 50 and 100 g/MT and Algamune™ ZPC-2 at 50 g/MT demonstrated a trend for reduced lesion scores compared to the infected control, but there were no statistically significant differences among the treatment groups. Finally, birds fed Algamune™ AM at 200 g/MT and Algamune™ ZPC-2 at 100 g/MT demonstrated significantly reduced OPG (63% reduction compared to infected control). Overall, these data suggest that low inclusion levels of beta-1,3-glucan derived from algae can promote improved performance and gut health while reducing oocyst shedding in commercial broilers challenged with Eimeria.

Key Words: beta glucan, Coccidiosis, Eimeria, broiler performance, lesions

M6 Experimental co-infection of SPF chickens with low pathogenicity avian influenza virus (LPAIV), subtypes H9N2, H5N2 and H7N9, and infectious bronchitis virus (IBV) Mar Costa-Hurtado¹, Diane Smith¹, Mark W. Jackwood², Erica Spackman², Eric Shepherd², Mary Pantin-Jackwood³ Southeast Poultry Research Laboratory USDA/ARS, Athens, GA, USA; ³Poultry Diagnostic and Research Center, Athens, GA, USA; ⁴SEPRL-ARS USDA, Athens, GA, USA

Avian influenza virus (AIV) and infectious bronchitis virus (IBV) are two of the most important respiratory viruses affecting poultry worldwide, but little is known about the effect of co-infection with these two viruses in poultry. Low pathogenicity (LP) AIV can produce from mild to moderate upper respiratory disease that can be exacerbated by other factors in the field. Since commercial poultry is routinely vaccinated with live IBV vaccines we evaluated the dynamics of LPAIV-IBV co-infections and the effect on disease outcome in chickens. Four-week-old specific pathogen free (SPF) white leghorn chickens were intraocular and intranasally inoculated with a live IBV Mass vaccine strain and with one of three different subtype LPAIV's: A/chicken/Egypt/12/2013 (H9N2), A/chicken/HK/221298/2014 (H7N9), and A/chicken/Mexico-Coahuila/IA20/11/2011 (H5N2), by simultaneous or sequential inoculation (LPAIV given 3 days after IBV). Viruses were also given individually. No clinical signs were observed in any of the experimental groups. However, differences in the titers of virus shed by the oropharyngeal route were observed and depended on the LPAIV strain used. No effect on H5N2 LPAIV shedding was observed in co-infected birds, this virus being shed in high titers from all inoculated birds. However, birds previously or simultaneously inoculated with IBV shed higher titers of the H9N2 LPAIV when compared to the single LPAIV infected birds. On the other hand, lower titers of the H7N9 LPAIV were shed by birds previously infected with IBV, but titers were higher in birds simultaneously inoculated. In conclusion, the effect of co-infection in chickens with IBV and LPAIV varies depending on the LPAIV and the timing of co-infection, with exacerbation, reduction, or no effect on virus shedding.

Key Words: Low pathogenicity avian influenza, Infectious Bronchitis Virus, co-infection, chickens

M7 Effects of Fermentation Product of Saccharomyces cerevisiae XPC™ in Chicken Diets on Resistance against Infectious Bronchitis Virus Cassandra Breedlove*, Aly Gheta, Stephen Gulley, Frederick van Ginkel, Kellye Joiner, Vicky van Santen, Haroldo Toro Auburn University, Auburn, AL, USA

The commercial Saccharomyces cerevisiae fermentation product XPC™, often used as feed additive in poultry production, has been associated with enhanced immune functions. We evaluated immune responses and protection after IBV challenge in naive and infectious bronchitis virus (IBV)-vaccinated specific-pathogen-free white leghorn chickens (groups n=50 each) receiving XPC at feed-additive concentrations of 2 lb/ton or 3 lb/ton. Naïve chickens receiving XPC and challenged at 21 days of age showed reduced respiratory signs and a tendency of less histological damage in the trachea 5 days after challenge. Treated birds also showed increased IgA and CD44+CD8+ lymphocytes in the spleen 10 days after challenge. Viral load in the trachea, serum IBV antibody levels, and numbers of splenic CD3+ and CD8+ lymphocytes did not show significant differences between treated and untreated challenged controls. In experiment 2, birds received the same XPC treatments but were vaccinated with a live attenuated IBV vaccine at 10 days of age and subjected to homologous challenge at 25 days of age. Evaluations performed 5 days after challenge showed reduced adverse respiratory reactions and significantly increased IgM and IgA lymphocytes in the Harderian gland in XPC treated chickens. XPC-treated chickens also showed significantly increased serum IBV antibody levels 20 and 27 days post challenge. Tracheal histopathology and viral load, and numbers of spleen CD44+ and CD3+ cells did not differ significantly between treated and untreated challenged controls. Some of the differences in response to IBV vaccination and/or challenge observed
between XPC-treated and untreated chickens provide evidence for a bene-

Key Words: infectious bronchitis, chickens, immune response

M8 Cytokine and chemokine gene expression in footpad dermatitis in chickens affected by incubation temperatures and litter conditions

Edgar Oviedo-Rondon1,2,3, Jenna Scott2, Abdoullah Outkiri2, Albaraa Sarsour3, Shelly Nolni1,3*Prestige Department of Poultry Science, North Carolina State University, Raleigh, NC, USA; 1North Carolina State University, Raleigh, NC, USA

Footpad dermatitis (FPD) incidence can be affected by litter conditions, and it was recently demonstrated that suboptimal incubation temperature profiles (INC) make chicks more susceptible to FPD. The objective of this experiment was to measure cytokine (IL-1β, IL-6, IL8L2) and interferon-γ (IFN-γ) gene expression (GE) in the footpad skin of 4 d-old Cobb 500 chicks from eggs incubated under 3 INC and placed in floor pens with either new wood shavings or used litter. The first INC maintained eggshell temperatures close to 38.0°C (S) for 21 d. The second profile (LH) had low (36.9°C) eggshell temperatures for the first 3 d and standard INC until the last 3 d when eggs were subjected to elevated (38.9°C) eggshell INC (H), as is observed in multistage machines. The third INC profile (SH) had S incubation until the last 3 d when eggs had H INC. At hatch, 180 chicks, 60 per INC treatment, were placed in 18 pens with either new pine wood shavings or used litter, each with 5 males and 5 females. At 4 d of age, 3 chicks per sex and per pen, 18 per treatment, were sacrificed, and footpad skin samples were taken. The GE was determined by RT-PCR, and the 3-new litter treatment combination was considered a control for fold-change comparisons. Data were analyzed in a CRBD in a 3x2x2 factorial arrangement with INC (S, LH, SH), litter type (new or used) and sex as main factors. Results indicated two-way interaction effects (P<0.05). In females, higher fold changes were observed on the GE of IL-1β (22-fold) and IL8L2 (5 to 18-fold) when chicks came from sub-optimal INC (SH or LH) and were exposed to used litter. Additionally, a 5-fold increase on the GE of IFN-γ occurred in females only when they were from the SH or LH profiles and exposed to new or used litter. In males, significant fold-changes were observed on GE of IL-1β (3.7-fold) and IL8L2 (2.7-fold) when LH and SH chickens were placed in new litter, but there was no effect on IFN-γ GE. It was concluded that sub-optimal INC make chicks more susceptible to developing a non-specific inflammatory response, and this effect is mainly observed in females.

Key Words: Footpad dermatitis, Gene expression, Cytokine, Incubation, Litter

M9 An outbreak of Goose Venereal Disease in a commercial breeder operation in California

Silvia Carnaccini1,2, Naola Ferguson-Noe1, Richard Chin1, Mark Bland1, Bruce Charlton1, Arthur Bickford1, Gabriel Senties-Cuá1,2,3*California Animal Health & Food Safety (CAHFS) Laboratory System, University of California, Davis, Turlock, CA, USA; 4Poultry Diagnostic & Research Center, University of Georgia, Athens, GA, USA; 5Cutler Veterinary Associates International, Moorpark, CA, USA

Six live male Toulouse breeder geese were submitted to the California Animal Health and Food Safety laboratory, Turlock Branch, due to poor fertility and hatchability during 2014 spring breeding season. The farm is a medium-large scale, multi-age and multi-breed duck and goose breeding commercial operation, which supplies eggs, balouts, meat, and related-products to ethnic markets in California. Only a Toulouse flock was affected, which consisted of approximately 360 birds, 90 males and 270 females. In March 2014 the fertility registered was below 40%, whereas no impact on egg production was observed. Hence, 40 of 90 male geese were removed (44.4%) consequent to phallic alterations. The lesions observed were confined exclusively to the male genital tract and severely compromised the possibility of mating. Severe granulomatous inflammation associated with bacteria and spermatozoa were disrupting the architecture of phalluses. Severe multifocal lymphoid nodules were seen histologically in the mucosa around the spermatic and ejaculatory ducts. Three different species of Mycoplasma were isolated from the phalluses, and these isolates were further characterized. In addition, Pasteurella multocida was isolated in combination with other bacteria. The P. multocida isolate was serotyped as well as further characterized. Hence, we report the history, histo-pathological observations, test results, identification and characterization of the microorganisms isolated.

Key Words: Goose, Venereal Disease, Mycoplasma, P. multocida, fertility

M10 Effects of in ovo injection of Inovocox EM1 vaccine and turn-out times on broiler performance

Adebayo Sokale1,2,3, E. David Peebles1, Christopher Williams1, 1Mississippi State University, Mississippi State, MS, USA; 2Zoetis Animal Health, Durham, NC, USA

The response of broiler chickens to 2 doses of the Inovocox EM1 vaccine and 2 turn-out times was determined from 0 d of incubation (doi) to d 35 posthatch (poh). The EM1 vaccine containing Eimeria oocysts was injected on 19 doi into Ross x Ross 708 hatching eggs. Birds were subjected to one of the following 6 treatments: treatment 1- non-injected control and turn-out on d 7 poh (NIC7); treatment 2- non-injected control and turn-out on d 10 poh (NIC10); treatment 3- 1× dose of EM1 vaccine and turn-out on d 7 poh (1× V7); treatment 4- 1× dose of EM1 vaccine and turn-out on d 10 poh (1× V10); treatment 5- 10× dose of EM1 vaccine and turn-out on d 7 poh (10× V7); and treatment 6- 10× dose of EM1 vaccine and turn-out on d 10 (10× V10). Site of injection (SOI) and embryonic stage score (ES) were determined from 19 doi. Hatchability of injected eggs (H), hatchability BW (HBW), and chick yield were determined on d 0 poh. Feed intake (FI), BW, body weight gain (BWG) and feed conversion ratio (FCR) were determined from d 0 to 35 poh. Data were analyzed by the MIXED procedure of SAS 9.3, with global and LS means comparisons considered significant at P ≤ 0.05. There was a significant treatment effect on BWG (P<0.003) and FCR (P=0.03) from d 21 to 28 poh. BWG was highest in the NIC7 group, and lowest in the 10× V17 group. FCR was highest in the 10× V110 group, and lowest in the NIC10 group. ES score and SOI accuracy were 4.60 ± 0.99 and 81.66 %, respectively. The ES and SOI results suggest that the developmental stage of the embryos corresponded to between 19.0 and 19.5 doi, with vaccine deposition primarily in the right breast muscle. The injection of EM1 vaccine at either a 1× or 10× dose had no detrimental effect on chick quality. However, growth performance may be negatively affected during peak oocyst cycling between d 21 and 28 poh. This effect may be related to the vaccine dose administered rather than the turn-out time employed.

Key Words: broiler, coccidiosis, in ovo injection

M11 Establishing the correlation between broiler body weight gain, gross lesion score, and microscores in three anticoccidial sensitivity tests

Miguel Barrios1,2,3, Manuel Costal1, Emily Kimmimun1, Lorraine Fuller1, Steven Clark2, Gene Pesti3, Robert Beckstead1, 1The University of Georgia, Athens, GA, USA; 2Zoetis, West Jefferson, NC, USA

Coccidiosis costs the poultry industry $3.2 billion worldwide every year. Anticoccidial Sensitivity Tests (AST) serve to determine the efficacy of several anticoccidials against Eimeria field isolates by measuring body weight gain, feed conversion ratio, gross intestinal lesions, and mortality in battery pen studies. Microscopic oocyst counts of intestinal scrapings (microscores) are often investigated. The goal of this study was to determine the correlation between broiler body weight, gross lesion score, and microscore in 3 AST. Day old broiler chicks were raised for 12 days on a standard corn-soy diet. On day 13, chicks were placed in Petersime batteries and treatment diets were provided. There were 6 birds per pen, 4 pens per treatment, and 12 treatments for a total of 288 chicks per AST. The treatments were as follows: 1: Non-medicated, non-infected, 2: Non-med-
icating, infected, 3: Lasalocid, 4: Salinomycin, 5: Dichloruril, 6: Monensin, 7: Decoquinate, 8: Narasin + Nicarbazin, 9: Narasin, 10: Nicarbazine, 11: Robenidine, and 12: Zoalene. On day 15, chicks were challenged with oocysts of *Eimeria* field isolates by oral gavage. On day 21, broilers were weighed, and gross lesion scores and microscores for *Eimeria maxima* were classified from 0 to 4 according to the Johnson and Reid (1970) methodology. All data were statistically analyzed using a logarithmic regression model. There was no correlation (P=0.12) between microscore and body weight gain. There was a positive correlation between gross lesions and microscores (P=0.004). However, there was also an interaction between microscore and isolate (P=0.001). This may be due to the differing pathogenicity of the challenge isolates. These results indicate that gross lesion scores are predictors of microscores. Additionally, the interaction between isolate and gross lesions demonstrates that the significance of the correlation between microscores and gross lesion scores may be dependent of the *Eimeria* strain. Future work should focus on more *Eimeria* isolates to establish a database, which would allow to build a model for population prediction.

**Key Words:** Cocidiosis, gross lesion score, microscore, AST, broiler

**M12 Adaptation of Embryo Attenuated Infectious Bronchitis Virus Arkansas to Kidney Cells**

Aly Ghetas*, Grace Thaxton, Cassandra Breedlove, Vicky van Santen, Haroldo Toro

The population structure of an embryo-attenuated infectious bronchitis virus (IBV) Arkansas (Ark) Delmarva Poultry Industry (DPI)-derived vaccine was characterized during serial passages in chicken embryo kidney (CEK) cells and after back-passage in embryonated chicken eggs (ECE) and in chickens. Both conventional and deep sequencing results consistently showed population changes occurred during adaptation to CEK cells. Specifically, thirteen amino acid (aa) positions seemed to be targets of selection when comparing the vaccine genome prior to and after 7 passages in CEK (CEKp7). Amino acid changes occurred at four positions in the S gene, and at two positions in the S gene large shifts in frequencies of aa encoded were observed. CEK adaptation shifted the virus population towards homogeneity in S. The changes achieved in the S gene in CEKp7 were maintained after a back-passage in ECE. Outside the S gene, amino acid changes at three positions and large shifts in frequencies at four positions were observed. Synonymous nucleotide changes and changes in non-coding regions of the genome were observed at eight genome positions. Inoculation of early CEK passages into chickens induced higher antibody levels and CEKp4 induced increased respiratory signs compared to CEKp7.

**Key Words:** infectious bronchitis virus, coronavirus, virus adaptation, genetic variation, Arkansas

**M13 Evaluation of the infection and transmission of wild type and recombinant strains of Newcastle Disease Virus in Japanese Quail**

Valerie Marcano*, Tim Olivier, Claudio Afonso* Southeast Poultry Research Laboratory (SEPRL) ARS, USDA, Athens, GA, USA; 2SEPRL, ARS, USDA, Athens, GA, USA

Newcastle disease virus (NDV) causes a range of clinical disease ranging from asymptomatic infection to severe disease with high mortality. Vaccination for NDV is practiced almost worldwide in commercial chickens. Attenuated live vaccines are most commonly used, with recombinant vaccines becoming increasingly popular. The target species for a NDV vectored vaccine are poultry species. However, since NDV infects at least 250 bird species, non-target species (wild birds) could be exposed and infected with these vaccine viruses. In spite of that, the infectivity and transmissibility of recombinant NDV and recombinant NDV vectored vaccines have not been examined in any species besides chickens. The widespread use of these vaccines and the routes of administration—which include aerosol or drinking water—pose an extremely high risk of exposure of the vaccine to wild birds. This study is part of a series of pathogenesis studies that aims to evaluate the infection and transmission of wild type and vaccine strains of NDV in non-target species. If these species can transmit the virus, this could result in the unrestricted spread of potentially pathogenic variants to other poultry farms and to wildlife. In this portion of the study, Japanese quail are being evaluated. Quail are often kept with other poultry species, and could potentially increase transmission and magnify outbreaks. In fact, ND outbreaks have occurred in Japanese quail in Nigeria in 2004 and in 2008. Two experiments were conducted. The first experiment aimed to study transmission and replication of recombinant NDV. In this experiment, 4 week old Japanese quail were divided into groups of 5 birds and infected with either virulent recombinant ZJ1-L, lentogenic recombinant ZJ1 (ZJ1-L), recombinant LaSota (rLaSota) or recombinant LaSota containing the H5 influenza insert (rLaSota-H5) at day 0 post infection (dpi). At 2 dpi four un-inoculated birds were placed with each group of inoculated birds. Clinical signs and mortality were recorded daily and birds were swabbed every other day until 14 dpi. The second experiment aimed to study the transmission and clinical signs caused by wild type strains of NDV. 4 week old Japanese quail were divided into groups of 7 birds and each group was infected with either CA02, Nigeria 2, Nigeria 23, PK/Karachi/33 or Israel 826.3 un-inoculated birds were placed with each of the groups at 0dpi. Similar to the first experiment, clinical signs and mortality were recorded daily and birds were swabbed every other day until 14 dpi. Clinical disease, mortality, number of birds shedding, number of contact birds infected, amount of virus shed and seroconversion rates were examined.

**Key Words:** Newcastle Disease Virus, Japanese Quail, vaccine, recombinant

**M14 Use of histomorphometric area measurements for determination of intestinal villus/crypt ratios in broiler chickens: comparisons to routine linear methods and documentation of age-associated intestinal changes**

Floyd Wilson*, Timothy Cummings, Taylor Barbosa, Chris Williams, John Dickson, Amanda Lawrence, David Peebles College of Veterinary Medicine, Mississippi State University, Petal, MS, USA; Zoetis, Starkville, MS, USA; Zoetis - Global Poultry, Durham, NC, USA; Zoetis Poultry Health, Durham, NC, USA; Mississippi State, MS 39762, Starkville, MS, USA; Mississippi State University, Starkville, MS, USA

The determination of intestinal villus to crypt ratios [V:C ratio] is a common method utilized to evaluate effects of various diet regimens on gut microanatomy and for the histologic quantification of intestinal responses to disease processes. Two methods for the determination of small intestinal V:C ratios were compared for early age chickens. A standard method for ratio determination based on ten length measurements of the two intestinal regions was compared to a new approach based on a single histomorphometric determination of the crypt and total mucosa areas using image analysis software. Subtraction of the crypt area from the total area provided the villus area and allowed for subsequent calculation of the V:C ratio. Villus micro-anatomic changes were also evaluated using scanning electron microscopic methods and those results for villus height were compared to the routine histological data. In general very close agreement was observed between ratio results using both the routine length and the new area method measurements. A similar major and highly significant reduction in the V:C ratio was observed occurring between hatch and day 7 using the two methods. The area method has the advantage of reduction in measurements required [only two area measurements required, compared to twenty length measurements]; and also facilitates a larger intestinal segment evaluation; which is of particular advantage for studies on intestinal disease conditions resulting in marked multifocal variation in villus statu. The study also further documents age-associated changes occurring in the V:C ratios of the small intestine during early post-hatch periods.

**Key Words:** Intestine, Histomorphometrics, Poultry, Broiler, Aging, Histomorphometrics, Poultry, Broiler, Aging
M15 Immunoleisions of melanopin receptive neurons in the adult Pekin drake attenuates the hormonal reproductive axis. Gregory S Fraley*, Kelly Frazier, Erin Alenciks, Amanda Porter Hope College, Holland, MI, USA

Several light sensitive receptors have been described in the avian brain that are thought to regulate the reproductive axis independently from the eyes and pineal gland. Recently, my lab has described the presence of three of these photoneuroendocrine systems in the Pekin duck: opsins, opsin-5, and melanopin. We set out to test the hypothesis that melanopin receptive neurons are necessary to maintain seasonal reproductive status in the Pekin drake. To accomplish this, 50-week-old Pekin drakes were housed in the aviary at Hope College under long day length (18 hrs lights on) conditions in floor pens (5 drakes per pen). To specifically lesion melanopin-receptive neurons, drakes were anesthetized (8 mg/kg Propofol, IV), given analgesics (2 mg/kg ketfen, SC) skin incised and a trephine hole drilled 10 mm caudal to bony orbits and 1 mm to the left of midline. A 33 gauge stainless steel needle attached to a Hamilton syringe was lowered stereotactically 3.5 mm ventral to dura into the lateral ventricle. Three microliters of an anti-melanopin-saporin conjugate (MSAP, 100 ng/µl) was injected into the lateral ventricle (n = 10). Control drakes were injected with 3 µl of equimolar unconjugated anti-melanopin and saporin (SAP, n = 10). The incision was closed with VetBond, and the drakes returned to the aviary after complete recovery from anesthesia. After 4 weeks, birds were euthanized (400 mg/kg FatalPlus, IP) and body weight measured, and brains, pituitaries, and testes collected and stored for analyses. MSAP-treated drakes had significantly (P < 0.001) reduced relative testes weights compared to SAP controls. qRT-PCR analyses (n = 5 per treatment) of anterior pituitary showed a significant reduction (P < 0.001) in both LH-beta and FSH mRNAs. Immunocytochemical analyses (n = 5 per treatment) showed a significant reduction in melanopin and GnRH-immunoreactivities. These data underscore the importance of the photoneuroendocrine system in maintaining the reproductive axis in seasonally breeding birds.

Key Words: deep brain photoreceptors, seasonal breeder, GnRH, GnIH

M16 Chronic feed administration of Dexamethasone increase intestinal permeability similar to feed restriction stress in broiler chickens Eduardo Vicuna*, Viviek Kuttapan, Rosario Seger-Galarza, Juan-David Latorre, Olivia Faulkner, Guillermo Tellez, Billy Hargis, Lisa Bielke University of Arkansas, Fayetteville, AR, USA

We have previously shown that intestinal barrier function can be adversely affected by stress, poorly digested diets, or feed restriction, resulting in increased intestinal inflammation-associated permeability. Presently, three Exp were conducted to evaluate the effect of dexamethasone (DEX) treatment on systemic (serum) Fluorescein isothiocyanate-dextran (FITC-d; 3-5kDa) absorption, indicative of increased gut epithelial leakage. In Exp 1, we compared DEX injection at a known stress-response-inducing dose of 1mg/kg on d3, 5, and 9 with feed administration at 0.57, 1.7, or 5.1 ppm d4-10, on FITC-d serum concentrations 2.5 hr after gavage with 4.16 mg/kg FITC-d. DEX administration, regardless of route or dose, resulted in marked (P<0.05) increased FITC-d passage into blood and detection in serum. Feed administration of DEX at any dose resulted in greater (P>0.05) gut permeability than injection, with numerically optimal effects at the lowest dose tested. In Exp 2-3, chicks were randomly assigned to shaving-bedded pens (Exp 2) or wire brooders (Exp 3) with starter ration containing either unmedicated Control (CON) or Treated (TRT) feed (0.57 ppm/kg, d3-10 Exp 2, d4-10 Exp 3), with feed and water provided ad libitum for 10 days. At d10, all chicks were treated by oral gavage with FITC-d and serum samples were obtained 2.5h post-gavage as described above. Additional samples of the right half of the liver were aseptically collected, diluted 1:4 wt/vol, serially diluted and plated on tryptic soy agar to evaluate total numbers of aerobic bacteria in liver as an index of bacterial translocation (BT). In both experiments, FITC-d absorption was significantly enhanced in DEX-treated chicks, again indicating increased paracellular leakage across the gut epithelium associated with dissolution of tight junctions. Dietary DEX administration resulted in numerically (Exp 2) or significantly (P<0.05) increased enteric BT to liver tissue, supporting the observation that dietary DEX causes a stress-like inflammatory GI response, which may contribute to subclinical or clinical disease, and may be a useful model for ongoing disease mitigation research related to stress-related diseases of GIT origin.

Key Words: Enteric inflammation, Dexamethasone, FITC-dextran, Bacterial translocation, Permeability

M17 Effect of in ovo feeding of dextrin-iodinated casein on mitochondrial and autophagy associated molecules in broiler embryos Shaymaya Abou-Saad*, Elizabeth Greene*, Alissa Piekariski*, Kentu Lassiter*, Billy M. Hargis, Lisa R. Bielke, Parag Chary, Sami Dridi*, Walter Bottje1 University of Arkansas, Fayetteville, AR, USA; 1Dept. of Poultry Science, Univ. of Arkansas, Fayetteville, AR, USA; Zoetis, Kalamazoo, MI, USA

This study was conducted to determine effects of in ovo feeding of dextrin and iodinated casein on expression of genes and proteins associated with mitochondrial- and autophagy-related mechanisms in broiler embryos. This experiment was conducted using a commercial Inovoject™ system at a commercial hatchery. Eggs, obtained from a 54 wk old broiler breeder flock on a single day, were treated at ~18.5 d of embryonic development in a 2 x 3 factorial design with 0, 240, or 480 mg iodinated casein (IC)/mL in a control solution (saline diluent) or dextrin (Dxt: 18% malto-dextrin and 10% potato starch dextrin); ~2500 eggs per group. The eggs were placed in hatch baskets (100 eggs/ basket, 5 baskets/ treatment) in an experimental incubator in a randomized block design. At 24 h post-injection, eggs were randomly selected (8 eggs/group). Portions of liver and heart from the 20 embryos were obtained and flash frozen in liquid nitrogen. Using appropriate primers, mRNA expression was determined by QPCR for PGCG-α, AMPK-α, orxin, ATG3, ATG12, LC3B, and Beclin1 in liver and heart. Protein expression was determined by western blot in the heart for ANT, ATG7 AMPK-α and Beclin. In the liver, ATG3, LC3B, and PGCG-α gene expression was elevated by IC480 whereas Dxt600 increased mRNA expression of orxin, PGCG-1α and ATG3. However, Dxt alone decreased expression of orxin and AMPK-α in the liver compared to Controls. In the heart, IC600 up-regulated mRNA expression of orxin and AMPK-α, but ATG3, ATG12, Beclin 1 and LC3B expression were down-regulated by the IC480 treatment. ATG7 and AMPK-α protein expression were up-regulated by IC600, Dxt600, and Dxt480 treatments. In addition, Dxt, IC480 and Dxt600 increased the protein expression of Beclin1. Dxt alone decreased AN and AMPK-α protein expression compared to the control group. The results indicate that in ovo feeding of dextrin-iodinated casein affects expression of mitochondrial and autophagy-related proteins that in turn could impact energetics in late term embryos. Supported in part by Zoetis, Inc (Kalamazoo MI).

Key Words: In ovo feeding, dextrin-iodinated casein, mitochondrial, autophagy, gene and protein expression

M18 Parental sex effect of parthenogenesis on hatchability of Chinese Painted quail Holly Parker*, Aaron Kiess, Chris McDaniel Mississippi State University, Mississippi State, MS, USA

Embryonic development of unfertilized eggs is known as parthenogenesis (P). In virgin and mated quail, P decreases albumen pH. Also in mated hens, hatchability as well as sperm-egg penetration are negatively impacted by P. However, it is unknown if the dam or sire is responsible for the decline in hatchability due to P. Therefore, the objective of this study
was to determine which parental sex has the greatest impact on hatchability of quail selected for P. In the current study to determine P in virgin hens, males were separated from females at 4 wk of age prior to sexual maturity. Dams and sires from 2 lines of birds were used: one selected for P and one not selected for P (controls, C). A 2 dam (C and P) x 2 sire (C and P) factorial arrangement of treatments was utilized with the following breeding pairs: C dams + C sires (CC), C dams + P sires (CP), P dams + C sires (PC), and P dams + P sires (PP). Parthenogenetic dams were selected based on their incidence of P as virgins, and sires were selected based on their sister’s incidence of P. Means were separated at P=0.05. Daily, eggs were collected and incubated at 37.5°C for 18 d. At 10 d of incubation (DOI) eggs were candled, and eggs showing little or no development were removed and broken to determine infertility, stage of embryonic failure, and albumen pH. After 18 DOI, eggs that did not hatch were broken to determine at what stage of embryonic development the hatching failure occurred. At 10 DOI, eggs from P dams yielded a higher percentage of parthenogens and early embryonic mortality as compared to eggs from C dams. However, eggs from P dams exhibited a lower albumen pH than did eggs from C dams after 10 DOI. Hatch of eggs set and hatch of fertilized eggs were less for P as compared to C dams. Also after 18 DOI, a greater percentage of eggs from P dams contained parthenogens and early embryonic mortality than did eggs from C dams. Interestingly, selection of the sire for P did not impact any hatching parameter. In conclusion, the presence of P in the dam has the greatest impact on hatchability. Because selection of P in the hen alone negatively impacts hatchability, it is possible that alterations within the ovum due to the P trait may inhibit normal embryonic development.

**Key Words:** Parthenogenesis, hatchability, fertility, albumen pH, embryonic mortality

M19 Both *Bifidobacterium animalis* and its metabolites impact broiler breeder sperm motility Melissa Triplett1, Christopher McDaniel1, Aaron Kiess2, Jonathan Morris1 1Mississippi State University, Mississippi State, MS, USA; 2University of Georgia, College of Veterinary Medicine, Athens, GA, USA

The use of antibiotics in poultry production is being challenged due to public concern. The poultry industry has started exploring alternatives to antibiotics such as probiotics. Probiotics have been shown to enhance performance, stimulate immune function, and reduce pathogenic bacteria in the GI tract of poultry. However, previous research from our laboratory has revealed that when rooster semen is exposed to *Bifidobacterium animalis* overall semen quality is reduced immediately upon exposure. Therefore, the objective of this research was to determine if *B. animalis* itself or its metabolites decrease semen quality by reducing sperm viability or sperm motility. Sperm were collected from 35 Ross 344 broiler breeders by the abdominal massage method and pooled. *B. animalis* was cultured overnight in reinforced clostridial broth prior to semen exposure. The treatments included semen exposed to: saline (control), reinforced clostridial broth alone, a 12 h culture of *B. animalis*, a centrifuged pellet of *B. animalis* resuspended in saline, and the supernatant. All 5 treatments were analyzed on a sperm quality analyzer to determine the sperm quality index (SQI), a fluorometric determination of the percentage of dead sperm, and a scanning electron microscope to visualize sperm-bacteria interactions. The reinforced clostridial broth treatment had a lower SQI compared to saline (216 vs 344 respectively); however, the *B. animalis* culture, the pellet, and the supernatant reduced the SQI drastically (53, 15, and 14, respectively; P = 0.0001). Additionally, all treatments that contained the reinforced clostridial broth, including the broth, *B. animalis* culture, and the supernatant treatments, increased percent dead sperm when compared to the pellet and saline treatments (41.9, 43, 42.8, vs 15 and 7.6% respectively; P = 0.0016). Electron microscopy revealed sperm bound with bacterial cells. In conclusion, the addition of reinforced clostridial broth to any treatment increased the percentage of dead sperm and reduced the SQI compared to saline. However, the *B. animalis* culture, the pellet, and the supernatant reduced the SQI much further, demonstrating that *B. animalis* and its metabolites actually reduce sperm motility directly and not sperm viability.

**Key Words:** Bifidobacterium, Broiler Breeder, Semen, Sperm Quality Index, Percent Dead Sperm

M20 The sperm storage tube epithelium (SST-E) and its role in sperm storage Murray Bakst1, United States Department of Agriculture, Beltsville, MD, USA

Despite playing an integral role in hen fertility, little is known about the cellular and molecular interactions between sperm and the SST-E. While sperm motility has been shown to be important in sperm storage in and release from the SST (Froman 2003), the role of the SST-E in mediating these activities is not known. Presentations at the past two IPSF meetings revealed that (1) microvillous vesicles (MV) blebbing from the SST-E are released into the SST lumen and interact with sperm and (2) glycoconjugates are present on SST-E microvilli. In this presentation, it will be argued that these two observations enable the SST-E to interact with resident sperm. The presence of specific terminal sugars on glycoconjugates observed on SST-E microvilli suggests that, like that observed in the mammalian oviduct, avian sperm may bind to the SST-E. If so, this could be the basis for a paracrine-like signal or a means of communicating endocrine signals. For example, progesterone recently has been shown to induce the release of sperm from SSTs. The MVs may supply resident sperm with metabolic substrates utilized by resident sperm (fatty acids), macromolecules necessary for membrane stabilization (inhibit lipid peroxidation), and be a source of cholesterol-rich lipid rafts. Lipid rafts would be incorporated into the sperm plasmalemma and possibly organize signalling molecules, influence membrane fluidity (increased membrane cholesterol will decrease membrane fluidity inhibiting an acrosome reaction). The following is suggested with regard to sperm in the SSTs: sperm metabolize exogenous fatty acids that may be derived from the MV; macromolecules associated with MVs suppress both lipid peroxidation and the acrosome reaction; sperm binding may initiate communication between the SST-E and resident sperm; the sperm residing in the SSTs swim against a fluid current and as sperm motility wanes sperm are carried out of the SST(Froman 2003); and the same fluid current disperses signals from the SST-E and the MV throughout the SST lumen.

**Key Words:** poultry, oviduct, fertility, sperm

M21 Assessing total body surface area of broiler chickens utilizing Computed Tomography (CT) technology Jonathan Morris1, Ajay Sharma2, Wayne Daley3, Robert Beckstead1 1The University of Georgia, Athens, GA, USA; 2The University of Georgia College of Veterinary Medicine, Athens, GA, USA; 3Georgia Tech Research Institute, Atlanta, GA, USA

The husbandry of poultry species is a complex process plagued by numerous challenges that must be overcome for optimal performance. One of these challenges is the retention or dispersion of heat as the birds grow. The single greatest influence on body heat loss is surface area to volume ratio. There appears to be a lack of information relevant to the modern broiler concerning an efficient method to calculate total surface area (TSA) and volume in order to optimize rearing conditions. The purpose of this study is to develop such a method whereby these variables may be accurately calculated directly from body weight and other easy to measure parameters. Starting at day of age, five male and five female Ross 708 broilers were weighed and imaged by CT scan (also called Computer Axial Tomography or CAT scan) each week from to eight weeks of age. The images were loaded into Osirix, an open-source DICOM (Digital Imaging and Communications in Medicine) viewer, in order to measure the length of the right and left humerus, radius, femur, tibia, and middle toe of each bird. The images were exported to and processed in Mimics. These processed images were then imported into a CAD program by way of a point cloud conversion to obtain TSA and volume. All parameters measured were found to be highly correlated (r² ≤ .96) with each other. These data were used to evaluate the accuracy of existing formulas for predict-
ing TSA such as Meeh’s formula and the Dubois-Dubois formula. Based on the variability of the accuracy of prediction of these methods, a new formula was developed incorporating additional parameters that can be calculated from measurements that are easily taken in the field. These images will be further analyzed to include different organs and tissues such as heart, lungs, muscle, and fat to provide deeper insights into differential growth patterns of broilers.

**Key Words:** CT scan, total surface area, volume, growth, broiler

**M23** Salmonella emerging serotypes for poultry industry: Salmonella Infantis identified in a broiler vertical integration Martha Pulido-Landínez1, Alejandro Banda2, Jean Guard3 'National University of Colombia, Bogota, DC, Colombia; 'Mississippi State University, Brandon, MS, USA; 'USDA, Athens, GA, USA

Salmonella Infantis (SI) was identified in a broiler vertical integration causing high mortality and poor productive performance in broiler chickens older than 14 days. During 2013, Salmonella was isolated from different sources across the vertical integration (n=169); 70% of these isolates belonged to the O9 group. S. Infantis was identified by Intergenic Sequence Ribotyping as the predominant serotype. SI was isolated from samples collected in feed mills, breeders, fertile eggs, broiler hatchery, baby chickens, broiler farms and slaughter plant. In broiler farms 60% of SI was isolated from organs of sick birds (liver, spleen, intestine, trachea and infrarostral sinus), and from environmental samples (feces, litter). When unusual serotypes for poultry (emerging and re-emerging) cause problems, frequently it is not easy to determine the proper control measures. Furthermore, several of these unusual serotypes have been determined to cause food related intoxications from different products of animal or vegetal origin. The importance of these results is the identification of SI causing disease in broilers that may cause further public health problems.

**Key Words:** Salmonella, Salmonella Infantis, Emerging serotypes, Broiler vertical integration

**M24** Effects of BioMos, Natustat, or AGP program Broiler Chicken Performance Greg Mathis1, Brett Lumpkins1, Ted Selton1 'Southern Poultry Research, Inc., Athens, GA, USA; ‘Alltech, Inc., Nicholasville, KY, USA

The objective of the study was to determine if a BioMos, Natustat, or BMD program would improve performance when fed to coccidial vaccinated broiler chickens. BioMos (mannanoligosaccharides) is a pre-biotic feed additive used to improve immune function and support beneficial bacteria. Natustat is a feed additive that is a proprietary mixture of organic minerals, yeast cell wall oligosaccharides, and plant extracts. BMD (bacitracin methylene disalicylate) is an antibiotic feed additive. A floor pen trial was run on built-up litter topped with pine shavings. The trial used a randomized complete block design (LSD P<0.05). Cobb 500 male broiler chicks were vaccinated for coccidia at hatch and then randomly assigned to 32 pens (8 blocks) of 50 chicks/pen providing 0.93 sq. ft per chick. A three phase dietary program was used based on commercial feed formulation standards; starter d0-18, grower d18-35, and finisher d35-42. Chicks were assigned to 4 treatments and fed one of the following diets: 1. Original XPC™ (XPC), currently available to the poultry industry to the acute onset of the disease, high incidence of mortality, difficulty in predicting an outbreak and lack of antibiotic alternatives for treatment. One of the reasons for the lack of new CD treatments has been the limited availability of consistent CD models in research settings. The objective of this study was to determine the impact of a broad-spectrum immune modulator, Original XPC™ (XPC), currently available to the poultry industry on mortality and performance of tom turkeys naturally challenged with CD. Nicholas tom poults (n=450) were placed on study at day of hatch and 22 birds was challenged with infected litter that had been previously used during a CD outbreak. Signs of CD appeared by 83d with a majority of the outbreak occurring after 94d until the end of the study at 109d. CD induced mortality (42-109d) was 19.19% for T1 & T3 compared to 1.67 & 1.69 for T2 & T4. Feed conversion ratio was significantly (P<0.05) improved by adding XPC to diets (T2 & T4) in birds given live coccidiosis vaccine, compared to control diets (T1 & T3) with and without salinomycin (40g) in the grower feed by 28d (1.43 & 1.40 vs. 1.47 & 1.44, respectively), during the colonization of coccidia following vaccination. By 42d feed conversion values were both 1.67 for T2 & T4 compared to 1.70 & 1.69 for T1 & T3, respectively. No differences were observed between treatments in OPG, indicating that addition of XPC to T2 & T4 did not interfere with colonization of coccidiosis and development of immunity during the trial. Results from this study demonstrate that XPC can be used in conjunction with a live coccidia vaccine to restore appetite, growth rate and improve feed conversion of broilers given a live coccid vaccine.

**Key Words:** Broiler, Cocc-vaccine, Original XPC, performance, coccidiosis

**M25** Original XPC™ improves performance in broilers receiving a live coccidiosis vaccine. Stephanie Frankenchab, Don McIntyre Diamond V, Cedar Rapids, IA, USA

Birds given a live coccidiosis vaccine often show signs of diminished appetite and slower-than-expected growth rate soon after vaccination. This study was conducted to compare the effects of a live coccidiosis vaccine in broilers, with and without the dietary inclusion of XPC (1.25 kg/mt). Ross 708 male broilers (n=1,280) were allocated to one of four treatments: Cocci-vaccine (T1), Cocci-vaccine + XPC (T2), Cocci-vaccine + Salinomycin (T3), Cocci-vaccine + Salinomycin + XPC (T4). A three-phase feeding program was fed to 16 pens per treatment, 20 birds per pen. All birds were vaccinated in the hatchery with Marek’s, IBD, NCDV & IBV, then sprayed with Coccivac-B (Merck) at 0d of age. Salinomycin (Sal) was used as a sub-therapeutic coccidiostat (40 g/l) in the Grower diet (16-28d). Birds and feed were weighed by pen at 16, 28, and 42d. Fecal samples were taken by pen at 14, 21, 28, and 35d to estimate oocysts per gram (OPG) of fecal matter. Birds consuming diets containing XPC (T2 & T4) had increased feed intake and significantly higher body weight at 28d (1.70 & 1.75 kg vs. 1.63 & 1.67 kg, respectively) and at 42d (3.29 & 3.31 kg vs. 3.20 & 3.26 kg, respectively) compared to their paired control treatments (T1 & T3). Feed conversion ratio was significantly (P<0.05) improved by adding XPC to diets (T2 & T4) in birds given live coccidiosis vaccine, compared to control diets (T1 & T3) with and without salinomycin (40g) in the grower feed by 28d (1.43 & 1.40 vs. 1.47 & 1.44, respectively), during the colonization of coccidia following vaccination. By 42d feed conversion values were both 1.67 for T2 & T4 compared to 1.70 & 1.69 for T1 & T3, respectively. No differences were observed between treatments in OPG, indicating that addition of XPC to T2 & T4 did not interfere with colonization of coccidiosis and development of immunity during the trial. Results from this study demonstrate that XPC can be used in conjunction with a live coccidia vaccine to restore appetite, growth rate and improve feed conversion of broilers given a live coccid vaccine.

**Key Words:** BioMos, Natustat, BMD, Coccidia

**M26** Evaluation of Original XPC™ and its effects on Clostridial Dermatitis induced mortality and performance of tom turkeys Dan Moore1, Don McIntyre2, Jonathan Broomhead2, Steve Davis1, Sam Hendrix1 'Colorado Quality Research, Wellington, CO, USA; ‘Diamond V, Cedar Rapids, IA, USA

Clostridial Dermatitis (CD) is a major concern for turkey producers due to the acute onset of the disease, high incidence of mortality, difficulty in predicting an outbreak and lack of antibiotic alternatives for treatment. One of the reasons for the lack of new CD treatments has been the limited availability of consistent CD models in research settings. The objective of this study was to determine the impact of a broad-spectrum immune modulator, Original XPC™ (XPC), currently available to the poultry industry on mortality and performance of tom turkeys naturally challenged with CD. Nicholas tom poults (n=450) were placed on study at day of hatch and subjected to one of two feed treatments: 1) Control and 2) XPC (2.5 lbs/ton). Treatments contained 9 replicate pens each and were assigned using a complete randomized block design. At 42d of age, each pen containing 22 birds was challenged with infected litter that had been previously used during a CD outbreak. Signs of CD appeared by 83d with a majority of the outbreak occurring after 94d until the end of the study at 109d. CD was diagnosed through gross examination and necropsy by a veterinarian and trained technicians. CD induced mortality (42-109d) was 19.19% for the control birds and 14.14% for the XPC fed birds (P<0.24). No statistical difference was observed in 42-109d body weight gains of 11.26 kg vs. 10.95 kg (P<0.05), and gross feed conversions were 2.96 vs. 2.64 for
the control and XPC birds, respectively. Body weight gains were similar at 14.1 kg and 13.8 kg (P>0.05), and gross feed conversions of 2.46 and 2.28 were observed from 0-109d for control and XPC birds, respectively. Overall, statistical differences in performance or mortality could not be seen due to variation within treatments. However, XPC decreased CD induced mortality by 26% resulting in practical improvements of 31pts in feed conversion during the challenge period (42-109d).

Key Words: Clostridial Dermatitis, turkey, mortality, model

M27 Field Studies: Preharvest Salmonella Control Using the Immune Modulator Original XPC™ in Broilers and Commercial Turkeys

Charles Hofacre1, Roy Berghaus1, Don McIntyre2, Doug Smith1
1The University of Georgia, Athens, GA, USA; 2Diamond V, Cedar Rapids, IA, USA

Statement of Purpose: Broiler and turkey processing plant interventions have successfully lowered Salmonella sp. prevalence from the initial incoming load of 45.9% (feathers) to 2.4% (post chill) (Berghaus). Higher incoming Salmonella levels may require additional interventions on the farm. Many controlled studies have been conducted evaluating the effectiveness of probiotics, prebiotics, vaccines, etc. for lowering Salmonella in the live bird.

Experimental Design: Two separate commercial field studies were conducted in broilers and turkeys to evaluate the efficacy of Diamond V Original XPC, a broad-spectrum immune modulator. In each study an equal number of houses on each farm were assigned one of two treatments, 2.5 lbs XPC/ton fed continuously (XPC), or non-treated control (CON). Two 16 house farms (1 broiler and 1 turkey) had half of the houses fed treatment and the other half a normal diet with no additive. There were four boot socks taken from each house the week of slaughter and were cultured for Salmonella prevalence. There were 25 broiler carcasses at rehang rinsed with 400 ml BPW using USDA-FSIS method. There were 25 ceca removed from the turkeys at rehang. In both carcass (broilers) and ceca (turkeys) the laboratory cultured for both Salmonella sp. prevalence and enumeration by Most Probable Number (MPN).

Results: There was a significant reduction in positive carcass rinses from XPC broilers (1/200, 0.5%) vs. CON broilers (17/200, 8.5%) P = .011. Furthermore, the load detected on the positive XPC carcass (n=1) was numerically less at 2.20 log10 MPN, compared to the average of 2.43 log10 MPN per carcass for CON. Commercial turkey Toms, ceca collected in the plant, XPC had a lower prevalence of 83/200 (41.7%) positive vs. control hens 133/200 (66.5%) positive (P<0.14). The mean Salmonella MPN (load) of the culture-positive samples was 0.43 log10 lower in XPC compared to CON (P=0.017).

*The University of Georgia
**Diamond V

Key Words: Salmonella, Colonization, Immune Modulation, Food Safety

M28 Immunomodulatory effects of Diamond V Original XPC™ supplementation on immune gene expression in broilers

W. K. Chou1, J. W. Park1, J. B. Carey1, D. R. McIntyre1, L. R. Berghman1, D. R. McIntyre2, L. R. Berghman1, D. R. McIntyre2, L. R. Berghman1, D. R. McIntyre2, L. R. Berghman1, D. R. McIntyre2
1Poultry Science Department Texas A&M University, College Station, TX, USA; 2Diamond V Mills, Cedar Rapids, IA, USA

A study was conducted to evaluate the effects of XPC on modulating adaptive immune responses to Newcastle Disease Virus (NDV) vaccination. One-day-old broilers were randomly assigned one of two treatments: 1.25 kg/ton XPC (T1) or control diet (T2). All broilers were vaccinated with Newcastle disease virus (NDV) on d1 (B1 strain) and d21 (La-Sota strain) via eye drop. Blood weight, feed consumption, feed conversion ratio, and mortality were recorded to monitor growth performance. There was no significant difference in body weights (P < 0.05) between T1 and T2. Due to only one pen per group, no statistical analysis was conducted for feed consumption or feed conversion. Blood and immune organ samples (thymus, bursa of Fabricius, and spleen) were collected to evaluate immune system development on days 14, 21, 28, 35 (blood only), and 42. Birds supplemented with XPC had significantly higher percentages of CD3+, CD4+, and CD8+ T-cells in the thymus on day 28, indicating production of more mature T-cells, which was consistent with gene expression results. Results suggest that XPC supplementation primes broilers to become more immunocompetent, without compromising growth performance.

Key Words: XPC, Immunomodulation, qPCR, Spleen, Thymus

M29 Effects of Diamond V Original XPC™ on modulating adaptive immune function in broilers

Jung-Woo Park*1, W.K. Chou1, L. R. Berghman1, D. R. McIntyre2
1Poultry Science Department Texas A&M University, College Station, TX, USA; 2Diamond V Mills, Cedar Rapids, IA, USA

This study was conducted to investigate the effect of Diamond V Original XPC (XPC), a broad-spectrum immune modulator, on immune function in broilers. One-day-old broilers were randomly assigned one of two treatments: 1.25 kg/ton XPC (T1), or control diet (T2). All broilers were vaccinated for Newcastle disease virus (NDV) on d1 (B1 strain) and d21 (La-Sota strain) via eye drop. Through histology observation, there was no significant difference in body weights (P < 0.05) between T1 and T2. Due to only one pen per group, no statistical analysis was conducted for feed consumption or feed conversion. Blood and immune organ samples (thymus, bursa of Fabricius, and spleen) were collected to evaluate immune system development on days 14, 21, 28, 35 (blood only), and 42. Birds supplemented with XPC had significantly greater thymus indices on days 28, and 42. Birds in T2 had significantly greater bursa of Fabricius indices on days 14 and 42, and a significantly greater spleen index on d21. The result of NDV antibody titer measurement showed the Immunoglobulin G level of T1 was significantly higher than T2 after 1st vaccination on day 14, and increased faster than T2 after boost on day 21. Cell proliferation results from blood had the same trend with NDV antibody titer results; T1 had significantly stronger T-lymphocyte abilities than T2 at d28. Through histology observation, there was no significant difference in the thymus medulla and cortex ratio between T1 and T2. In the spleen, T1 contained significantly more white pulps at d14 than T2. These results demonstrate that XPC supplementation influenced broiler immune system development at an early stage.

Key Words: XPC, Immune function, antibody titer, spleen, thymus

M30 PCR Eimeria diagnostics from broiler complexes across the United States and Canada

Emily Kimmunity1, Lorraine Fuller1, Greg Mathis1, Steven Clark3
1University of Georgia, Athens, GA, USA; 3Southern Poultry Research, Athens, GA, USA

Twenty-nine Anticoccidial Sensitivity Tests sponsored by Zoetis Inc. (Durham, NC) were conducted in 2014 at the University of Georgia and Southern Poultry Research (Athens, GA). Field isolate Eimeria species were confirmed using Polymerase Chain Reactions (PCR). In contrast to morphological comparison, PCR offers reliable and relatively easy discrimination between the species. Along with running PCR, samples were
diagnosed morphologically and the results from PCR and morphology were compared. PCR primers used were unique to each species and ran with positive controls for confirmation of desired band size. The primers used were for *E. maxima*, *E. tenella*, *E. necatrix*, *E. praecox*, *E. brunetti*, *E. mitis* and *E. acervulina*. *E. acervulina* was seen in 96% of the samples (n=28), *E. brunetti* 86% (n=25), *E. maxima* 93% (n=27), *E. mitis* 48% (n=14), *E. necatrix* 24% (n=7), *E. praecox* 86% (n=25) and *E. tenella* 89% (n=26). Vaccination records were also used to compare the species variation between the farms. With 24% prevalence, pathogenic *E. necatrix* warrants further investigation as a potential vaccine addition. Future plans include comparison of the species at the same farms over several years and observe any changes over time.

**Key Words:** Coccidia, PCR, Anticoccidial Sensitivity Test

### Processing & Products

**M31 Ultrasonic for Disinfection** Akilul G Giorges, Doug Britten, John Pierson Food Processing Technology Division Georgia Tech Research Institute, Atlanta, GA, USA

The pathogens intervention system is a key part of poultry processing. A disinfection system that can use chemical disinfectants effectively, reduce and/or eliminate harmful byproducts is in demand more than ever. The goal of this project was to evaluate the effectiveness of sonication (ultrasound) for inactivation of *Salmonella* with and without a disinfection agent (chlorine, peracetic acid) in poultry (chiller) water.

The experiment was designed to investigate the ultrasonic effect of various power intensities, volumes, and exposure times with several repetitions. All ultrasound experiments were conducted in isothermal conditions to eliminate disinfection via indirect heat input from the ultrasonic probe. The data from the *Salmonella* inoculated DI water tests showed a correlation between an increase in ultrasonic energy, increase in exposure time, and decrease in volume that led to better disinfection of Salmonella. The data demonstrates that ultrasound can be used to inhibit *Salmonella* growth.

This study also evaluated the effectiveness of ultrasound and chemical disinfection agents (chlorine or peracetic acid (PAA)) in *Salmonella* inoculated water, surrogate chiller water and poultry chiller water. The synergy effect for chlorine (1.66, 3.32 and 4.98ppm) and PAA (0.75, 1.5 and 2.25ppm) in water is evaluated by assessing the disinfection agents with approximately 40kJ of ultrasonic energy (65W for 10 minutes) in *Salmonella* inoculated DI water. When comparing the data of chemical disinfection with the combination of ultrasonic and chemical, the disinfection is greater for the combined system than the disinfection observed with chemicals only. Surrogate chiller water (5g of chicken skin and fat per litter of DI water) was treated with combined chlorine (16.6 ppm) and ultrasound in parallel to chlorine treatment alone. The experiment of surrogated chiller water was also repeated using peracetic acid concentrations of 0.75, 1.5, and 2.25ppm. A similar trend of log reduction was observed for combination ultrasound and chemicals treatment for all concentrations of chlorine and PAA.

The ultrasonic disinfection trend in poultry chiller water was found to be similar to that of DI water experiments. Furthermore, the poultry chiller water with additional chemicals (16.6ppm chlorine and 2.25ppm PAA) and ultrasonic were also tested. The data show the combined system disinfection better than the chemical alone. However, more work is needed to characterize the actual chiller water. In all cases, samples treated with combined ultrasound and chemicals exhibited better disinfection than samples treated with chemical alone.

**Key Words:** sonication, disinfection agents, Salmonella

**M32 Dissolved Air Flotation as superior pre-treatment for poultry waste water** Wilbert Menkveld, Sipke Verbeek Nijhuis Water Technology B.V., Doetinchem, Netherlands; ‘Nijhuis Water Technology Inc., 560 West Washington Blvd, Unit 320, Chicago, Illinois, 60661, IL, USA

Dissolved air flotation (DAF) has been successfully applied as industrial wastewater treatment for many years. Recent technological improvements have expanded the applicability to the pre-treatment of wastewater. Nijhuis Water Technology, known for supplying more than 1700 DAF systems worldwide developed a new ‘Intelligent DAF’ which achieved better COD and TSS removal compared to current DAF systems due to smarter flow pattern, smaller bubble size and intelligent aeration control. Up to 60% of the total suspended solids can be removed by DAF from poultry slaughterhouse wastewater. With chemical additives the removal increases up to 99% removal of suspended solids and up to 85% COD removal.

Extensive research with the Intelligent DAF proved that the energy usage of the recirculation and aeration could be decreased up to 30% in comparison to older DAF installations at similar suspended solids and COD removal. Due to the large contribution of the recirculation and aeration to the total energy demand of a DAF system, a significant energy reduction up to 25% is obtained by the ‘Intelligent DAF’ system. This yields an energy usage of 0.03 kWh/m³ and 0.05 kWh/m³ wastewater for DAF systems with and without chemical additives, respectively. The research and the first full scale Intelligent DAF installations have proven that treatment of industrial wastewaters gives higher removal efficiencies at lower energy use per m³ treated waste water.

**Key Words:** DAF, poultry slaughterhouse wastewater, energy efficiency, flocculation, flotation

**M33 The Aecomix™ system: converting waste and waster in one reactor towards clean water and biogas** Wilbert Menkveld Nijhuis Water Technology B.V., Doetinchem, Netherlands

Food and beverage production plants are major wastewater contributors and often have food waste. Particularly plants with wastewaters with a significant total suspended solids and/or fats, oils and greases like in the dairy, redmeat and chicken industry needs to pre-treat their wastewater before high rate anaerobic reactors can be applied. This pre-treatment generally includes undesirable chemical treatment and generates a concentrated sidestream which needs to be dealt with.

The Aecomix™ reactor is an innovative anaerobic reactor with solids retention, particularly suited to treat such effluents, together with available organic wastestreams. In this manner two waste streams are dealt with in one system and a high level of conversion to biogas is achieved. The solids retention is achieved by Dissolved Biogas Flotation. A full scale Aecomix™ reactor treated the effluent of a chocolate/candy factory with a COD concentration varying between 10,000 – 60,000 mg/l at an average of 30,000 mg/l. The removal for COD and TSS was more than 95% on average. To meet with local discharge regulations a post aerobic biological treatment may be required. The excess sludge from this aerobic system can be returned to the Aecomix™ reactor, which is another advantage over high rate (UASB type) reactors. The Aecomix™ is approximately 20% lower in operational costs compared to a chemical treatment plant followed by an UASB reactor. The Aecomix™ system provides a single step process solution for different substrates from dairy, redmeat and other food industries, with a high removal efficiency (on organic matter). It is proven to be a robust process with advantages such as integrated gas storage.

Frozen pre-stuffed turkeys are convenient and may be cooked either after thawing or direct from solid state. All carcasses (4.35kg) were from 12wk heavy hens of common background. Each was cooked in a raised-wire
shallow Al pan using a standard oven (163°C) to an 85°C internal breast. Prior to freezing, all crop and body cavities had been filled with bread cubes having 50% added water by weight to increase RTW by 20%. Each of 4 treatments involved 7 RTC carcasses: thawed to +5°C when cooking was initiated with frozen repetitions at -5, -15 and -25 to enable regression analysis. Time to attain breast end-point was 44 min when starting temp was +5°C which increased to 63 min when -5°C with similar values at lower starting temperatures (P<***Q). Total cooking loss was similar among all treatments when stuffing was included (20.4%, P:NS), but calculation after its removal indicated a loss from +5°C carcasses of 26.6% while it was greater those that had been frozen with similar values among treatments (28.3%, P<**Q). Total drip of cooking loss from stuffed carcasses was 26.2% when +5°C but lower and similar among frozen treatments 22.9% (P<*,Q). Analysis of stuffing removed from a thawed +5°C carcass that was not cooked indicated 64.9% moist and 16.6% fat , 11.8% CP, and 7.0% ash on a DM basis. Cooking led to 10.2% gain in weight for the crop-body cavity composite that was similar among treatments (P:NS); however, their moist content decreased from the level at initiation of cooking, particularly when frozen (crop, 59.4% at +5°C vs 55.8% frozen, P<**Q: Body cavity, 56.9% at +5°C vs 52.8% frozen, P<***Q). Accretion of fat accounted part of the reduction in moist with crop being similar to body cavity which was similar among treatments (21% DM, P:NS), while CP increase with crop was greater than body cavity (13.7% DM vs 11.7%, P<*) with each being similar, regardless of starting temperature (P<*,Q). Yield of parts as well as breast and thigh meat proportions were not affected nor were their compositions altered by method of cooking. Caloric increase for solid-liquid phase change dominated the increased cooking time when frozen and marginal changes in losses, yields, and compositions of stuffing occurred, regardless of starting carcass temperature.

Key Words: Biogas production, COD reduction, Dissolved Biogas Flotation, High Rate Anaerobic treatment, wastewater

M34 Cooking Frozen Turkey Containing Stuffing: Preparation Characteristics Once Thawed and From Progressively Reduced Solid Temperatures Ed Moran*, Laura Bauermeister Auburn University, Auburn, AL, USA

Frozen pre-stuffed turkeys are convenient and may be cooked either after thawing or direct from solid state. All carcasses (4.35kg) were from 12wk heavy hens of common background. Each was cooked in a raised-wire shallow Al pan using a standard oven (163°C) to an 85°C internal breast. Prior to freezing, all crop and body cavities had been filled with bread cubes having 50% added water by weight to increase RTW by 20%. Each of 4 treatments involved 7 RTC carcasses: thawed to +5°C when cooking was initiated with frozen repetitions at -5, -15 and -25 to enable regression analysis. Time to attain breast end-point was 44 min when starting temp was +5°C which increased to 63 min when -5°C with similar values at lower starting temperatures (P<***Q). Total cooking loss was similar among all treatments when stuffing was included (20.4%, P:NS), but calculation after its removal indicated a loss from +5°C carcasses of 26.6% while it was greater those that had been frozen with similar values among treatments (28.3%, P<**Q). Total drip of cooking loss from stuffed carcasses was 26.2% when +5°C but lower and similar among frozen treatments 22.9% (P<*,Q). Analysis of stuffing removed from a thawed +5°C carcass that was not cooked indicated 64.9% moist and 16.6% fat , 11.8% CP, and 7.0% ash on a DM basis. Cooking led to 10.2% gain in weight for the crop-body cavity composite that was similar among treatments (P:NS); however, their moist content decreased from the level at initiation of cooking, particularly when frozen (crop, 59.4% at +5°C vs 55.8% frozen, P<**Q: Body cavity, 56.9% at +5°C vs 52.8% frozen, P<***Q). Accretion of fat accounted part of the reduction in moist with crop being similar to body cavity which was similar among treatments (21% DM, P:NS), while CP increase with crop was greater than body cavity (13.7% DM vs 11.7%, P<*) with each being similar, regardless of starting temperature (P<*,Q). Yield of parts as well as breast and thigh meat proportions were not affected nor were their compositions altered by method of cooking. Caloric increase for solid-liquid phase change dominated the increased cooking time when frozen and marginal changes in losses, yields, and compositions of stuffing occurred, regardless of starting carcass temperature.

Key Words: Biogas production, COD reduction, Dissolved Biogas Flotation, High Rate Anaerobic treatment, wastewater

M35 Post-mortem pH decline in broiler carcasses subjected to either air or ice chill environments Sara Orłowska1,2, Audrianna Rogers, Alex Gilley, Fred Pohlman, Nicholas Anthony University of Arkansas, Fayetteville, AR, USA

When muscle is converted to meat, post-mortem pH decline occurs. If this decline occurs too slowly or too rapidly, meat quality suffers. Previous research has shown that cooling rates may have an effect on pH decline. This study characterizes pH change over a 24 h period for divergently selected lines (24 h color L*) and evaluates the response of these lines to different chill methods. The broiler lines used included the random bred control (RBC) as well as the High L* (HMC) and Low L* (LMC) meat color lines. It is hypothesized that the HMC line would have a faster rate of decline and a lower ultimate pH than the LMC line. In addition, a faster chill rate would result in a slower pH decline. The study consisted of three replications of twenty-four male broilers, eight from each line. Broilers were reared on litter floor pens to 8 wk at which time they were processed. Carcasses were equally and randomly assigned by line to either open air or ice-bath chilling. Temperature and pH measurements were collected on the breast and thigh muscles immediately after exsanguination, 15 minutes post-mortem and every hour until deboning at 4 h. Temperature and pH measurements were recorded at 6, 8, 10, 12, 16, 20 and 24 h. Breast meat color was measured at 4, 12 and 24 h. Within the HMC and LMC lines, no treatment differences were observed for pH decline or 24 h breast meat color. When averaged across treatments, the rate of pH decline was greatest with the HMC line and lowest with the LMC line with the RBC line being an intermediate. For all lines, pH decline stopped between 6 and 8 h post mortem indicating the completion of rigor mortis. Differences were observed between lines for 24 hour L* indicating that the divergent lines behaved as expected. Understanding of the interaction of pH and temperature decline for lines known to vary in meat characteristics will allow for management techniques that can be implemented ante and post-mortem to help improve meat quality.

Key Words: broiler carcass, chill method, meat color, meat quality, pH

M36 Meat quality of broiler breast fillets with white stripping and woody breast muscle myopathies Vishwesh V. Tijare*GS1, Famous Yang1, Christine Z. Alvarado2, Craig Coon1, Casey M. Owens1 University of Arkansas, Fayetteville, AR, USA; 2Texas A&M University, College Station, TX, USA

The global poultry industry has been faced with emerging broiler breast meat quality issues including conditions known as white striping (WS) and woody (WD) breast. White striping is characterized by white striations parallel to muscle fibers primarily in breast fillets while woody breast characteristics are hardiness of the raw fillets. This study was conducted to evaluate effects of WS and WD hardness on meat quality traits in broiler breast fillets. A total of 285 birds were processed at 61 d of age and deboned at 4h postmortem. All fillets were scored for severity of white striping based on Kuttappan et al. (2012). Additionally, fillets were evaluated for degree of hardness based on tactile evaluation. Fillets were then scored as hard (WD1), slightly harder (WD2) and hardest (WD3) along with normal (no hardness or striping, NORM), moderate and severe white striping. For meat quality analyses, 135 fillets which were categorized as normal for both WS and WD (CONT), mild for WS and WD (MILD), severe for WS and mild for WD (SEVWS), severe for woody and mild for WS (SEVWD), and severe for both WS and WD (SEVBOTH). Fillets were used to assess sarcomere length (SL), gravimetric fragmentation index (GFI), marination uptake (MU), cook loss (CL), and Meul...
M37 Evaluating breast meat tenderness using a blunt version of the Meuullenet-Owens Razor Shear method of broilers raised for small or big bird market programs. Famous L. YangGS1, Vishwesh V. Tijare1, Aline Giampietro2, Casey M. Owens1

1University of Arkansas, Fayetteville, AR, USA; 2FCAVE-UNESP, Jaboticabal, Brazil

Broiler breast meat tenderness is an important meat quality attribute and previous research has suggested that older market broilers have tougher meat at times compared to younger broilers (e.g., 8 vs. 6 weeks). The Meuullenet-Owens Razor Shear (MORS) method was developed to assess broiler meat tenderness in recent years. A blunt version of MORS has been reported to be a more sensitive method at higher degrees of toughness. An experiment was conducted using standard breast yield (SY) and high breast yield (HY) commercial male broilers. Of each strain, 108 birds were commercially processed at 40 d age and 95 birds were commercially processed at 54 d age. Muscle pH, color (L*, a*, and b*), sarcomere length (SL), myofibrillar diameter (MD) were measured. Breast fillets were cooked to 76°C and cook loss, MORS and a blunt version of MORS measuring energy (MORSE, BMORSE) while 6 and 24 h were similar (P>0.05) to each other and less than those deboned at 2 h (P<0.05). Using the MORSE, values were higher than MORSE values overall (P<0.05). As severity of WS or WD increased, MU decreased (P<0.05), and cook loss of non-marinated and marinated fillets both increased with increasing severity of WS or WD (P<0.05). The MORSE of SEV/BOTH fillets was higher (P<0.05) compared to other fillets; however, no differences for MORSE of non-marinated fillets were noted. Results of this study suggest that severe degrees of white striping and woody (hardness) together or alone negatively impact meat quality.

Key Words: broiler, myopathy, white striping, woody breast, meat quality

M38 Salmonella presence and counts on different skin parts from turkey carcasses Ye PengGS1, Walid Q Alali2, Mark A. Harrison3, Xiangyu Deng2

1University of Georgia Department of Food Science and Technology, Griffin, GA, USA; 2USDA-ARS Russell Research Center, Athens, GA, USA

Turkey skin of drumstick, thigh and wing is currently utilized as a source of fat in ground products. Salmonella contamination in the three parts of skin is thought to be a potential source of this pathogen in ground tur-key. The goal of this study is to determine the prevalence and numbers of Salmonella in skin of turkey parts (drumstick, thigh, and wing). Turkey flocks predicted to be highly contaminated with Salmonella based on results of boot-sock tests are sampled. From each flock, fifteen samples per bird part type are collected at post-chill and tested for Salmonella using most probable number (MPN) and enrichment methods. So far, samples from five flocks have been collected and tested. Salmonella prevalence in skin of drumstick, thigh and wing was 16%, 16%, 20%, respectively. Mean Salmonella number per gram of skin per sample type was 0.29 MPN/g (drumstick), 0.17 MPN/g (thigh), 0.14 MPN/g (wing), which were not significantly different (P>0.05). Therefore, skin of turkey wing might be a more significant source of contamination in ground turkey compared to the thigh and drumstick skin.

Key Words: Salmonella, ground turkey contamination, skin types, prevalence, MPN method

M39 Effect of sub-lethal oxidative stress of chlorine on biofilm forming ability of various Salmonella strains Janak DhakalGS1, Chander Sharma Mississippi State University, Starkville, MS, USA

The present study was conducted to evaluate the effect of sub lethal oxidative stress (generated by sub inhibitory chlorine concentration) on the ability of different Salmonella strains to form biofilm on polystyrene surface at two different temperatures (30°C and 4°C). Three Salmonella serotypes S. Enteritidis (ATCC 4931), S. Heidelberg (ATCC 8326), S. Typhimurium (ATCC 14028) and 12 other Salmonella strains (isolated from poultry products) were exposed to the sublethal chlorine concentration (150 ppm) in Tryptic Soy Broth (TSB) for 2 h at 30°C and 4°C. The biofilm forming ability of the strains was assessed by cultivating the chlorine exposed and untreated control cells in TSB in a 96 wells polystyrene microtiter plate for 48 h at 30°C and 4°C. Biofilm formation evaluation was carried by crystal violet staining method and quantified by the optical density measurements at 600 nm. Six wells for each strain and control were used for the experiment and the whole experiment was repeated three times. The results of the study revealed that there were strain variations on biofilm formation by Salmonella on polystyrene surface in response to sub-lethal chlorine/ oxidative stress. Out of 15 strains tested, chlorine exposed S. Heidelberg (ATCC 8326) at 4°C formed stronger (P<0.05) biofilm as compared to control that was not exposed to chlorine stress. At 30°C, S. Heidelberg (strain ID 72) and S. Newport (strain ID 107) formed stronger (P<0.05) biofilm as compared to the non-treated controls. Sub-lethal chlorine exposure to some of the other Salmonella strains enhanced their ability to form biofilm but the difference was not statistically significant (P> 0.05) compared to control. S. Heidelberg showed increased biofilm formation at both 4°C and 30°C after exposure to sub-lethal chlorine. These findings indicate the potential of stronger biofilm formation by some Salmonella strains upon exposure to sub-lethal chlorine concentrations in food processing environments. Further studies are undergoing to determine the effect of sub lethal oxidative stress on the ability of different Salmonella strains to form biofilm on different food contact surfaces under different temperatures.

Key Words: Salmonella, Biofilm, Chlorine, Sublethal concentration, Polystyrene surface

M40 Addition of charcoals to broilers feeds did not impact Salmonella Typhimurium colonization or persistence, or the pH of the crop or duodenum during a 6 wk growout Kimberly WilsonGS1, Dianna Bourassa2, Adam Davis3, Elizabeth Freeman4, R.Jeff Buhr5

1The University of Georgia, Athens, GA, USA; 2USDA-ARS Russell Research Center, Athens, GA, USA

The objective of this study was to evaluate the impact of 3 types of charcoals added to feeds at 0.3% on Salmonella colonization and persistence, and the pH of the crop and duodenum during a 6 wk growout. A total of 1,280 male chicks (32/pen) were placed into 40 pens (10 pens for each
of the 4 dietary treatments). On the day of placement, 2 seeder chicks/pen were orally gavaged with 3 x 10^7 nalidixic acid resistant Salmonella Typhimurium, and returned to the pens to commingle with penmates. The feed treatments were: basal control, 0.3% bamboo charcoal, 0.3% activated bamboo charcoal, and 0.3% pine charcoal that were added to both starter (1 to 14 d) grower (14 to 28 d), and finisher (28 to 42 d) feeds. At wk 1 and 2, ceca from 1 seeder and 1 penmate broiler/pen were sampled and cultured for Salmonella. From the penmate broiler the crop and duodenum were exposed to record the luminal pH. Ceca were Salmonella positive in all chicks (both seeders and penmates) sampled at wk 1 and 2. By wk 3 Salmonella prevalence in cecae detected by direct plating had begun to decrease to 34%, at wk 4 to 24%, at wk 5 to 23%, and by wk 6 to 12%. Following defeathering the Salmonella prevalence for enriched breast skin samples was significantly higher (P<0.05) at 40% for the control, compared to 10% for bamboo charcoal, 15% for activated bamboo charcoal, and 0% for pine charcoal. The pH of the crop decreased weekly but there were no detected feed treatment differences in pH within any wk. The pH at 1 wk for the crop ranged from 5.84 to 6.44 across treatments and differed compared to wk 2 to 6 (3.83 to 6.12). Duodenal pH varied minimally from 5.8 to 6.1. Overall, the small amount of feed chicks consume in the first wk may contribute to the higher pH of the crop and enable Salmonella from the seeders to spread to and colonize penmate chicks. Adding charcoals at 0.3% to broiler starter diets did not prevent Salmonella colonization, but charcoals added to grower diets may have hastened Salmonella elimination from ceca and resulted in significantly lower Salmonella recovery from breast skin samples following defeathering.

**Key Words:** charcoal, feed, Salmonella, pH crop, broiler

**M41 Effect of Original XPC on prevalence and numbers of Salmonella (S.) from ceca of turkey hens inoculated at 1 d of age with S. Typhimurium and at 56 d with S. Heidelberg D. P Smith1, G. F. Mathis2, C. L. Hofacre3, R. D. Berghaus3, D. R. McIntyre4 Diamond V, Cedar Rapids, IA, USA; 2SPR Group, Athens, GA, USA; 3University of Georgia, Athens, GA, USA

Salmonella (S.) contamination of live poultry may occur early or late during the growout period, and may involve different serovars. Pre-harvest interventions must be evaluated for their efficacy against multiple exposures and serovars of S. during the life of the flock. This study was conducted to determine the effect of XPC (a broad-spectrum immune modulator) on the prevalence and cecal colonization of commercial turkey hens from early and late exposure to Salmonella (Typhimurium and Heidelberg, respectively). One day-old turkey hen pouls (n=60) were placed in each of 24 pens (n=1440). Twelve pens of hens were fed a diet including XPC at a level of 1.25 kg/mT (trt = XPC); the remaining 12 pens were fed the same diet without XPC (Control). On d 1, 20 birds in each pen were orally inoculated with S. Typhimurium (log 10^7 CFU). On d 42, ten (10) hens that had not been inoculated were euthanized and ceca collected aseptically to determine S. prevalence. On d 56, 20 additional birds (not previously inoculated) in each pen were orally inoculated with a nalidixic-acid-resistant strain of S. Heidelberg (log 10^7 CFU). On d 84, 10 hens from each pen that were not inoculated with either serovar were euthanized and ceca collected aseptically for S. prevalence and MPN. There was no difference (P > 0.05) in cecal S. prevalence observed between Control and XPC hens at 42 d (mean of 22% positive), nor was Control and XPC cecal prevalence different at 84 d (mean of 91% positive). Turkey hens fed XPC had significantly lower numbers of S. (P < 0.05) compared to Control hens (mean MPN of 1.1 vs. 2.9, respectively). XPC was an effective pre-harvest intervention against two inoculations of two different S. serovars in turkey hens.

**Key Words:** turkey hens, Salmonella, XPC, pre-harvest food safety

**M42 Evaluation of a novel biologic formulation to reduce Salmonella in market age broilers** Jose Luis Vicente1, Jacob Lum, Matthew Faulkner, Ross Wolfenden Pacific Vet Group USA Inc., Fayetteville, AR, USA

Salmonella has long been known to be a common foodborne pathogen. Poultry meat, while not the only source of Salmonella, is one of the most commonly implicated sources in outbreaks of human salmonellosis. Poultry companies are currently taking extraordinary efforts within the processing plants to reduce carcass contamination, but since the source of Salmonella in poultry meat is from the bird itself, not the plant, it is prudent to begin interventions in the field. Several field interventions have been evaluated in the past with varying levels of success. Presently, a specifically selected bacteriophage cocktail and a specifically selected probiotic formulation were evaluated alone or in combination. Briefly, market age broilers were challenged with Salmonella Enteritidis (SE), then later treated with the Probiotic (PRO), bacteriophage (PG), or the combination of the two (COMBO). The crops were aseptically removed and cultured for the presence and quantification of SE. SE was found to be significantly reduced (P < 0.05) in all treatment groups as compared to the untreated control (CON). While 3.30Log10 cfu SE/g crop content was enumerated from the CON, 1.74Log10, 1.95Log10 and 1.12Log10 were isolated from the PRO, PG, and COMBO groups respectively. This indicates that all three treatment groups may be potential candidates to reduce SE in commercial broiler flocks.

**Key Words:** Salmonella, Bacteriophage, Probiotic, Poultry

**M43 Inhibition of Salmonella Typhimurium by Cultures of Cecal Bacteria during Aerobic Incubation** Arthur Hinton Jr2, Gary Gamble1, Kimberly Ingram1, Ensa Taha1, Ronald Holser1 Russell Research Center; Athens, GA, USA; 2Tuskegee University; Tuskegee, AL, Afghanistan

Two trials were conducted to examine the ability of cecal bacterial cultures from broilers to inhibit growth of Salmonella Typhimurium during aerobic incubation. Cecal broth media was inoculated with 10 µl of cecal contents from 6 week old broilers taken from 2 separate flocks. Cultures were incubated aerobiocically at 37°C for 48 h. Supplemented cecal media was prepared by the addition of: #1) 0 mM ethanol, lactate, and succinate; #2) 104 mM ethanol and 50 mM lactate and succinate; #3) 208 mM ethanol and 100 mM lactate and succinate; or #4) 321 mM ethanol and 150 mM lactate and succinate. Each medium was inoculated with 0.25 ml of the cecal culture, 10^4 cfu/ml of Salmonella, or the cecal culture and Salmonella. Inoculated media were incubated aerobiocically at 37°C for 21 days, and aliquots of media were collected on days 0, 7, 14, and 21 for analysis. Cecal bacteria and Salmonella were enumerated, and cecal colonies were selected for identification by the Biolog Bacterial Identification System. Results from Trials 1 and 2 indicated that after 21 days of incubation, between log 6 and 7 cfu/ml of Salmonella were recovered from all media inoculated with Salmonella only. Conversely, in Trial 1 after 21 days, log 4 to 5 cfu/ml of Salmonella were recovered from all media inoculated with Salmonella and cecal cultures. However in Trial 2, no Salmonella were recovered on days 14 or 21 from supplemented medium #4 inoculated with Salmonella and cecal cultures. Furthermore, log 0.74, 2.27, and 4.67 more Salmonella were recovered from Trial 1 than Trial 2 from supplemented media #2, 3, and 4, respectively, inoculated with Salmonella and cecal cultures. Cecal isolates were identified primarily as Enterococcus spp. in addition to Proteus mirabilis, Bacillus lentus, Paenibacillus wynnii, Streptococcus gallolyticus, and several isolates not identified by the Biolog. Findings indicate that cecal cultures incubated aerobiocically may possess anti-Salmonella activity related to the ability to utilize metabolites produced by intestinal bacteria. However, cultures from different flocks may vary in their ability to inhibit the growth of Salmonella; therefore, all cecal cultures may not be suitable sources of bacterial isolates required to formulate effective, defined probiotic cultures.

**Key Words:** Broilers, competitive inhibition, cecal bacteria, lactate, succinate

---

**ABSTRACTS OF PAPERS**

**Poult. Sci. 94 (E-Suppl. 1)**
M44 Re-evaluation of broiler carcass scalding protocols on the recovery of Campylobacter from breast skin after defeathering
Amanda Howard1, Kimberly Wilson1, Dianna Bourassa1, R-Jeff Buhr2
1The University of Georgia, Athens, GA, USA; 2USDA-ARS Russell Research Center, Athens, GA, USA
This research re-evaluated the impact of scalding protocols on the recovery of Campylobacter from breast skin following defeathering after preliminary processing trials detected Campylobacter from breast skin for 4/8 carcasses that had vents plugged and sutured prior to scalding. Published research indicated that when fecal expulsion during defeathering was prevented carcass breast skin was Campylobacter negative when sampled following immersion scalding at 58.3°C/137°F for 90 s and defeathering. Five days after oral challenge with a gentamycin resistant strain of Campylobacter coli (108 cells), broilers were subjected to a 12 h feed withdrawal and transported (5 broilers per solid bottom coop) to the pilot plant. Batches of 5 broilers (2 batches for each scalding protocol) were stunned at 15 V for 10 s, bled for 2 min, and during bleeding vents were plugged and sutured closed. Carcasses were hard scalded at 60°C/140°F for a total immersion time 90 s in either a single, double, or triple tanks. The pickers had been adjusted to achieve acceptable defeathering with minimal overpicking of the hips and elbows. All carcasses were defeathered for 30 s in a single 4 bank picker, and breast skin (including the sternal and pectoral feather tracts) was aseptically excised. The picker was rinsed with 82°C/180°F water between each batch of carcasses and the scalders were drained and rinsed after completion of 1 batch for each scalding protocol. With direct plating, Campylobacter was not recovered from any carcasses that were single tank scalded (0/10), but was recovered from 2/10 carcasses that were double tank scalded, and from 4/10 that were triple tank scalded. Breast skin from all carcasses was Campylobacter positive when samples were plated after 24 h enrichment. These results agree with the published results, that when the carcasses vents are plugged and sutured and then are single tank scalded for 90 s no Campylobacter was recovered from breast skin sampled by direct plating. However, comparable results are not obtained when scalding immersion time is subdivided in double (45 s each) or triple (30 s each) tanks.
Key Words: Campylobacter, broilers, scalding, defeathering

M45 Detection of Campylobacter on the outer surface of retail broiler meat packages and from the exudate within
Mark Berrang1, Brian Oakley2, Richard Meinersmann1
1USDA-Agricultural Research Service, Athens, GA, USA; 2Western University, Pomona, CA, USA
Previous work has suggested that outer surfaces of retail broiler meat packaging may be contaminated with Campylobacter presenting a potential hazard to the consumer through direct transfer or by cross contamination of other products or surfaces. The objectives of this study were to measure the prevalence of Campylobacter detected on the outside of retail broiler meat packages and compare that to the prevalence detected on exudate from inside those same packages. Chicken meat products were purchased at retail, one package individually bagged per store per sample day. Effort was made to exclude packages that showed obvious signs of leaking or exposure to other leaky packages. Samples included: whole carcasses, wings, drum-sticks, bone-in thighs, boneless-skinless thighs and bone-in breast halves. Ten packages of each type of product were purchased (N=60). The exterior surface of each package was sampled by pre-moistened sponge, the package was sanitized, opened and exudate was collected from within the package. Sponge diluent and exudate were direct plated and enriched for the presence of Campylobacter spp. Overall, 27 of 60 packages (45%) had detectable numbers of Campylobacter in the exudate within. This included some of each type of product. Despite efforts to avoid leaking packages, upon arrival at the lab and further examination three packages were found to be leaking small amounts of exudate. Overall, 1 of 60 packages had detectable numbers of Campylobacter on the outer surfaces. This package was one of the three characterized as leaky. Campylobacter isolates from inside and outside of the positive package were characterized using multi-locus sequence typing and found to be indistinguishable. Although a substantial percentage of retail broiler meat packages may have Campylobacter on the inside, the outer surface of intact, non-leaky packages can be reasonably expected to be free of Campylobacter.
Key Words: Campylobacter, packaged broiler meat, retail, package surface, product exudate

M46 Comparison of Selective Campylobacter Media for Detection and Enumeration of Naturally Occurring Campylobacter spp. on Poultry
Charlotte Steininger1, Mark Berrang2, Mark Harrison1
1University of Georgia, Food Science and Technology, Athens, GA, USA; 2USDA-Agricultural Research Service, Athens, GA, USA
Campylobacter spp. are among the most common cause of bacterial foodborne diarrhea illness; poultry has been linked as a primary source of contamination. Detection and enumeration of low numbers of naturally occurring Campylobacter spp. on poultry is difficult due to the presence of competing microflora that are not eliminated by selective media. This study compared the effectiveness of various combinations of enrichment broths and plating media to detect naturally occurring Campylobacter spp. in broiler carcass rinse samples. Campy-Cefex Agar (CCA) and RF Campylobacter Agar (RFA) were used for enumeration of Campylobacter spp. recovered from 100 mL broiler carcass rinses. These two selective plating media were also used for Campylobacter detection following enrichment in Bolton broth and Bolton broth supplemented with 0.1 µg/mL triclosan (T-Bolton). On average, enumeration of carcass rinse on RFA resulted in a 2.5-3.5 cfu/mL log recovery of Campylobacter spp. with little contamination by background microflora, while enumeration on Campy-Cefex agar resulted in a 1.5-3.0 cfu/mL log recovery of Campylobacter spp. with a significant amount of contamination by background microflora. When enriching for positive or negative, the combination of Bolton broth and CCA resulted in 0-10% positive, the addition of triclosan to the Bolton broth improved recovery on CCA to 30-40% positive. Enrichment in Bolton and plating on RFA resulted in 90-100% positive samples, and enrichment using T-Bolton paired with RFA plating media was the most effective combination resulting in 95-100% positive samples. When enumerating or enriching for naturally occurring Campylobacter spp. in broiler carcass rinsate, RFA or T-Bolton broth followed by plating on RFA proved to be most effective in the elimination of background microflora, therefore allowing for more accurate enumeration and enrichment procedures.
Key Words: Campylobacter spp., Campy-cefex agar, RF agar, supplemented Bolton broth, Campylobacter methodology

M47 Quantifying moisture content on eggs that have been sweated in various environments
Janet Grady1, Pat Curtis1, Kevin Keener3
1Auburn University, Auburn, AL, USA; 3Purdue University, West Lafayette, IN, USA
There are instances where shell eggs may be moved from cold storage into ambient temperature with high humidity such as before wash and before or during transportation. Under these conditions it is of concern that bacteria can grow and migrate through the shell pores into the egg. Objectives of this experiment were to 1) Compare three methods of quantifying condensate on sweated eggs and 2) to quantify moisture content on refrigerated shell eggs sweated at two different temperatures (22 °C and 32 °C) and 60% humidity. For Objective 1, 90 fresh, unwashed eggs were obtained from the Auburn University Poultry Farm. These eggs were individually weighed and placed in plastic flats in a refrigerator at 7 °C stored for four weeks. The eggs were then set out in plastic flats at room temperature (22 °C, 50% RH) for approximately one hour to form maximum condensation. 30 of the eggs that were previously weighed were weighed again. 30 paper towels were weighed, and then the condensate was wiped from the surface of the next 30 eggs. The wet paper towels were re-weighed. Both
tests were repeated three times. A pinless moisture meter was also tested. ANOVA was run on this data. The results indicated that there was no significant difference in quantifying egg sweat by egg weight or weight of moisture absorbed on a paper towel (P≤0.05). For objective 2, a single egg was sweated in two environments (32 °C, 60% RH and 32 °C, 60% RH) on a tared scientific scale. The egg weight was recorded from beginning of condensation formation to the point where the egg dried. This was repeated three times for each environment. A greater amount of sweat is formed at a faster rate (0.2177 g/min compared to 0.1311 g/min) at 32 °C, 60% RH than at 22 °C, 60% RH. A greater amount of condensate is formed on eggs sweated in a warmer environment compared to room temperature (0.653 g and 0.393 g). In conclusion, both weighing an egg before and after sweat and wiping the surface moisture off a wet egg and weighing the paper towel are adequate methods to quantify moisture on sweated eggs. The rate of adsorption is greater than the rate of desorption on sweated eggs. A greater amount of condensation is formed on eggs sweated in a warmer environment compared to room environments. Temperature and humidity influence the rate of condensation formation and the total amount of condensate formed on eggs.

Key Words: shell eggs, egg sweating, egg safety, food safety, egg processing

M48 Impact of extended stun duration and voltage on the recovery of consciousness in broilers C.E. Harris1, Dianna Bourassa2, Kimberly Wilson3, R. Jeff Buhr2 1The University of Georgia, Athens, GA, USA; 2USDA-ARS Russell Research Center, Athens, GA, USA; 3University of Georgia, Athens, GA, USA

Typical electrical stun duration for broilers in the United States is from 5 to 15 s (depending on voltage), but would be considerably longer if and when the kill-line stopped. The welfare and conscious/unconscious status of broilers within the stunner cabinet is a concern while the line is stopped and when the line restarts. Therefore, the effect of stun duration (60, 90, or 120 s) at two voltages (15 or 20 V pulse DC at 550 Hz) was investigated in a pilot processing facility. Two or more broilers were selected by weight between 2.9 to 3.1 Kg and were subjected to a 12 h feed withdrawal. Individual broilers were hung on the shackles line, feet wet to maximize ground contact, and line was started. The standard stun duration in this pilot plant stunner is 10 s, so at 5 s when the broilers were at the middle of the stunner cabinet (brine depth 2.5 cm) the line was stopped for an additional 50, 80, or 110 s. The line was then restarted and the broilers stunned for the remaining 5 s. Upon exiting the stunner cabinet the broilers were immediately removed from the shackles line and placed on the floor on their side to enable observation of ventilation and/or mandibular movements. Within 120 s, if the broiler did not exhibit any skeletal muscle movements and the comb became pale, they were recorded as not recovered. Recovered broilers initiated movement within 15 s and were able to maintain vertical posture at 120 s when placed on their feet. Broilers were individually stunned in sequential batches of 5 broilers at the same voltage setting and duration before changing parameters. All broilers stunned at 15 V for 60 s recovered (5/5 broilers). However, broilers stunned at 15 V for 90 s did not recover (0/5 broilers) and no broilers stunned at 15 V for 120 s recovered (0/5 broilers). Broilers stunned at 20 V for 60 s only 3/6 broilers recovered, unexpectedly those broilers stunned at 20 V for 90 s to 2/5 recovered, and no broilers were tested at 20 V for 120 s. For stun durations of 60, 90, or 120 s for either 15 or 20 V, recovery of consciousness did not appear to be related to a lower stunning amperage (21 to 49 mA) compared to those that did not recover (23 to 44 mA).

Key Words: electrical stunning, stun duration, consciousness, broiler
chicken house) total energy consumption of LED, was 54% less than the combination of CFLs (55W 6d & 7.2W 15d).

Ceiling mounted lamps with widely distributed light caused birds to scatter. LED, provided concentrated light intensity & improved 21d body weight uniformity. By emitting intense light (>12.8 fc) only at the feeder, LED attracts & retains birds in critical areas.

Key Words: AviLighting™, Light Emitting Diode, incandescent, chicken, antibiotic free

M51 The effect of Brazilian propolis on leg health in broilers reared under heat stress Usama Mahmoud1, Mootaz Abdel-Rahman2, Madeha Darwish3, Todd Applegate4, Heng-Wei Cheng4 1Purdue University, Lafayette, IN, USA; 2Assiut University, Assiut, Egypt; 3Livestock Behavior Research Unit, USDA-ARS, Lafayette, IN, USA

This experiment was conducted to examine the effect of dietary supplement with green Brazilian propolis on latency to lie test for leg strength, gait score and leg abnormalities in broiler chickens exposed to chronic heat stress (from 15 to 42 d of age). Fifteen-d-old, male broiler chickens (Ross 708) were randomly allocated to 6 treatments (4 pens/treatment; 21 birds/pen). The dietary treatments were basal diet (control) and 5 concentrations of propolis (100, 250, 500, 1000, and 3000 mg /kg diet, respectively). The average temperature and relative humidity during the day time was (31.7±0.3˚C and 56±4) while at night was (28.8±0.4˚C and 58±3) respectively. At 42 d of age the all birds were scanned for leg abnormalities (slipped tendon, curled toes and crooked toes). Additionally, 10 birds/pen randomly selected for gait scoring (0 -2 ) and 5 bird/pen were used for latency to lie test. The data was analyzed by means of SPSS 22.00 Software using the general linear models (GLM) followed by simple regression model procedure. Supplementation of broiler chickens diets with 250 mg/kg of green Brazilian propolis improved the leg health indicators of broilers reared under heat stress condition.

Key words: Broiler, propolis, heat stress, leg health

M53 Bacterial Prevalence on Broiler Farms from an Integrator in Alabama Katrina English1, Kenneth Macklin1, Manpreet Singh2, Laci Olivia1, James Kreling1, Annuay Segrest1 1Auburn University, Auburn, AL, USA; 2Purdue University, West Lafayette, IN, USA

Poultry are common sources for the pathogens Salmonella, Clostridium perfringens, and Campylobacter. Some of these pathogens are often identified during processing but the exact source of contamination can come from several sources, including the poultry house environment, hatchery, and through vectors such as equipment and personnel. In this study we focused on the bacterial prevalence in the average poultry house environment over the course of a single grow-out period. A survey was sent out to all of the growers for a single integrator in Alabama to determine what the average farm for this integrator was based off of flock history, litter, house, farm, and management characteristics. Based off of the survey, four poultry farms were selected for bacterial sampling. All farms had chicks placed within one day of each other and were sampled three separate times at even intervals throughout the grow-out cycle (D1, 14, 30). For each sampling, each house was sampled in quadrants by using drag swabs and by taking grab litter samples. A representative sample of twelve birds from each house was also cloacally swabbed. Drag swabs and cloacal swabs were enriched and tested for the presence of Salmonella and Campylobacter respectively. Litter samples were diluted and plated on the appropriate media to enumerate total - Salmonella, Clostridium perfringens, anaerobic bacteria, and aerobic bacteria.

Salmonella incidence for each sampling period from the litter samples ranged from 1.6% - 10.9%, from drag swabs Salmonella incidence was between 18.8% - 56.3%, and the incidence of Salmonella from the cloacal swabs was between 4.2% - 6.3%. Clostridium perfringens was found to vary from 2.82 Logs to 4.034 Logs, and only two samples, both from the second sampling were positive for Campylobacter.

Based off the sampling results, it is evident that both Salmonella and Clostridium perfringens are available and present in the poultry house environment and are a potential reservoir for these bacteria.

Key Words: prevalence, Salmonella, Campylobacter, Clostridium perfringens, poultry house

M54 Isolation, screening and identification of Bacillus spp. as direct-fed microbial (DFM) candidates for aflatoxin B1 biodegradation Rosario Galarza-Seeber1, Juan Latorre, Billy Hargis, Guillermo Tellez University of Arkansas, Fayetteville, AR, USA

Aflatoxins are commonly found in cereals worldwide and bring significant threats to the food industry and animal production. The limitations of present physical and chemical methods to decrease aflatoxin in feed ingredients encouraged research on biological methods of degradation. Some Bacillus spp. are identified as generally recognized as safe (GRAS) organisms with probiotic properties in humans and animals. The purpose of the present study was to evaluate the ability of Bacillus spp. as direct-fed microbials (DFM) to biodegrade aflatoxin B1 using an in vitro digestive model simulating in vivo conditions. Sixty nine Bacillus isolates obtained from intestinal and soil samples were screened using a selective media method against 0.25 and 1.0 µg/mL of aflatoxin B1 (AB1) in modified Czapek-Dox medium. Plates were incubated at 37°C and observed every two days during two weeks. Selection criteria was based on growth, reduction of fluorescence and area of clearance around each colony. Three candidates showed an inhibitory halo clearly visible after 48 hours of evaluation. Analysis of 16s-DNA identified the strains as B. amyloliquifaciens, B. megaterium and B. subtilis. In vitro compatibility test among the strains was also conducted. Isolates were individually sporulated using a solid fermentation method and combined. Spores were incorporated into 1 of 3 experimental feed groups: 1) Negative control, unmedicated starter broiler feed with no AB1; 2) Positive control (PCON), negative control feed contaminated with 1 ppm of AB1; 3) Treated (TRT), positive control feed supplemented with 10⁶ spores/gram. Following digestion (3:15h), supernatants and digesta were collected for high pressure liquid chromatography (HPLC) analysis by triplicate. No significant differences (P > 0.05) were observed in the concentrations of AB1 in neither the supernatants nor digesta samples evaluated by HPLC between PCON or TRT groups. Further studies to evaluate the possible biodegradation effects of the Bacillus-DFM in broiler chickens fed with naturally contaminated feed ingredients are in progress.

Key Words: Aflatoxins, Bacillus, DFM, biodegradation, broiler feed

M55 Effect of prolonged administration of dexamethasone in feed on intestinal permeability in broiler chicks Eduardo Vicaña1, Vivek Kuttappan, Rosario Seeber-Galarza, Juan-David Latorre, Olivia Faulkner, Guillermo Tellez, Billy Hargis, Lisa Bielke University of Arkansas, Fayetteville, AR, USA

We have previously shown that intestinal barrier function can be adversely affected by stress, poorly digested diets, or feed restriction, resulting in increased intestinal inflammation-associated permeability. Presently, three Exp were conducted to evaluate the effect of dexamethasone (DEX) treatment on systemic (fluorescein isothiocyanate-dextran 4kDa (FITC-d) levels, indicative of increased gut epithelial leakage. In Exp 1, we compared DEX injection, a known stress-response-inducing dose of 1mg/kg, once per day, on d3, 5, and 9 with feed administration at 0.57,
Key Words: Necrotic enteritis, broiler, coccidia

Dietary inclusion of 15% DDGS have an effect on development of NE and the same CP challenge dose. Diet with high DDGS level and CP challenge DDGS had a greater FCR compared to diets consisting of 0% DDGS with med=0.383. Eimeria spp. did not show any significant differences between treatments, and Quantity One software was used to generate phylogenetic trees. DDGE gels exhibited characteristic banding patterns, indicating the success of the treatment. The data were analyzed using Duncan’s Multiple Comparison Method. NE scores for the treatments with CP 108 CFU/ml (0.4285) were significantly higher (p<0.05) than those of any lower dosed treatments (none=0.2565, low=0.3395, med=0.383). Eimeria spp. did not show any significant differences between treatments. Feed conversion ratio (FCR) day 14-28, was significantly greater for the high dosed treatments (1.641) than those receiving lower doses (none=1.4959, low=1.5689, med=1.5537). Diets with 15% DDGS had a greater FCR compared to diets consisting of 0% DDGS with the same CP challenge dose. Diet with high DDGS level and CP challenge had a significantly higher FCR. These data support the hypothesis that dietary inclusion of 15% DDGS have an effect on development of NE and negative effect on overall performance.

Key Words: Necrotic enteritis, broiler, coccidia

M58 Gastrointestinal parasitic prevalence and associated risk factors in backyard poultry at three ecological zones of Nepal Bibek Regmi*, GS Agriculture and Forestry University, Bhutaha, Nepal

A study was conducted in backyard poultry at Chitwan (160 – 164 masl), Myagdi (1600 – 1620 masl) and Mustang (2650 – 2710 masl) from the three ecological regions of Nepal viz. terai, hill and mountain respectively from November, 2012 to February, 2013 to know the prevalence of gastrointestinal parasites and the associated risk factors. Sample size was randomly selected 35 households from each ecological zone for questionnaire survey. The fecal samples of birds aged greater than 1 month proportional to the number of birds in respective households were collected as per the sampling frame; 1 from 1 to 3 birds, 2 from 4 to 6 birds, 3 from 7 to 9 birds and so on. The questionnaire and the microscopic observation data were collected, coded, computed and analyzed by SPSS-16 and MS-EXCEL 2007. Descriptive statistics like frequencies and percentages were used to represent the data and chi-squared test was used to find out the association of prevalence with the risk factor variables. The overall gastrointestinal parasitic prevalence was found to be 82.87% with highest infection rate in terai (70.75%) followed by hill (56.03%) and in mountain (35.73%). The difference in prevalence was statistically highly significant (P = 0.00: P < 0.01) for different ecological zones. The prevalence rates for different ages, sexes and management systems were slightly different but the differences were not statistically significant (P > 0.05). With regards to the number of species of parasite per chicken, most chickens (61.88%) were harboring multiple species i.e. two to six different species of parasites which is 74.67 percentage of the positive samples. The highest percentage of infection was due to Raillietina spp. (42.54%) followed by Anchoebiotania spheoides (33.70%), Ascaridia galli (30.39%) and Heterakis spp. (19.89%). This can be concluded here that there is a high prevalence of gastrointestinal parasitic infection in backyard poultry of Nepal. The gastrointestinal parasitic prevalence is significantly influenced by the varying altitude of the ecological zones but unaffected by the age of birds, and the type of their housing system. Descriptive statistics reveals that the overall status of management, feeding, nutrition and health care of backyard poultry is very poor in Nepal.

Key Words: gastrointestinal, risk factors, backyard poultry, ecological zones, households

M57 Effects of feeding dried distillers grains with solubles to broilers challenged with C. perfringens and Eimeria on necrotic enteritis Laci MacKay*, GS, James Kreling, William Dozier III, Kenneth Macklin University, Auburn, AL, USA

Necrotic enteritis (NE) is an enterotoxemia that affects flocks worldwide. Broiler diets which rely heavily on inclusions of indigestible non-starch polysaccharides increase the prevalence of NE due to augmented viscosity of the intestines. Dried distillers grain with solubles (DDGS) has become a popular additive included in broiler diet due to its availability in large quantities however, it is less-digestible for poultry. A total of 480 male Ross x Ross 708 chicks were randomly assigned one of two experimental levels of DDGS (0 or 15%) for both the starter and grower phases. There were four different levels of C. perfringens (0, 104, 106, 108 CFU/ml) to accompany each of the experimental diets, giving six replicates (10 birds/rep) for each of the eight treatments. On day 18, all challenged birds were orally inoculated with an Eimeria spp. cocktail (20,000 sporulated oo-cysts) consisting of a mixture of E. maxima and E. acervulina. C. perfringens (CP) was administered on day 21, 22, and 23 at the above-mentioned levels by 1 ml oral gavage. On day 28 birds were necropsied and scored for NE and coccidia lesions. The ceca was removed for recovery of CP. All results were analyzed using GLM, if significant (p<0.05) means were further separated using Duncan’s Multiple Comparison Method. NE scores for the treatments with CP 108 CFU/ml (0.4285) were significantly higher (p<0.05) than those of any lower dosed treatments (none=0.2565, low=0.3395, med=0.383). Eimeria spp. did not show any significant differences between treatments. Feed conversion ratio (FCR) day 14-28, was significantly greater for the high dosed treatments (1.641) than those receiving lower doses (none=1.4959, low=1.5689, med=1.5537). Diets with 15% DDGS had a greater FCR compared to diets consisting of 0% DDGS with the same CP challenge dose. Diet with high DDGS level and CP challenge had a significantly higher FCR. These data support the hypothesis that dietary inclusion of 15% DDGS have an effect on development of NE and negative effect on overall performance.

Key Words: chicken, dexamethasone, stress, bacterial translocation, gastrointestinal permeability

M59 Cecal Salmonella and indigenous microflora response to Original XPC™-fed broilers Stephanie Roto*, GS, Sang In Lee, Peter Rubinelli, Si Hong Park, Steven Ricke University of Arkansas, Fayetteville, AR, USA

The objectives of this research were to assess the response among the gut microflora of broiler chickens, and to determine the prevalence of Salmonella in broilers fed antibiotic-free commercial broiler diets, with and without the addition of salinomycin, and observe the effects of supplementing Diamond V Original XPC™ (Diamond V, Cedar Rapids, IA). Male broiler chickens (n=1280) were randomly assigned to floor pens. Sixteen replications of twenty male birds per pen were fed one of four possible treatments: control (T1), XPC (T2), salinomycin (T3), or XPC + salinomycin (T4). All broiler chicks were spray-vaccinated in the hatchery with a standard dose of coccidiosis vaccine (Coccivac-B, Merck). At 0, 2, 4 and 6 weeks of age, 24 birds were randomly selected from each treatment group for cecal content analysis. Denaturing gradient gel electrophoresis (DGGE) was used to compare microflora in cecal contents among the treatments, and Quantity One software was used to generate phylogenetic trees. DGGE gels exhibited characteristic banding patterns, indicating the cecal microflora achieved detectable stability as the birds matured. Phylogenetic analyses at week 2 showed stabilization in T2 and T4 groups, while week 4 data indicated further stabilization in T4. Based on preliminary sequencing of select DGGE bands, Bacteroides appeared to be common at weeks 4 and 6. To determine Salmonella prevalence, XLT-4 and BG media were used; 22.2, 13.9, 16.7, and 2.8% of samples tested positive for Salmonella in treatment groups 1, 2, 3, and 4 respectively. After statistically pooling all treatments as two groups, based on the presence or
absence of XPC in the diets, JMP genomics software was used to compare Salmonella prevalence. Salmonella prevalence was significantly lower (p < 0.05) in XPC-supplemented treatment groups (T2 and T4).

Key Words: XPC, cecal microflora, broiler, Salmonella, DGGE

M60 Antimicrobial Effect of an Essential Oil Blend on Surface-attached Salmonella on Polyvinyl Chloride Sangyoon Song1,2, Walid Alali3, Joseph Frank4, Charles Hofacre5 1University of Georgia Center for Food Safety, Griffin, GA, USA; 2University of Georgia Department of Food Science & Technology, Athens, GA, USA; 3University of Georgia Poultry Diagnostic and Research Center, Athens, GA, USA

Introduction: Polyvinyl chloride (PVC) is basic material for drinking water lines for chickens. Inner surface of PVC pipe can be susceptible to microbial effects. Biofilm which can cause Salmonella infection to chickens are known to have great resistance against antimicrobials. Chlorine is used to control the biofilm, but it cannot efficiently decrease the Salmonella cells of internal organs of chickens by intake. However, essential oils are proven they can reduce the Salmonella cells of internal organs of chickens. Hence, efficacy of essential oils (EO) to prevent the slime formation can be tested.

Purpose: The objective was to compare the efficacy of an essential oil blend to reduce attached Salmonella cells on PVC with chlorinated water and untreated control.

Methods: PVC coupons (n=30) sanitized with ethanol were prepared and 3.6 × 10⁷ CFU/mL of Salmonella cocktail (Entertidis, Heidelberg, and Typhimurium) were incubated with the coupons in 30mL TSB per sample for 6h at 37°C with 100 rpm to develop the attachment. Antimicrobial treatments were performed for coupons (n=10/group) with EO (500 µg/mL), sodium hypochlorite (5 µg/mL), or sterile deionized water, and they were incubated at 25°C for 24 h with 100 rpm. The surfaces of the coupons after rinsing with PBS were swabbed with sterile sponges and stomached in 50mLs of D/E neutralizing broth. Next, enumeration with XLT-4 and enrichment with BPW and TT was conducted. Furthermore, pHs of the antimicrobials were measured at three different conditions (without Salmonella cells, before the treatment, and the treatment).

Results: Average log₉ CFU/cm² (+ standard error) of EO treated group and sodium hypochlorite treated group were 0.19 ± 0.13 and 0.86 ± 0.22 respectively. On the other hand, the control group showed 3.87 ± 0.054 indicating statistically significant reduction of Salmonella cells by two antimicrobials. The number of Salmonella positive samples per group was 2 (EO), 9 (chlorine), and 20 (sterile deionized water) out of total 20 samples per group, indicating statistically significant difference among the three groups. Finally, EO group did not show remarkable changes in pH showing around pH 3.6-3.7. However, chlorine group showed different pH depending on the timing; pH 8.00 when no Salmonella cells existed, pH 6.96 before the treatment and pH 6.38 after the treatment. Sterile deionized treated group showed consistent pH value no matter when the measurement timing was, indicating pH around 6-6.3.

Significance: The potential of EO to substitute chlorine to both prevent biofilm and control Salmonella cells in chicken internal organs was verified.

Key Words: Salmonella Biofilm, Essential Oil, Microbial Attachment, Drinking Water, Polyvinyl chloride

M61 A non-invasive approach for predicting 4-day percent breast yield in broilers Alex Gilley*GS, Sara Orlowski, Adrianna Rogers, Judith England, Nicholas Anthony University of Arkansas, Fayetteville, AR, USA

Abstract Traditional selection for breast yield in broilers occurs relatively late on the growth curve and during a time of hypertrophic muscle growth. Recently we have developed three research lines, including a random brood control (RBC), H4D, and L4D selected for high and low percent breast yield at 4 days of age. Selecting for 4-day percent breast yield shifts the focus from hypertrophic muscle growth to hyperplasic muscle growth. Recent work has shown the selection for 4-day percent breast yield to result in increased percent breast yield as early as E19 (19 days of incubation) and continuing to d42. The current method for determining percent breast yield is highly invasive and requires the bird to be sacrificed to obtain parts weight. Sacrificing the bird for data collection forces sib selection to occur and while sib selection is effective, direct selection would result in more rapid genetic progress and higher practicality for industry use. Therefore, the objective of this study was to determine if multiple and logistic regression could be used to predict 4-day percent breast yield, and categorize birds with high and low percent breast yield through the use of external and non-invasive body measurements. The explanatory variables include body weight, length, and girth, breast width and length, and body composition measurements collected from a DEXA (Dual Energy X-ray Absorptiometry) machine. The data set included 15 measurements taken from all lines at 4 days of age, with 266 birds used for training the models and 67 birds used for validation. The prediction ability of the multiple regression models was determined by evaluating R-Square, Adjusted R-Square, and MSE, while the evaluation of logistic regression included AIC, BIC, AUC, and misclassification rate. Adjusted R-Square values ranged from 0.76 to 0.82 implying that external body measurements along with body composition measurements via the DEXA, offer an accurate and non-invasive alternative for determining 4-day percent breast yield.

Key Words: broilers, breast, yield, regression, DEXA

M62 Variation in water usage between different drinker lines in a broiler house. Cody Brown*GS, Michael Czarick, Brian Fairchild University of Georgia, Athens, GA, USA

Water and feed consumption are correlated, making water intake an effective method of monitoring feed consumed. However, there is a deficiency of research on drinking habits in field conditions. The objective of the current study was to monitor water usage of all drinker lines within a commercial broiler house. The 40×500’ broiler house had eight enclosed drinker lines with four in the front and back halves (full house brooded). Ultrapro flow water meters were attached to each individual drinker line and water usage was recorded every minute with a data logging system starting at day 7 through a 39 day flock. Drinker line height and water pressure were recorded and efforts were made to minimize variation between them throughout the flock. Water usage patterns of the 4 drinker lines were compared in both the front and back halves of the house.

There was no significant difference in water usage between the front and back halves of the house. Water usage tended to be symmetrical across the width of the house. Initially, day 7-10 approximately, the birds tended to use more water from the two outside drinker lines than the inside drinker lines. Between 14-34 days of age, the birds used more water from the inside drinker lines than the outside drinker lines. Water usage between the lines was similar the last six days of the flock. Chicks were unloaded between the wall and the feed line when they were placed in the house which may explain the slightly higher water consumption during the first period. As the chicks spread out using the larger area in the middle of the house they began to use the inside drinkers more. There were some disruptions in the pattern that appeared to be due to feeder and drinker line management.

Key Words: Drinker utilization, Water consumption, Drinking patterns

M63 Comprehensive study of the effects of egg storage, floor and nest eggs, and broiler breeder flock age on hatchability and 14-day livability, feed conversion ratio, and body weight in broiler chicks. Emily Lhamon*GS1, D. E. Yoho2, L. Butler3, R. K. Bramwell2 1University of Arkansas, Fayetteville, AR, USA; 2Center of Excellence for Poultry Science, University of Arkansas, Fayetteville, AR, USA; 3Cobb-Vantress, Inc., Siloam Springs, AR, USA

The objective of this study was to determine the effects of egg treatment and handling on the viability and efficiency of Cobb broilers. Three ex-
Experimental trials were set up. Egg storage duration, floor versus nest eggs, and broiler breeder flock age. In the egg storage trial, eggs were collected from the same flock and stored for four, eight, twelve, or sixteen days. In the floor versus nest egg trial, eggs were collected from a flock notorious for laying outside of the nest box and eggs from a sister flock that laid inside the nest box. The broiler breeder flock age trial, hatching eggs were obtained from four breeder flocks aged 27, 37, 46, and 56 weeks. Each trial was completed at the University of Arkansas Research Farm. Eggs were procured from Cobb-Vantress, Inc., set, and hatched at the University Hatchery. Birds were grown out in replicates by treatment for 14 days according to industry standards and provided feed and water ad libitum. An initial trial and a replicate were performed for each experiment. Data was collected and analyzed at weeks one and two for: feed conversion; average bird weight (including placement weight); mortality (livability); percent hatch; percent hatch of fertile; and percent fertility. For the egg storage Trial 1, significant differences were found in percent hatch ($P < 0.0009$), percent hatch of fertile ($P < 0.0014$), and percent fertility ($P < 0.0288$). Trial 2 found significant differences in feed conversion ratio for weeks one and two ($P < 0.0002$ and $P < 0.0236$, respectively), average bird weight at placement ($P < 0.0002$), percent hatch ($P < 0.0001$), percent hatch of fertile ($P < 0.0001$), and percent fertility ($P < 0.0209$). No statistical differences were found for any of the criteria in either trial of the floor versus nest egg treatments. Research for the flock age trials is currently ongoing. We can conclude the storage of eggs has more impact on hatchability than on growth performance. However, wherever the egg was laid (floor or nest), has no significant effect.

Key Words: egg storage, floor and nest eggs, flock age, broiler performance, hatchability

M64 Effect and Distribution of Probiotic Spray on Microbial Properties of Hatcher Cabinets Lucas Graham1,2, Lucas Bielke3, Kyle Teague1, Jennifer Bielke1, Ross Wolfenden3, Lisa Bielke1, 1University of Arkansas, Fayetteville, AR, USA; 2Pacific Vet Group-USA, Fayetteville, AR, USA

Control of microbial bloom in hatcher cabinets may have an effect on GIT colonization in neonatal chicks, and may be an optimal time for administration of beneficial bacteria. Two experiments testing the effect of a selected probiotic administration in commercial hatch cabinets on microbial recovery were conducted. In Exp 1, combinations of either dry (D) or aqueous suspension (W) of Bacillus spores (B) plus lactic acid bacteria (LAB; W; LAB) were sprayed at transfer only, or 3 time points (transfer, 20% hatch, 50% hatch). Combinations included a single spray of D BS + LAB (W;Trt 1), a single spray of W spores + LAB (Trt 2), or 3 applications of W spores + LAB (Trt 3). Each (six) Tryptic soy agar (TSA), Rogosa agar (RA), and MacConkey’s agar (MCA) plates were distributed in cabinets for 5 min before spray treatment at transfer, ~50% pip, ~20% hatch, ~50% hatch, and ~75% hatch. At ~20% pip and ~20% hatch Enterobacteriaceae recovery on MCA was suppressed ($P < 0.05$) in all treatments at all time points. At ~50% hatch, Trt 1 had 1.0 log$_{10}$ lower CFU on MCA compared to controls, and Trt 3 resulted in increased LAB CFU on RA and TSA ($P < 0.05$). By ~75% hatch, MCA CFU were the same for all treatments, but Trt 1 increased Bacillus recovery and Trt 3 increased LAB CFU on RA. Trt 2 did not result in differences at any time points, suggesting that multiple applications of probiotic are best for survival of LAB in hatch cabinets, and spray of D BS is optimal for persistence. Thus, for Exp 2, commercial hatch cabinets were sprayed 3X (transfer, 20% and 50% hatch) with D BS and W LAB; control cabinets received a formaldehyde spray. CFU recovery on all media was higher in treated cabinets ($P < 0.05$) at 20% hatch, RA incidence of 6% in control vs. 70% in treated cabinets. Throughout the test period, diminution of differences between control and treated recovery of Enterobacteriaceae on MCA became apparent as formaldehyde control cabinets increased CFUs. Bacillus recovery remained high throughout the time period. These results suggest that probiotic spray into hatch cabinets may decrease bloom of Enterobacteriaceae and increase levels of Bacillus and LAB, which may increase colonization of GIT with beneficial microflora.

Key Words: probiotics, hatcher cabinets, Bacillus, lactic acid bacteria

M65 Effect of a lactic acid bacteria-based probiotic in ovo on hatchability and recovery of bacteria in broiler chicks Kyle Teague1,2, Lucas Graham1, Lisa Bielke3, Ross Wolfenden3, Billy Hargis1, Guillermo Tellez1, University of Arkansas, Fayetteville, AR, USA; 2Pacific Vet Group-USA, Fayetteville, AR, USA

Early colonization of beneficial bacteria in chicks may improve GIT development and performance parameters such as early mortality and feed conversion ratios and in ovo injection has been suggested as a potential efficient mechanism of administration. Presently, we evaluated the effects of either two co-administered egg shell-originate MRS-recoverable bacteria (MRSR; Exp 1) or a single MRSR or FloraMax® (FM; Exp 2) on hatchability and GIT recovery of selected bacterial groups on d1 post-hatch. In Exp 1, d18 embryos were injected into the amnion with either saline (CON) or 2x10^9 CFU of MRSR. After hatch, intestinal samples were collected for microbial recovery on MRS and tryptic soy agar (TSA). Hatchability was not affected by in ovo treatment (93% CON vs. 94% MRSR). Foregut (duodenum-Meckel’s diverticulum) MRSR recovery was 6.05 ± 0.32 Log$_{10}$ CFU, which was higher ($P < 0.05$) than CON at 3.25 ± 0.63, and followed a similar trend on TSA. In the hindgut (Meckel’s diverticulum – cecum), MRSR treatment resulted in 8.71 ± 0.16 Log$_{10}$ CFU vs. 5.57 ± 1.01 Log$_{10}$ MRSR-recoverable in CON ($P < 0.05$), and also followed a similar trend on TSA. The analogous results on MRS and TSA may reflect growth of administered bacteria capable of growing on both types of media. In Exp 2, in ovo injection of MRSR (8x10^5 CFU), FM (6x10^5 CFU), or saline on hatchability and GIT colonization were evaluated. FM had the highest hatchability at 98%, followed by saline at 96%, and MRSR at 91%. FM and MRSR both increased MRSR recoverable bacteria over CON ($P < 0.05$), while only MRSR increased TSA growth in the foregut. No differences in microbial colonization were noted on MRS and TSA in the hindgut. Enterobacteriaceae were not suppressed on MacConkey’s agar in either the foregut or hindgut by either in ovo treatment (evaluated Exp 2 only), possibly due to low administration levels of probiotic, suggesting that higher doses are necessary for GIT colonization effects and may be related to survivability of bacteria during final stages of embryogenesis. Taken together, these studies show that appropriate probiotics can be administered in ovo without significant effects on hatchability and may promote early enteric colonization of beneficial microflora throughout the GIT.

Key Words: in ovo, probiotics, hatchability, lactic acid bacteria

Metabolism & Nutrition I

M66 Growth and carcass characteristics of broilers fed varying levels of processed cassava waste meal Stanley Omoikjojo1, Dick Obasoyo2, Ambrose Alli University, Ekpoma, Nigeria

An eight week feeding trial was conducted to assess the replacement value of processed cassava waste meal (PCWM) on the growth performance and carcass characteristics of one hundred and forty four day-old Anak 2000 broiler chickens. Thirty six chicks each were randomly selected per treatment group based on their average initial weights and was assigned to each of the four treatment diets (1, 2, 3 and 4) in a complete randomized design (CRD). Each treatment group contained three replicates of twelve chicks. The dietary treatments significantly ($P < 0.05$) affected the performance and carcass traits of the broiler chickens at both starter and finisher phases. Results on the growth performance of broiler chickens showed...
that only the average live weight was significantly (P<0.05) increased with a corresponding increase in the inclusion levels of (CWM) up to 45% at the starter phase, whereas, at the finisher phase, all the performance indices except feed: gain ratio were significantly (P<0.05) influenced. Live-weight, defeathered and eviscerated weights were significantly (P<0.05) influenced by the test diets. The results suggest that processed cassava waste meal can be included in broiler diets up to 45% without any adverse effect on the growth performance and carcass quality of the birds.

Key Words: Broilers, Cassava waste meal, Growth, Carcass yield

M67 Nitrogen corrected apparent metabolizable energy and lipid digestibility of distillers corn oil sources varying in free fatty acid content fed to growing broilers William Dozier1, Kurt Perryman1, Brian Kerr1 Auburn University, Auburn, AL, USA; 2USDA-Agricultural Research Service, Ames, IA, USA

Ethanol manufacturers are extracting approximately 2 to 6% distillers corn oil (DCO) from distillers dried grains with solubles as an additional source of revenue. However, these oil sources can have variable concentrations of free fatty acids (FFA), which may limit their application as a suitable dietary energy source for broilers. Therefore, the objective of this experiment was to determine the AME, and lipid digestibility of DCO samples with different concentrations of FFA. Eight hundred sixty-four Ross × Ross 708 male broilers were placed in 96 battery cages and fed a practical starter diet until 19 d of age. Broilers then received 1 of 9 dietary treatments consisting of 94% corn-soybean meal basal diet (3,025 kcal/kg; 20% CP) and 6% test oil source. Oil sources included refined corn oil, 95% FFA product produced from DCO feedstock, 5, 10, and 15% FFA DCO, poultry oil, animal-vegetable oil blend, and soybean oil. A dietary treatment of 94% basal diet and 6% dextrose was used to determine the AME, of the basal diet required to calculate the AME, of each test oil source. Following a 7 d dietary adaptation phase, a 48 h balance assay was conducted to determine lipid digestibility and AME, of each oil source. The 95% FFA product produced from DCO had lower (P < 0.05) AME, (6,276 kcal/kg) than all other oil sources (7,930 kcal/kg). Lipid digestibility was lowest (P < 0.001) for 95% DCO (83.0%) and highest (P < 0.001) for the refined corn oil (91.6%) and soybean oil (91.4%). No linear or lack of fit effects (P > 0.05) were observed for any response variable between the 5, 10, and 15% FFA DCO sources. These data demonstrated that DCO sources with less than 15% FFA content are suitable as an energy source for growing broilers, whereas the 95% FFA product had poor AME, as a result of reduced lipid digestibility.

Key Words: distillers corn oil, free fatty acid, apparent metabolizable energy, broiler

M68 Efficacy of β-mannanase on broiler growth performance and energy utilization in the presence of increasing dietary galactomannan Rocky Latham1, Brandon Carter2, Jake Pieniazek1, Jason T. Lee1 Texas A&M University, College Station, TX, USA; 2Elanco Animal Health, Greenfield, IN, USA

An experiment was conducted to investigate the impact of β-mannanase inclusion on growth performance, viscosity, and energy utilization in broilers fed diets varying in galactomannan (GM) concentrations. A 3 (GM concentration) x 3 (β-mannanase inclusion) factorial randomized complete block design included 12 replicates of 29 male broilers per replicate for a 42 day experiment. Efforts were made to reduce the amount of soybean meal, and thus GM, in the basal diet. Guar gum was included in the diet at 0, 0.15, or 0.30%. Beta-mannanase was included at 0, 200, or 400 g/ton. Broilers were fed a starter (d 0-14), grower (d 15-28), and finisher (d 29-42). Growth performance was monitored and ileal contents collected on d 14, 28, and 42 to determine ileal digestible energy (IDE) and intestinal viscosity. Increasing levels of GM negatively (P<0.05) influenced body weight (BW) following the starter and grower periods and increased mortality corrected feed conversion ratio (FCR) throughout the study. This reduction in growth performance was related to increases (P<0.05) in intestinal viscosity and decreases (P<0.05) in IDE associated with GM inclusion. Inclusion of β-mannanase in GM containing diets improved average male BW to levels similar to diets without GM. Improvements in FCR were also observed with β-mannanase inclusion, however, only in diets containing supplemental GM. Increases (P<0.05) were observed in IDE with β-mannanase inclusion. Beta-mannanase inclusion resulted in multiple observed significant interactions in growth performance, intestinal viscosity, and IDE. In conclusion, β-mannanase improved IDE, reduced intestinal viscosity, and improved growth performance. The observed benefit in this study was dependent upon dietary GM inclusion rate.

Key Words: Broiler Performance, Ileal Digestible Energy, Intestinal Viscosity, Beta-mannanase, Galactomannan

M69 Effect of chronic cold stress on hypothalamic neuropeptide gene expression in young chicks Phuong Nguyen1, Elisabeth Greene1, Geraldine Hufi2, Sonia Tsai Hsiu-Chuan2, Peter Ishola1, Annie Donoghue2, Sami Dridi1 University of Arkansas, Fayetteville, AR, USA; 2USDA, Fayetteville, AR, USA

Extremes temperature has significant impact on the growth performance of poultry, especially young birds by causing stress. Studies showed that acute and chronic cold stresses affect the chickens in different aspects such as physiology, metabolism, production, health and welfare. This study aimed to assess the effect of chronic cold exposure on hypothalamic neuropeptide gene expression, circulating metabolites, body temperature and growth performance in young chicks.

In the experiment, 80 male broiler chicks (one day old) were randomly assigned in four floor pens (20 birds/pen), which are located in two different temperature rooms (2 pens/room). The temperature of control room was 32°C, while the cold room temperature started at 26.7°C and reduced gradually every day to 20°C at the seventh day of the experiment. On the first day of the study, average body temperature (bt) of cold-exposed chicks was remarkably higher than the control group (P<0.05), and then it was lower than the body temperature of control birds from day 2 to day 7. Cold exposure reduced feed intake and paradoxically increased body weight, resulting in 19 points increase in FCR compared to the control group. Moreover, cholesterol blood level in chronic cold stress chicks was significantly higher than in the normal condition chicks (P<0.05). Chronic cold exposure significantly down regulated the hypothalamic expression of NPY, CART and adiponectin receptor 1 and 2 compared to the control chicks.

In conclusion, cold exposure of chicks during first week of age affects hypothalamic neuropeptide gene expression and growth performance.

Key Words: cold stress, hypothalamic neuropeptide, gene expression, chick

M70 Effect of heat and enzymes on nitrogen-corrected apparent metabolizable energy (AMEn) of mechanically-pressed soybean meal (MPS) and the use of MPS on production performance of broiler chickens Banuka Rajapakse1, Derek Anderson Department of Plant and Animal Sciences, Faculty of Agriculture, Dalhousie University, Truro, NS, Canada

Two trials were conducted to determine the effect of heat and enzymes on AMEn of MPS and to evaluate the effect of graded levels of MPS on production performance of broilers. The cage trial was a completely randomized design (510 chicks) with 2 (7 or 11% oil level) x 2 (heat or no-heat) x 4 (carbohydrate, protease, lipase or no-enzyme (NE)). The AMEn values determined using excreta and diets, were used to formulate starter, grower and finisher diets for the floor trial with 0.05% Superzyme®. The floor trial was as a randomized complete block design with 2 (heated 9 or 13% oil meal) x 4 (0, 5, 10 or 15% inclusion). A total of 2560 day-old broiler chicks were placed within 64 floor pens. In the cage trial, carbo-
Supplementation of LMH cells to oxidative stress using several doses of H2O2 heat stress has a direct effect on hepatic orexin transcription. Exposure in vitro (mRNA and protein) of orexin and its receptors (ORXR1 and 2) in quail acute heat exposure significantly down regulated the hepatic expression and LMH cell line using PCR and Western blot analysis, respectively. Receptors are expressed (mRNA and protein) in chicken and quail liver unknown. In the present study, we found that prepro-orexin and its related receptors in avian liver associated receptors in avian liver expression of RXRα, RXRγ, TLR-4, IL-1β, IL-2, IL-10, and IL-12 gene expression amount may be beneficial. The LPS increased (>0.01) the liver:BW ratio at 3 h post-injection and supplemental choline and betaine above recommended amounts may be beneficial.

**Key Words:** Broilers, Heat-Stress, Environment, Choline, Betaine

M73 Immunomodulatory effects of 25-hydroxycholecalciferol treatment in a chicken macrophage and T-cell line Antrinus Morris*GS, Ramesh Selvaraj The Ohio State University, Wooster, OH, USA

Bio synthesis of 1,25-dihydroxycholecalciferol (1,25(OH)2D), is mediated by the enzyme 1α-hydroxylase using 25-hydroxycholecalciferol (25(OH)D) as a substrate. This experiment investigated the effect of 25(OH)D in vitro treatment on a chicken macrophage cell line (HD11 cells) stimulated with coccidial antigens and or chicken T-cell line (ConA-B1-VICK) stimulated with Con A. HD11 cells were grown in a medium supplemented with either 200 nM of 25(OH)D or 1,25(OH)D and stimulated with coccidial antigen for 12 h. ConA-B1-VICK cells were grown in a medium supplemented with either 200 nM of 25(OH)D or supernatant from HD11 cells treated with 25(OH)D and stimulated with LPS or with 100 nM of 1,25(OH)D and stimulated with Con A for 12 h. At 12 h post-coccidial antigen stimulation, HD11 cells treated with 200 nM of 1,25(OH)D had increased nitrite production (<0.01) compared to HD11 cells treated with 0 or 200 nM of 25(OH)D that had amounts below the limits of quantification. Post-coccidial antigen stimulation, HD11 cells treated with 200 nM of 25(OH)D or 1,25(OH)D had 28 and 14-fold less (P<0.01) 1α-hydroxylase mRNA amounts compared to the control group treated with 0 nM of 25(OH)D or 1,25(OH)D. Treatment of HD11 cells with 25(OH)D decreased IL-10 mRNA by 1.7-fold, but 1,25(OH)D treatment increased the amounts of IL-10 mRNA by 2.7-fold (P < 0.01) compared to the control group. ConA-B1-VICK cells stimulated with Con-A for 120 h, had 1.7 to 4.4-fold less (P<0.01) 1α-hydroxylase mRNA amounts across all treatment groups compared to the group treated with 25(OH)D. ConA-B1-VICK cells treated with 100 nM of 1,25(OH)D, or supernatants from HD11 cells treated with 25(OH)D and stimulated with LPS, there was 1.3 to 1.4-fold less (P<0.01) IFN-γ mRNA. In conclusion, both 25(OH) and 1,25(OH)D could suppress the inflammatory gene IL-1β mRNA in HD11 cells post-coccidial antigen stimulation, but Con-A stimulated ConA-B1-VICK cells required 1,25(OH)D to suppress the IFN-γ mRNA.

**Key Words:** 25-hydroxycholecalciferol, Chicken macrophages, Chicken T-cells, Interleukin-1beta, IFN-gamma

M74 Lutein has anti-inflammatory effect in LPS-challenged broiler chickens Mariana Lemos de MoraesGS*GS1, Elizabeth Santin2, Andréa Machado Leal Ribeiro1, Kirk Charles Klasing3 University of Rio Grande do Sul, Porto Alegre, Brazil; 1University of Paraná, Curitiba, Brazil; 2University of California, Davis, Davis, CA, USA

We investigated the effect of lutein on the inflammatory response of broiler chickens subjected to an immune challenge using Salmonella LPS. Cobb chicks (360; 1 - 22 days of age) were allotted in a completely randomized design with or without dietary supplementation of lutein at 50 mg/kg (ORO GLO, Kemin Industries, Inc., USA). At day 20, half of the birds were injected with LPS. Samples of liver, spleen and duodenum were collected at 3 and 16 h post-LPS challenge for qPCR analysis of Rfax, RXRγ, TLR-4, IL-1β, IL-2, IL-10, and IL-12 gene expression quantification. Lutein promoted a positive effect on immunomodulation. While LPS upregulated IL-1β (P < 0.05) and IL-12 (P ≤ 0.09) mRNA expression, lutein decreased (P < 0.07) these pro-inflammatory cytokines in the liver. Lutein also downregulated splenic TLR-4 mRNA (P ≤ 0.09) and plasmatic nitric oxide (P < 0.05) 16 hours after the LPS challenge. The LPS increased (P < 0.01) the liver:BW ratio at 3 h post-injection and decreased (P < 0.01) the BWG at 3, 16 and 40 h, this response was not affected by dietary treatment. Our findings suggest that lutein has an anti-inflammatory effect in broiler chickens.
M75 Effect of breeder age on yolk fatty acid composition and yolk absorption during embryonic development Nirun Boonsinchai1,2*, Justina Caldas1, Phiphab Sodse2, Karen Vignale2, Monticha Putsakum3, Ethan Holt1, Andrew Magnuson1, Jinrong Wang1, Judith England1, Craig Coon1 1University of Arkansas, Fayetteville, AR, USA; 2Nutreco; Trouw Nutrition USA, Highland, IL, USA; 3Sukhothai Thammathirat Open University, Nonthaburi, Thailand

The objectives of the present study were to determine the effect of breeder hen age on yolk absorption and fatty acid profiles in yolk at different stages of development (fresh yolk, E18, and at hatch). Hatching eggs (n=125) were obtained from breeder hens (Cobb 500) in the same flock at 28, 35, and 49wk of age. Egg weights were selected with a range of 5g difference for each age: 53-57g, 58-62g, and 66-70g for 28, 35, and 49wk hens, respectively). Twenty five eggs (or hatched chicks) were used for each sampling, and 6 yolks were saved for fatty acid determination. Fatty acid compositions in blood plasma were also determined (n=6). As expected, yolk weights in all stages, and yolk free body weight at hatch showed the same patterns as their original egg weights, which significantly increased by age (P<0.001). Yolk absorption from E1 to E18 significantly increased (P<0.05) by age (23.52, 25.02, and 28.04% for 28, 35, and 49wk, respectively). However, rate of yolk absorption from E18 to hatch slowed down by age, resulting in the lowest (P<0.001) total yolk absorption in embryo from 49wk hens, as compared to those from 28 and 35wk hens (65.14 vs. 75.90 and 75.48%, respectively). Fatty acid concentrations (mg/g dry yolk) decreased throughout embryonic development period (P<0.001). Fatty acid concentrations in fresh yolk increased from 28wk to 35wk and reduced again at 49wk of age (P<0.001), which is in agreement with fatty acid contents in plasma. In addition, concentrations of fatty acids were higher in yolk from older hens at E18 and at hatch (P<0.001). Although percent of total yolk absorption was lower in 49wk-old hens, the total amounts of fatty acids being absorbed were higher (P<0.001) in older hens (4.87, 6.11, and 6.53g for 28, 35, and 49wk, respectively). The higher amount of residual yolk at hatch together with its higher concentrations of fatty acid contents in plasma hatched from older hens may result in the better growth rate as has been documented. In conclusion, the rate of yolk absorption was higher in embryo from younger hens, but the concentration of yolk fatty acids and the quantitative size of available yolk for embryo was larger from older breeders thus providing more fat for embryo gain and livability.

Key Words: yolk absorption, fatty acid profiles, breeder age, embryonic development

M76 The effects of incubation conditions and trace mineral source in broiler breeder and broiler progeny diets on the live performance of Ross 708 male breeders. Colin Caraway1*, Stacey Homem2, Greg Page1, Wilbert Litjens1, John Brake1 1North Carolina State University, Raleigh, NC, USA; 2Nutreco; Trouw Nutrition USA, Highland, IL, USA; 3Nutreco; Canada Agresearch, Guelph, ON, Canada; 4Nutreco; Seklo Feed Additives, Tilburg, Netherlands

The effects of trace mineral (Zn, Mn, Cu, and Se) source and incubation humidity on feed intake (FI), BW, and feed conversion ratio (FCR) of male breeders reared to 42 d were evaluated in a 2x3 factorial arranged experiment with 2 incubation humidity (RH) profiles and 3 trace mineral (TM) sources in both 40-wk-old broiler breeder and progeny diets. Ross 708 broiler breeder diets were supplemented with TM composed of either inorganic (INO), organic (ORG), or a combination of organic and inorganic (MIX) trace minerals from 21 wk of age. Eggs were divided into 2 groups for incubation at HIGH and LOW RH of 70% and 53% RH, respectively, from E0 to E10 but similarly thereafter. The RH profiles were selected to represent the range of industry practice. Chicks were randomly assigned to 72 floor pens, with 12 birds per pen. Breeders were fed a starter, grower, and finisher diet containing the same TM source as their respective parents. Incubation RH affected (P<0.05) BW of chicks at placement, with HIGH RH chicks exhibiting the greatest BW. At 42 d, TM source increased BW stepwise with ORG < INO < MIX (P<0.01; 3134 g < 3188 g < 3252 g). The MIX breeders consumed the most (P<0.05) feed through 42 d with MIX > INO > ORG (5243 g > 5153 g > 5077 g). Additionally, HIGH incubation RH decreased (P<0.01) FI of INO breeders through 42 d, which led to a significant decrease (P<0.05) in BW through 28 d. In contrast, there were no significant FI or BW differences due to incubation RH in MIX or ORG breeders. At 42 d, ORG breeders incubated at LOW RH exhibited an improved (P<0.05) FCR when compared to all other treatment interactions (1.59 vs 1.61/1.62).

Key Words: trace minerals, organic minerals, incubation humidity, broilers, broiler breeders

M77 Effect of Escalating Level of Guar Meal Supplemented with or without β-Mannanases on Productive Performance of Broilers Munawar Hussain1* University of animal and veterinary and Animal Sciences Lahore, Okara, Pakistan

Experiment was conducted to evaluate the effect of escalating level of guar meal supplemented with or without β-mannanases on productive performance of broilers. Seven hundred and fifty day old male broiler chicks were used in 2x3 factorial arrangement under completely randomized design. Birds were weighed and randomly divided into six groups of five replicates (twenty five, birds/replicate) each. Six iso-nitrogenous and isocaloric broiler diets were formulated using two levels of guar meal (GM), i.e., 3 and 6% (GM3 and GM6, respectively) and three types of enzyme i.e., 0, Fermented product of Bacillus Subtisits WL-1 and other one is fermented product of Bacillus Subtisits WL-1, Broiler

Key Words: Guar Meal, β-Mannanase, Bacillus Lentus, Bacillus Subtisits WL-1, Broiler
M78 Phosphorus and phytase application to broiler breeder grower and layer diets affect egg weight and body weight during production
Yun Mei Lin1, John Brake1, Peter Plunstead2, North Carolina State University, Raleigh, NC, USA; 2Department of Animal and Wildlife Sciences, University of Pretoria, SA Dansico Animal Nutrition, DuPont Industrial Biosciences. Marlborough, UK, Pretoria, South Africa
Malborough, UK, South Africa

The effects on egg weight, egg components, and broiler breeder female BW of a 6-phytase derived from Buitiaecula spp. expressed in Trichoderma reesei in corn-soy-wheat bran grower (7-26 wk of age) and layer (27-64 wk of age) diets that varied in available phosphorus (AvP) were determined. Dietary treatments for the grower and layer diets, respectively, were: (A) 0.45% AvP and 0.42% AvP, (B) 0.3% AvP and 0.15 AvP, (C) 0.3% AvP and 0.15 AvP, each with 250 FTU/kg phytase, (D) 0.3% AvP and 0.15 AvP, each with 500 FTU/kg phytase. Dietary Ca was provided on a 2:1 basis with AvP in grower diets while dietary Ca was 2.7% in the layer diets as adjusted for phytase contribution. Weight of all eggs laid on a single day was determined weekly from 29 to 36 wk of age, and at 41, 53, 64, and 65 wk of age. Shell thickness, and percentage yolk, albumen, and shell were determined at 31, 41, 50, and 60 wk of age. Egg weight was reduced (p<0.05) by the (B) 0.3% AvP grower 0.15 AvP layer treatment relative to the (A) 0.45% AvP grower 0.42% AvP layer treatment while phytase in C and D treatments restored (p<0.05) egg weight at 30, 34, 41, 64, and 65 wk of age. Cumulative egg weight was 63.2, 62.0, 63.2, and 63.1 for treatments A, B, C, and D, respectively. This demonstrated that AvP and phytase significantly influenced egg weight. Female BW did not differ between treatments.

Key Words: broiler breeder, phytase, egg weight, available phosphorous, albumen

M79 Impact of variable corn nutrient content, AME prediction, and xylanase inclusion on broiler growth performance Rocky Latham1, Helen V. Masey O’Neill2, Tara York1, Cody Flores1, Jason T. Lee1, Texas A&M University, College Station, TX, USA; 2AB Vista, Marlborough, United Kingdom

An experiment was conducted to investigate the effect of corn nutrient value associated with geographical location (Iowa, Minnesota, and Texas), xylanase inclusion, and formulation based on an AME prediction equation on broiler performance. A 3 (corn source) x 2 (NIAM prediction vs NRC fixed value) x 2 (xylanase inclusion, 0 vs 16,000 BXU/kg) factorial randomized complete block designed study included 10 replicates of 20 male broilers per replicate for a 42 day experiment. In the fixed corn diets, each dietary treatment contained the same concentration of each corn source while the AME prediction treatments were formulated based on corn NIR nutrient analysis and AME prediction equation (ABVista, Marlborough, UK). The dietary program consisted of three dietary phases; starter (d 1-18), grower (d 19-33), and finisher (d 34-41) with growth performance monitored at feed changes. Xylanase increased (p<0.05) starter feed consumption and d 18 BW (2.1%), and an increase in BW (4.6%) was observed using the predicted AME values. Corn source continued to impact broiler performance throughout the remainder of the trial as Texas consistently outperformed (p<0.05) IA with increased BW and reduced mortality corrected FCR. Dietary adjustment with AME predicted values for each corn source consistently improved (p<0.05) growth performance. The TX corn source had the highest average BW with a 2.9% increase (p<0.05) over the IA corn source. Early FCR was improved (p<0.05) with the predicted AME value diet fed broilers, decreasing FCR by 3%. Multiple significant interactions were observed between the corn source and the adjustment method. For example with d42 FCR, making the adjustment had an impact of 9 or ten points for MN or IA respectively but only 2 for TX. This experiment demonstrates the impact of variable corn nutrient content and the potential improvement when using NIR technology for ingredient nutrient specifications.

Key Words: broiler performance, xylanase, AME, Corn Source

M80 Liquid application method (LAM), feed form (FF) and feed pan location effects on D28-56 Ross x Ross 708 male broiler performance and processing characteristics Robert B Sellers1, Chris McDaniel1, Joseph S. Moritz1, Kelley G. S. Wamsley1, Mississippi State University, Starkville, MS, USA; 2West Virginia University, Morgantown, WV, USA

Previous research manufactured diets to quantify the effects of FF (75 or 55% pellets) and LAM (Mixer or Post-Pellet) addition of fat and liquid phytase) on feed quality and phytase segregation as diets were augmented throughout a commercial poultry house feed system. Six feed pan sampling locations were identified throughout the line at 0, 15, 30, 32, 44, and 58m. Overall, percent fines increased as feed was augmented throughout the commercial feed line, with the beginning and end of the feed line exhibiting the largest fluctuations. Phytase activity varied based on FF and LAM. For diets manufactured utilizing Post-Pellet LAM, areas with increased fines also had increased analyzed phytase. Diets utilized in this previous research were collected from Locations 1 (0-30 m) and 2 (32-58 m) for use in the current study to create a 2 FF (55 or 75% pellets) x LAM (Mixer or Post-Pellet) x 2 Location (0-30 or 32-58 m) factorial arrangement to determine effects on D28-56 broiler performance. On D0, Ross x Ross 708 male broilers were placed in floor pens and fed common diets until D28. On D28, pen weights were equalized (density of 0.09 m3/bird) and each of the eight treatments were randomly assigned to twelve pens (96 total). The experimental period was from D28-56; on D56, birds were weighed individually to determine bird weight uniformity, and 4 birds/pen were selected for processing. A FF x LAM x Location interaction established that birds fed 75% pellet diets yielded higher D28-42 BW gain as compared to all treatment combinations except for birds fed 55% pellet diets manufactured utilizing Mixer LAM for Location 2 (p=0.028). Birds fed 75% pellet diets had improved D28-56 BW gain, as well as increased D57 carcass and total breast weight, as compared to birds 55% pellet diets (p=0.015, 0.028, and 0.048, respectively). A 3-way interaction for D56 bird uniformity revealed that for Post-Pellet LAM, birds fed 75% pellets had improved uniformity for Location 1 as compared to both birds fed 75% pellets for Location 2 and birds fed 55% pellets for Location 1 (p=0.037). Overall, feed quality at the point of consumption affected both performance and yield; however with Post-Pellet LAM, weight uniformity of birds was affected by the distance feed traveled within a broiler house.

Key Words: broiler performance, bird uniformity, nutrient segregation, phytase, feed manufacture

M81 Effect of enzyme complex in pellet or mash feeds with different nutritional levels on the performance of broilers from 1 to 21 days old Bruno Carvalho1, Melissa Hannas, Luiz Fernando Albino, Victor Barros, Bruna Kreuz, Horacio Santiago Rostagno Federal University of Viçosa, Viçosa, Brazil

The objective of this research was to evaluate the effect of an enzyme complex, in pelleted or mashed feeds with two nutritional levels, on broilers performance. A total of 1920 Cobb male broilers were randomly assigned into 8 treatments (a factorial 2) with 10 replicates of 24 birds each, from 1 to 21 days old. The treatments consisted of two diets with nutritional levels (NL) differing in metabolizable energy, digestible amino acids and available phosphorus (recommended for the age or reduced according to the nutritional matrix of the enzyme complex) in 2 feeds forms (FF), with or without the enzyme complex (EC). Birds and feed were weighed at day 1 and 21 to determine the weight gain (WG), feed intake (FI) and feed conversion (FC). Data were subjected to ANOVA and compared by SNK test (p<0.05).

Better FC were observed in diets with recommended NL or with EC. There were three-way interaction for WG and FI (Table 1). Pelletizing is an important tool to increase WG in broilers. However, a higher WG is
also accompanied by higher FI. The EC is more efficient in mashed feeds, with the best performance parameters observed in reduced NL. The reduction in NL cause loss in animal performance and can be alleviated by the addition of the EC and/or pelleting.

Table 1: Triple Interaction between diet form (DF), nutrient levels (NL), and enzyme complex (EC) on weight gain (WG) and feed intake (FI) of broilers from 1 to 21 days old.

<table>
<thead>
<tr>
<th>Mashed</th>
<th>Pelleted</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>Recommended</td>
<td>Reduced</td>
</tr>
<tr>
<td>-</td>
<td>743aAx</td>
<td>661bBx</td>
</tr>
<tr>
<td>+</td>
<td>765aAa</td>
<td>741aAx</td>
</tr>
<tr>
<td>FI</td>
<td>1072aAx</td>
<td>1009aAx</td>
</tr>
<tr>
<td>+</td>
<td>1048aAx</td>
<td>1066aAx</td>
</tr>
</tbody>
</table>

M82 Effects of varying coccidiosis control and inclusions of algal beta-1,3-glucan (ABG) on D0-59 Ross x Ross 708 male broiler performance and processing

Cameron Cardenas1, Wei Zhai1, Robert Levine2, Kelley Wamsley1 Mississippi State University, Starkville, MS, USA; 2Algal Scientific, Northville, MI, USA

The objective of the current study was to determine the effects of inclusion of algal beta-1,3-glucan (ABG) in diets using an ionophore regimen (IR) or a live coccidiosis vaccine (LCV), with and without antibiotics (AB), on D0-59 male Ross x Ross 708 performance. Diets were of commercial formulation, containing corn, soybean meal, as well as a meat and bone meal blend. Two ABG products were tested, with the only difference being that one contained 2% zinc as a zinc polysaccharide complex (ABG1) and the other contained no zinc (ABG2). Treatments requiring IR utilized an ionophore (lasalocid) at 68g/t for D0-46 and AB (virginiamycin) at 15g/t for D0-52. Experimental diets were as follows: Treatment requiring IR utilized an ionophore (lasalocid) at 68g/t for D0-46 and AB (virginiamycin) at 15g/t for D0-52. Experimental diets were as follows: Treatment requiring IR utilized an ionophore (lasalocid) at 68g/t for D0-46 and AB (virginiamycin) at 15g/t for D0-52.

M83 Effects of commercially available antibiotic alternatives on 0 to 41 d male broiler chicken intestinal morphology and microflora

Xi Wang1, Yuhua Farnell, Aaron Kiess, Kelley Wamsley, Wei Zhai Mississippi State University, Starkville, MS, USA

In a companion study, a total of 1,040 one-day-old male Ross × Ross chickens were randomly assigned 1 of 5 experimental diets: a basal diet (served as a negative control diet, NC), a basal diet supplemented withmannanoligosaccharides and β-glucans (Pre), a basal diet supplemented with 3 Bacillus subtilis strains (Pro), a basal diet supplemented with prebiotics and probiotics (Pre + Pro), and a basal diet supplemented with antibiotics and anticoccidials (PC). The basal diet contained corn, soybean meal, and bone meal blend. There were 16 replicate pens per treatment and 13 birds per pen. Broilers fed PC diets exhibited early benefit in terms of increased BW gain from d 15 to 27, while those fed diets containing Pre + Pro exhibited compensatory growth from d 28 to 41.

Key Words: Beta Glucan, Ionophores, Antibiotics, Live Coccidiosis Vaccine, Broiler Performance

Key Words: broiler, intestine morphology, microflora, prebiotics, probiotic
M84 Response of broilers to Virginiamycin and a Xylanase enzyme under summer condition Derek Elmor1, G. M. Pesti1, M. J. Da Costa1, K. W. Bafundo2, H. M. Cervantes2, G. M. Pesti1, J. W. Bafundo3

The objective of this study was to compare responses of 22 ppm Virginiamycin (VM) and a commercial xylanase (XYL) reported to improve the digestibility of typical complex diets fed in the United States. The treatments included a negative control, VM, the XYL, and a combination of the two. Diets recommended by the XYL manufacturer were fed containing distiller’s dried grains with solubles (DDGS) and poultry by-product meal. The basal diets contained 3035, 3115 and 3170 kcal/kg in the starter (0 to 14d), grower (14 to 35d) and finisher (35 to 66d), respectively; Diets were balanced to 1.20, 1.05 and 0.98% total lysine, respectively. A total of 960 Cobb 500 male chicks were housed in 48 floor pens with built-up litter. Each pen had 20 birds. Birds and feed were weighed at the end of each dietary phase for performance analysis. Data were analyzed as completely randomized design with a factorial arrangement of treatments. At 14d VM inclusion improved (P<0.01) both BW (411 vs. 437) and FCR (1.41 vs. 1.25). For the grower phase an interaction (P<0.05) of treatments was observed. When VM was present, the XYL decreased FCR by 0.03. Additionally at 35d VM increased (P<0.01) BW by 0.111 kg. At 44 days the control birds weighed 2.743 kg, the VM-fed birds weighed more (2.829 kg; P<0.05) but the enzyme-fed birds had similar weights, (2.676 kg; P=0.415). VM improved feed conversion ratio (FCR main effect means; 1.70 versus 1.64), but the enzyme was without significant effect (main effect means, 1.66 versus 1.68). However, when both products were supplemented, FCR was improved by an additional 0.02 over VM alone (1.65 versus 1.63; significant interaction; P<0.004). Even though BW were below breeder performance objectives the FCRs were better (1.71). This was likely due to the reduction in feed intake induced by hot summer conditions. VM was effective at promoting general health and performance (growth and feed utilization), while the XYL was effective at improving feed utilization when combined with VM. The significant interaction for FCR demonstrates that healthier birds are better able to utilize feed to maximize performance.

Key Words: Virginiamycin, Xylanase, Broiler, Performance

M85 Influences of Virginiamycin and Magni-Phi on broiler performance M. J. Da Costa1, K.W. Bafundo2, H. M. Cervantes2, G. M. Pesti1, J.W. Bafundo3

The usage of antibiotics in broiler diets as health and performance promoters is widely recognized. However, industry has been looking for alternatives to these products due to consumer demands. The objective of this experiment was to evaluate the effects and interactions of supplementing diets with Virginiamycin (VM) and Magni-Phi (Phibro Animal Health) on broiler performance. Magni-Phi is a proprietary blend of triterpenoid saponins primarily prepared from the quillaja tree, Quillaja saponaria. 1,920 day-old male Cobb 500 were placed in 48 pens with used litter divided among two rooms. There were 3 dietary phases starter (0 to 18d), grower (19 to 32d), and finisher (33 to 42d). Dietary treatments consisted of two levels of VM (0 and 22 ppm) combined with 4 levels of Magni-Phi (0, 150, 200 and 250 ppm). Birds and feed were weighed at the end of each phase for performance evaluation. Data were analyzed as a CRBD with a 2 x 4 factorial arrangements of treatments with the two rooms used as blocks. At 18d a treatment interaction (P<0.01) was observed in BW gain. Both Magni-Phi and VM increased BW gain, however the effect of Magni-Phi was much greater when VM was not present. No effects (P>0.05) on FCR or mortality were observed for the starter phase. For the grower phase, VM increased (P<0.05) BW gain by 25g and decreased (P<0.05) FCR by 0.02. From 0 to 32d 200 ppm of Magni-Phi increased (P<0.05) BW gain by 50 g compare to birds fed 0 ppm. Again, supplementation of VM increased (P<0.01) BW gain by 26g during the finisher phase. From 0 to 42d a treatment interaction (P<0.05) was observed. In this phase inclusion of VM and Magni-Phi increased BW gain; however the effect of Magni-Phi was much greater when VM was not present and had maximum effects at 200 ppm. The FCR at 42d was reduced (P<0.05) by 0.03 by the inclusion of VM. In conclusion, the overall performance was improved by the inclusion of VM or Magni-Phi. Also, optimum level of Magni-Phi was shown to be dependent on the presence of VM. Across all the dietary phases, Magni-Phi showed a quadratic effect on BW gain when VM was not present, with the maximum gain obtained when birds were fed 200 ppm.

Key Words: Magni-Phi, Virginiamycin, broiler, performance

M86 Where do probiotics live and work? Anne Ballou1, Rizwana Ali, Jim Croom, Matthew Koci North Carolina State University, Raleigh, NC, USA

While producers are heavily invested in improving the health of American food animals, consumer pressure is driving them to do so while also minimizing the use of antibiotics. Consequently, probiotics have become a popular way to modify the gut microbiome to improve host health, but the intestinal niches in which they are most active are still largely unknown. Though most intestinal microbiome studies focus on the fermentative regions (rumen, cecum, colon) where bacterial load is highest, these bacteria may also affect the pregastric and small intestine regions where environmental conditions and lower concentrations of established bacteria may be more conducive to colonization or growth. Using a broiler chicken model, our laboratory evaluated the impact of a probiotic consortium (PrimaLac; Lactobacillus acidophilus, Lactobacillus casei, Enterococcus faecium, and Bifidobacterium thermonucleofus) on location-specific gut microbiomes. Following continuous supplementation of feed with PrimaLac (0.3% w/w) from hatch to 28 days of age, digesta samples were collected from 6 sites in the intestinal tract. Microbial 16S RNA from digesta samples was sequenced using an Illumina MiSeq and analyzed with Qiime and PrimerE. Analysis of the microbiome in each location reveals a high proportion of Lactobacillus and Streptophyta in the upper GI, and Rikenellaceae and a variety of Clostridiales genera in the cecum. Percent dissimilarity analysis (SIMPER) of treatments and locations shows a significant change in ileal composition (P<0.01) as probiotic supplementation increases total Lactobacillus (22% to 83%) while decreasing Candidatus Arthromitus, Enterococcus, and Streptophyta. Cecal composition is also affected (P<0.05), with the probiotic treatment increasing Lactobacillus (1% to 14%), decreasing Rikenellaceae and Clostridiales. Further research is underway to determine the significance of some of these changes, but it is clear that to fully understand the value of direct fed microbial products, we need to evaluate their impact on the length of the intestinal tract, not only the fermentative regions.

Key Words: Gut, Microbiome, Probiotic, Chicken, Lactobacillus

M87 Evaluation of multiple direct fed microbial (DFMs) on male broiler growth performance Kolton Page1, Cody Flores1, Ray Poursalam1, Jason Lee1 Texas A&M University, College Station, TX, USA; 1Kerry Inc, Dallas, TX, USA

An experiment was conducted to evaluate the effect of multiple DFMs on male broiler growth performance. The experimental design consisted of six dietary treatments with 10 replicates including 46 male broilers per replicate pen. Broilers were fed a three phase dietary program to include a starter (d 1-14), grower (d 15-30), and finisher (d 31-42). Diets were non-medicated and fed in mash form. All broilers received coccidiosis vaccination at d 0 of age for the control of coccidiosis and reared on litter from three previous flocks. The dietary treatments included a positive control containing bacitracin methylene disalicylate (BMD) at 55g/MT, negative control (NC – non-medicated), NC + Lactic acid producing bacteria (DFM LAB) at 100 g/MT, NC + LAB at 1000 g/MT, NC + combined Bacillus licheniformis and Bacillus subtilis (DFM B) at 100 g/MT, and NC + DFM LAB 50 g/MT + DFM B 50 g/MT. Body weight (BW), mortality
corrected feed conversion ratio (FCR), and feed consumption (FC) were determined on d 7, 14, 21, 30, and 42. The inclusion of BMD increased BW through 30 d of age, increased FC throughout the experiment, and reduced FCR through the grower phase of production. An early impact on BW was observed with the inclusion of both DFMs separately increasing (p<0.05) d 7 BW as compared to the NC diet fed broilers. Increases (p<0.05) in BW continued through 30 d of age with inclusion of DFM LAB (100 g/MT) and DFM B (100g/MT). At the conclusion of the trial, the inclusion of DFM LAB (100 g/MT) increased (p<0.05) d 42 BW and FC compared to the NC fed broilers. The increases in BW resulted in reductions in FCR in DFM LAB and DFM B included at 100 g/MT through the grower phases. Simultaneous inclusion of both DFMs did not provide any benefit during the experiment. These data support the benefits of DFM inclusion in poultry diets, demonstrate that inclusion rate is critical to benefit, and indicate that combinations of multiple DFMs do not necessarily result in additional benefits.

Key Words: broiler, direct fed microbial, performance

M88 Evaluation of a direct fed microbial (DFMs) on broiler growth performance and processing yield Kyle Smith1,2, Hunter Walters3, Jacob Price1, Nathan Augspurger2, Michael King2, Sona Son2, Jason Lee2 1Texas A&M University, College Station, TX, USA; 2JBS United, Inc., Sheridan, IN, USA; 3Microbial Discovery Group/ JBS United, Inc., Franklin, WI, USA

Two experiments were conducted to evaluate the impact of a Bacillus-based DFM on broiler growth performance. In both experiments, diets were non-medicated and fed as a crumble (starter) or pellet. All broilers received coccidiosis vaccination at d 0 of age for the control of coccidiosis and reared on litter from three previous flocks. In experiment 1, broilers were fed a three phase dietary program to include a starter (d 1-14), grower (d 15-28), and finisher (d 29-42). Experiment 1 included three treatments with 10 replicates of 35 straight run broilers per replicate. The treatment groups included a non-medicated control, and the DFM fed at two levels of 100 and 250 g/ton. No impact of DFM inclusion was observed on BW throughout the experiment. Inclusion of DFM at the lower level of inclusion decreased (P<0.05) starter mortality corrected feed conversion ratio (FCR) as compared to the control diet (1.370 vs 1.309). Feed conversion was also reduced (P<0.05) through 28 d of age with the inclusion of the low level of DFM as compared to the control (1.499 vs 1.457), however, no statistical separation was observed at 42 d of age. In experiment 2, only the low level of DFM inclusion (100 g/ton) was evaluated as compared to a non-medicated control diet and the growout period was extended to 48 d of age. Each treatment included 10 replicate pens with each containing 35 male broilers per replicate pen. Broilers were fed a four phase dietary program to include a starter (d 1-14), grower (d 15-28), finisher (d 29-42), and finisher (d 43-48). The response to DFM inclusion was a BW weight increased (P<0.05) starter (d 1-14) BW and FCR throughout the experiment, and increased BW and FCR (P<0.05). However, in experiment 2, intake of both DFMs and FCR resulted in higher BW and lower FCR than CON group (P<0.05). Broilers from DFMs in experiment 2 showed increased weight (kg) and bone composition (Ca%, P%). In experiment 1, treatment with DFM2 improved BW and FCR (P<0.05). However, in experiment 2, intake of both DFMs and FCR resulted in higher BW and lower FCR than CON group (P<0.05). Bone composition was only improved by DFM2 (P<0.05; Ca%, P%). Results of this study suggest that consumption of a selected Bacillus-DFM producing a variable set of enzymes, could contribute to enhanced performance, intestinal microbial balance and bone quality in broiler chickens consuming a diet that contains DGDS.

Key Words: Bacillus-DFM, DGDS, enzymes, microbiota, bone quality

M89 Inclusion of Bacillus direct-fed microbes in a broiler diet containing corn-DDGS: Effect on performance parameters, microbiota population and bone quality Juan Latore1,2, Jose Vicente2, Xochitl Hernandez-Velazco1, Ross Wolfenden3, Billy Hargis2, Guillermo Tellez3 1University of Arkansas, Fayetteville, AR, USA; 2Pacific Vet Group-USA, Inc., Fayetteville, AR, USA; 3Universidad Nacional Autonoma de Mexico, Mexico City, Mexico

Distiller’s dried grains with solubles (DDGS) have increasingly been used in poultry diets as consequence of increasing grain costs. DDGS have a variable compositional value and a high inclusion of this co-product has been considered as a risk factor for GI diseases such as necrotic enteritis. Presently, two experiments were conducted using a starter corn-soybean diet (0-7d) and a corn-soybean-DDGS (8%) grower diet (7-28d) with or without inclusion of a Bacillus-DFM. In both experiments, day-of-hatch chicks were randomly assigned to three different groups: Control group without DFM (CON), commercial-DFM group (DFM1) and candidate-DFM group (DFM2), previously selected based on in-vitro digestion model enzyme profile. Eight pens of 20 chicks (n=160/group) in each experiment. Bacillus-DFM spores were included to reach a concentration of 109 spores/g of feed. Performance parameters of body weight (BW), feed intake (FI) and feed conversion (FCR) were evaluated. Additionally, in experiment 2, one broiler per pen was humanely killed and intestinal samples were collected to determine the microbiota population of total lactic acid bacteria (LAB) and total gram negative bacteria (GNB) at day 28. Simultaneously, both tibias were evaluated for bone strength (kg/mm2) and bone composition (Ca%, P%). In experiment 1, treatment with DFM2 improved BW and FCR (P<0.05). However, in experiment 2, intake of both DFMs and FCR resulted in higher BW and lower FCR than CON group (P<0.05). Broilers from DFM2 in experiment 2 showed increased bone strength (kg/mm2) and bone composition (Ca%, P%). Results of this study suggest that consumption of a selected Bacillus-DFM producing a variable set of enzymes, could contribute to enhanced performance, intestinal microbial balance and bone quality in broiler chickens consuming a diet that contains DGDS.

Key Words: Bacillus-DFM, DGDS, enzymes, microbiota, bone quality

M90 Understanding white striping using protein turnover Karen Vignale1, Justina V. Caldas2, Judith England3, Nirun Boonsinchai4, Andrew Magnuson5, Erik D. Pollock2, Casey M. Owens3, Sami Dridi6, Craig N. Coon7 1University of Arkansas, Fayetteville, AR, USA; 2University of Arkansas Stable Isotope Lab, Fayetteville, AR, USA

A study was conducted to evaluate the effect of white striping on protein turnover and gene expression of genes related to protein degradation and fatty acid synthesis. The objective of this study was to elucidate why white stripes appear in heavy market broilers. A total of 560 1 day old male broiler chickens were allocated in a total of 16 pens, 35 broilers per pen. Birds were fed under Cobb nutritional recommendations and were raised until 60 days of age. A CRD was conducted with a 2X3 factorial arrangement (two scores: severe and normal, and 3 samples sites). At day 60, 17 birds (16 infused one control) were randomly selected and infused with a 150 mM solution of 15N Phen 40% APE (atom percent excess). A small piece of breast muscle tissue was taken for gene expression analysis of the following genes: murf-1, atrogin-1, IGF-1, insulin receptor (IR), fatty acid synthetase, and acetyl CoA carboxylase (ACC). Blood samples were also taken from the same birds for insulin and VLDL plasma level analysis. Each bird was euthanized after 10 minutes of infusion and scored for white striping (NORM or SEV). Samples of the breast muscle were taken at different layers (ventral, mid, dorsal). A sample of excreta of each bird was also taken. Out of the 16 samples taken, only ten were selected for analysis based on the white striping score (5 NORM and 5 SEV). Fractional synthesis rate (FSR) and Fractional breakdown rate (FBR) were determined using GCMS. No significant differences (P>0.05) were
found in fractional synthesis rate (FSR) between with SEV and NORM or fat mobilization. Further studies are needed to better understand why birds with severe white striping are degrading more muscular protein and mobilizing more fat.

**Key Words:** white striping, protein turnover, gene expression, VLDL, insulin

**M91 Effects of quantitative feed restriction on myopathies of the Pectoralis major muscles in broiler chickens at 32, 42, and 50 days of age** Kathryn Meloche1, Sacit Bilgili, William Dozier 1Auburn University, Auburn, AL, USA

Recently, increased incidences of white striping (WS), wooden breast (WB), and idiopathic necrosis (N) of the breast fillet have been observed in multiple commercial broiler strains. Although numerous anecdotal reports indicate that these issues are associated with growth rate, limited formal research has been conducted to investigate this relationship. Therefore, an experiment was conducted to determine if myopathies of the *Pectoralis major* muscles are influenced by differences in growth rate obtained through quantitative feed restriction. Male broiler chicks of a high-yielding commercial strain were placed into 28 pens (25 birds/pen) equipped with plastic slats to prevent coprophagy. All birds received identical starter (1 to 10 d), grower (11 to 32 d), finisher (33 to 42 d), and withdrawal (43 to 50 d) diets that were formulated to meet or exceed nutrient recommendations from the primary breeder. Each pen of birds was randomly assigned to 1 of 4 pair-feeding programs (TRT 1: ad libitum; TRT 2: 95% of TRT 1 intake; TRT 3: 90% of TRT 1 intake; TRT 4: 85% of TRT 1 intake) with 7 replicate pens per treatment. Feed intake and mortality were recorded daily. Individual BW was recorded at 10, 31, 42, and 49 d of age. Blood samples were collected from 4 birds per pen at 31, 41, and 48 d of age and subsequently analyzed for plasma creatine kinase (CK) and lactate dehydrogenase (LDH). At 32, 43, and 50 d of age, 4 birds per pen were euthanized for necropsy. The right breast fillet of each bird was visually inspected for WS, WB, and N. Feed intake, BW gain, and mortality were reduced (P ≤ 0.01) with decreasing feed allocation. No differences in feed conversion ratio (unadjusted for common BW) were observed. At all ages evaluated, severity of WB, WS and N was reduced with decreasing feed allocation (P ≤ 0.05). Plasma CK and LDH levels were significantly (P ≤ 0.05) elevated in birds with WB at 32 and 41 d of age. These results show the effect of quantitative feed restriction on broiler growth performance and breast muscle myopathies. Practical feeding programs which might reduce the incidence of breast myopathies while maintaining optimal performance require further evaluation.

**Key Words:** broiler, feed restriction, breast fillet, myopathy

**M92 Effect of vaccination for coccidia and Sporulin® inclusion on broiler performance during natural exposure to Clostridium perfringens** Alamanada Calvert1, Christa Honaker2, Chris Ott3, Diego Paiva4, Marie Schirmacher1, Kendre Stringfellow2, Audrey McElroy1

Management of intestinal integrity following coccidia vaccination is critical to optimizing bird performance as well as preventing secondary complications, such as necrotic enteritis (NE). Inclusion of probiotics to promote beneficial intestinal microflora in combination with coccidial vaccination programs is a possible means to support intestinal function and bird performance during intestinal challenges. This experiment evaluated two coccidia vaccines combined with a probiotic in an environment with naturally occurring NE. Cobb 500 male broilers obtained on day of hatch were divided into 6 treatment groups with 12 replicate pens of each (n=30 birds/pen). Bacitracin methylene disalicylate was included in each treatment group, and they were Salinomycin (SAL), SAL+Sporulin® (Combination of three *Bacillus subtilis* isolates), Vaccine 1 (VAC1), VAC1+Sporulin®, Vaccine 2 (VAC2), and VAC2+Sporulin®. Birds were placed on litter from a previous flock with NE. Birds and feed were weighed by pen on d0 and with feed changes on d14, 28, and 35. Significance is reported at P < 0.05. On d14, BW of broilers in the groups SAL, SAL+Sporulin®, and VAC1 were significantly higher than VAC1+Sporulin® and VAC2+Sporulin®. On d28, BW was similar between all treatments with the exception of SAL being significantly higher than the VAC2+Sporulin® group. On d35, broilers in the VAC2+Sporulin® group weighed significantly less than those in SAL, VAC1+Sporulin®, and VAC2. A similar response was seen on d42 with SAL and VAC1+Sporulin® group broilers heavier than VAC2+Sporulin®. Significant differences in feed conversion (FC) occurred from d14-28 and d28-35. From d14-28, SAL+Sporulin® resulted in the most efficient FC, while VAC2 and VAC2+Sporulin® were less efficient. From d28-35, VAC1 resulted in the least efficient FC and all other groups were significantly better. The only difference in mortality was seen from d28-35 with VAC2+Sporulin® having significantly higher mortality than VAC1 or VAC1+Sporulin®. Results from this study suggest that bird performance was differentially affected by two coccidial vaccines and inclusion of Sporulin®, however, in combination with VAC1, Sporulin® appeared to result in improved performance of broilers during a natural necrotic enteritis episode.

**Key Words:** coccidia, bacillus subtilis, clostridium perfringens

**M93 Determination of the minimum infectious dose of the Arkansas DPI-type Infectious Bronchitis virus administered via hatchery spray cabinet** Christina Leysen1, Deborah Hilt, Brian Jordan, Mark Jackwood

Infectious bronchitis virus (IBV) is a highly infectious pathogen that causes infectious bronchitis (IB) in chickens. IB is one of the most economically important respiratory diseases in poultry and all commercial broilers are vaccinated against it. IBV vaccines are live-attenuated virus and confer protection in a serotype specific manner, making appropriate vaccination protocols critical for preventing disease. Previous studies have shown that the ArkDPI type IBV vaccines do not protect against virulent Ark challenge when the vaccine is applied by mass spray, and the cause can be correlated to poor infection and replication at early time points post vaccination in chicks. When the vaccine is applied at the same dose by eye drop, however, early replication of vaccine virus is achieved and the vaccine protects against challenge. It is our hypothesis that the minimum infectious dose of ArkDPI type vaccine needed to achieve adequate protection when administered by hatchery spray cabinet is inherently higher than by eye drop administration. To test this hypothesis, several groups of 100 broiler chicks were vaccinated with increasingly higher doses of vaccine.
using a commercial spray cabinet. The level of replication was monitored and compared to eye drop administration. To confirm that protection was achieved, chickens were challenged with pathogenic Arkansas virus Determining the minimum infectious dose of ArkDPI vaccine needed to properly immunize birds when applied by mass spray is critical for preventing this disease in the field and will have an immediate impact on the commercial poultry industry.

**Key Words:** Infectious bronchitis virus, Minimum infectious dose, Hatchery spray cabinet, ArkDPI

### M94 Transmission of heterologous IBV challenge after bivalent vaccination in broiler chickens

**Eric Shepherd**, Christian Lapp, Deborah Hill, Mark Jackwood, Brian Jordan

*The University of Georgia College of Veterinary Medicine, Athens, GA, USA*

Avian Infectious Bronchitis Virus (IBV) is a gammaCoronavirus (CoV) that is highly infective and causes an economically significant upper respiratory tract disease in chickens. To combat this disease, all commercial chickens are vaccinated against IBV in a serotype specific manner. To combat variant IBV serotypes, the poultry industry has begun using multivalent (multiple serotype) vaccine protocols in an attempt to generate cross-protection against heterologous IBV serotypes. Previous work in our laboratory has shown that multivalent vaccination can protect chickens from clinical signs and lesions associated with IBV infection, but the chickens still shed virus into the environment. Whether shed virus is significant is currently unknown. We hypothesize that the viral load shed into the environment after challenge with a heterologous IBV is not significant in well-vaccinated birds, but may be in birds where proper immunity was not developed. To test this hypothesis, we housed 40, 1-day-old broilers at industry stocking density in a colony room. Twenty broilers were vaccinated with Ma5 and Det722 commercial vaccines by eye drop and the other 20 were left unvaccinated to serve as controls for vaccine transmission in a broiler flock. Separately, 20, 1-day-old broilers were housed in isolators as unvaccinated controls. At 35 days of age, directly vaccinated birds were challenged with 1 × 10^6 EID₅₀ of pathogenic Arkansas serotype IBV and unvaccinated controls were added to the floor with the challenged group. Every 5 days post challenge, all broilers were evaluated for viral load and respiratory signs and 5 birds from each group were necropsied for lesion scoring. Based on respiratory signs and lesions, directly vaccinated birds were protected from challenge at all time points. Unvaccinated and unchallenged contact birds were protected from signs and lesions at all time points except 10 dpi and unvaccinated and unchallenged controls were protected at 5 and 20 dpi, but not 10 and 15 dpi. Viral loads were detected in all birds at different time points post challenge. Based on this data, it would seem that challenge virus shed into the environment by infected birds is not significant if the population is well vaccinated, but can cause signs and lesions in naive birds.

**Key Words:** Infectious Bronchitis Virus, Arkansas, Multivalent Vaccination, Transmission, Ciliostasis

### M95 Potential of glycoprotein J gene deleted infectious laryngotracheitis virus (ILTV) strain as a live attenuated vaccine

**Gustavo Henrique Schneiders, Sylvia M. Riblet, Maricarmen Garcia**

*University of Georgia, Athens, GA, USA*

Infectious laryngotracheitis (ILT) is a serious and widespread respiratory disease of chickens caused by *gallid herpesvirus type 1* (GaHV-1), commonly known as infectious laryngotracheitis virus (ILTV). The disease is controlled by vaccination with live and recombinant viral vector vaccines. Although ILTV live attenuated vaccines are capable of containing outbreaks, their residual virulence cause undesirable vaccine reactions. In this context there is a need to develop more stable, efficacious and cost effective live attenuated ILTV vaccines. Our hypothesis is that attenuation of ILTV by deletion of virulence determinants will yield more stable attenuated strains than those obtained by continuous passages in embryos or cells. Our long-term goal is to evaluate the potential of ILTV gene deleted strains as live vaccines for *in ovo* and mass application. The specific aim of this study is to evaluate the safety and efficiency of vaccination with an ILT virus lacking glycoprotein J (NΔgJ) when applied *in ovo* followed by boost vaccination at 2 and 8 days of age. Specific pathogen free (SPF) and commercial layer embryos were vaccinated at 19.5 days of incubation with a 3000 TCID₅₀ dose of the NΔgJ, followed by a boost vaccination, via gavage/ intranasally. Mortality, clinical signs, weight gain, and viral loads of the challenge virus will be assessed. Preliminary data showed no differences in hatchability between groups of birds, 5% mortality was recorded during the first week for SPF birds, while no mortalities were recorded for layers. Mortality after challenge varied from 0% to 4% among vaccinated groups of birds and reached a 12% in non-vaccinated challenged group of birds. Quantitative real time PCR analysis will be performed in tracheal swabs collected at 4 dpc to determine the loads of 63140 virus in the trachea post-challenge.

**Key Words:** Gallid herpesvirus, protection, glycoprotein J, live vaccines, gene deletion

### M96 Replication of infectious laryngotracheitis virus (ILTV) in the conjunctiva, nasal cavity, and hardier gland after eye-drop, intranasal and gavage inoculation

**Gabriela Beltran, Guillermo Zavala, Maricarmen Garcia**

*The University of Georgia, Athens, GA, USA*

Infectious laryngotracheitis virus (ILT) belongs to the *Alphaherpesvirinae* subfamily, genus *Gallid herpesvirus* 1 species. ILT is an acute respiratory disease of chickens that can result in severe losses due to mortality and/or decrease in egg production. ILT is controlled through vaccination with either live attenuated or recombinant viral vector vaccines. ILTV live attenuated vaccines tissue culture origin (TCO) vaccine and chicken embryo origin (CEO) vaccines are administered via eye drop, water and spray, routes that are intended to trigger mucosal immunity. Although studies on ILTV replication and tissue tropism had been conducted, a lack of knowledge still exists on ILTV tropism for respiratory tissues other than the trachea. The mucosal tissues of the nasal cavity and the conjunctiva as well as the paracor renders are the first to come in contact with the virus during vaccination or natural infection. These structures contain associated lymphoid tissues and most-likely play an important role in the induction of innate immune responses. Therefore it is of vital importance to determine the level of viral replication that occurs in these tissues and how the route of inoculation influences replication. The long-term goal of this project is to determine the associations between viral replication, inoculation route, and the nature of the innate immune responses in these tissues and how they relate to disease resistance. The immediate aim of this study is to investigate the replication patterns of virulent ILTV isolate 63140 in conjunctiva, nasal tissues, hardier gland and trachea after eye drop, intranasal and gavage inoculations of SPF birds. Tissue samples will be collected at days 1, 3, 5, and 7 post-inoculation. Viral replication will be evaluated by detection of viral antigens using immunohistochemistry (IHC). Viral replication will be also assessed by quantification of viral genomes using real time PCR.

**Key Words:** Innate Immunity, Associated lymphoid tissues, Replication patterns
Inflammation accomplished by feeding young peafowl embryonated eggs of *Histomonas meleagridis* in peafowl. In that report, transmission of *H. meleagridis* as a vector and reservoir for infection, but direct transmission by *Heterakis gallinarum* as a vector and reservoir for infection, based on isolate DNA sequences, was likely chickens with osteomyelitis in broilers with a dietary combination of Bacillus subtilis (Bacillus subtilis C-3102) direct-fed microbial and yeast cell wall product IMW50™, which is incorporated into rations prior to feed pelleting. BacPack 2X is resistant to pelleting temperatures up to 194°F. Male broilers reared on wire flooring resulted in a significant (P < 0.05) increase in the incidence of BCO compared to hatch-mates reared on wood shavings. The prophylactic feeding of BacPack 2X resulted in a significant (P ≤ 0.05) reduction in the incidence of BCO in broilers reared on wire flooring at 56 days-of-age compared to broilers receiving a control feed. The feeding of BacPack 2X also significantly (P ≤ 0.05) delayed the age of onset of BCO compared with broilers fed the control feed. Clinically healthy broilers that had been reared on wire flooring for 56 days had higher body weights when they had been fed the diet containing BacPack 2X.

### Key Words
BCO, Calsporin, Direct-fed microbial, yeast cell wall, lameness

---

#### M99 Enteric Inflammation Modeling for Induction of Spondylolisthesis (Kinky Back) in Broilers

Linda Biekle1, Johel Biekle1, Vivek Kuttappan1, Eduardo Vicia1, Randle Moore2, Rosario Seger-Galarza1, Juan-David Latorre1, Amanda Wolfenden1, Olivia Faulkner1, Guillermo Tellez2, Billy Harigis2, University of Arkansas, Fayetteville, AR, USA; 2University of California, Davis, California Animal Health and Food Safety Laboratory, Turlock, CA, USA; 3University of California, Davis, California Animal Health and Food Safety Laboratory, Tulare, CA, USA; 4University of Georgia, Department of Poultry Science, Athens, GA, USA

Spondylolisthesis (kinky back) lameness is related to abscess of T4 vertebrae (T4V) in heavy broilers, and has been linked to *Enterococcus cecorum* (EC), a common GIT microbe. Kinky back incidence occurs at a rate of 3-9% in affected flocks, and can manifest as early as 6 weeks of age. We evaluated the effect of early induction of enteric inflammation, using potential non-infectious models, on EC recovery from T4V region. Experiment 1 compared levels of dexamethasone (DEX) feed inclusion (DEX; 1X = 0.57 mg/kg of feed; 3X = 1.7 mg/kg of feed; 9X = 5.1 mg/kg of feed d4-d15) or injections (DEXI; 1 mg/kg BW, 6 injections every 48h, d4-d14) on serum Fluorescein isothiocyanate-dextran (FITC-d, d11) and Gram+ microbial recovery from T4V region on d15. Serum levels of FITC-d in all DEX feed groups were higher (P < 0.05) than control, while DEXI group was higher than control but lower than DEXI. Gram+ recovery from T4V followed a similar pattern with increased CFU in all DEX groups (P ≥ 0.05) from both DEXI and control. Experiment 2 evaluated multiple enteric inflammation models for effect on serum FITC-d and *Enterococcus* recovery from T4V. Inflammation groups included DEXI (0.57 mg/kg d4-15), rye-based diet (RBD; d7-15), or 15% dried distiller’s grains with solubles diet (DDGS; d1-15) and all birds were challenged with a cocktail of 5 different EC on d11. A negative control (CON, no EC) and EC only control (ECC) were included. Serum levels of FITC-d (d11) were higher (P < 0.05) in all inflammation groups than CON and ECC. Incidence of T4V EC recovery on d15 was 75%, 50%, and 55% for DEXI, RBD, and DDGS, respectively, which was significantly higher than CON (10%) and ECC (15%). These studies suggest early enteric inflammation models may increase gut leakage of EC to T4V region and markers such as serum FITC-d and EC T4V recovery in young broilers may predict kinky back.

### Key Words
Kinky back, enteric inflammation, Fluorescein isothiocyanate-dextran, Dexamethasone, DDGS

---

#### M98 Reducing the incidence of bacterial chondronecrosis with osteomyelitis in broilers with a dietary combination of Bacillus subtilis C-3102 (Calsporin) and IMW50 yeast cell wall preparation

John Schleifer1, A. Al-Rubaye2, R. F. Wideman3, Y.M. Kwon4, T. Lohrmann1, Quality Technology International, Inc., Elgin, IL, USA; 2University of Arkansas, Fayetteville, AR, USA

Bacterial chondronecrosis with osteomyelitis (BCO) is the leading cause of lameness in commercial broilers produced in North America. BCO has been experimentally reproduced at a high incidence in male broilers reared on wire flooring. The wire flooring enhances the torque and shear stress on the growth plates of the proximal femora and tibiae. A diverse population of bacteria has been identified in association with this syndrome. The hypothesis is that bacteria enter the blood stream by translocating from the intestinal tract. The hematogenous circulation of these bacteria infect micro-fractures and clefts in the growth plate region of rapidly growing bones. In this study, BacPack™ 2X was fed prophylactically, starting at one-day-of-age to reduce intestinal bacterial translocation. This treatment was compared to hatch-mates that received a control diet and were reared in the same environmental and management conditions. BacPack 2X is a proprietary blend of Calsporin™ (Bacillus subtilis C-3102) direct-fed microbial and yeast cell wall product IMW50™, which is incorporated into rations prior to feed pelleting. BacPack 2X is resistant to pelleting temperatures up to 194°F. Male broilers reared on wire flooring resulted in a significant (P ≤ 0.05) increase in the incidence of BCO compared to hatch-mates reared on wood shavings. The prophylactic feeding of BacPack 2X resulted in a significant (P ≤ 0.05) reduction in the incidence of BCO in broilers reared on wire flooring at 56 days-of-age compared to broilers receiving a control feed. The feeding of BacPack 2X also significantly (P ≤ 0.05) delayed the age of onset of BCO compared with broilers fed the control feed. Clinically healthy broilers that had been reared on wire flooring for 56 days had higher body weights when they had been fed the diet containing BacPack 2X. The results of this study indicate that the prophylactic feeding of BacPack 2X provides a mechanism toward the reduction of BCO-related lameness in broilers.

### Key Words
BCO, Calsporin, Direct-fed microbial, yeast cell wall, lameness

---

#### M97 Characterization of Histomonas meleagridis in peafowl

Lorelei Clarke1, H.L. Shivaprasad2, Silvia Camaccini1, Robert Beckstead4, Daniel Rissi1, University of Georgia, Department of Pathology, Athens, GA, USA, 1University of California, Davis, California Animal Health and Food Safety Laboratory, Tulare, CA, USA; 2University of California, Davis, California Animal Health and Food Safety Laboratory, Turlock, CA, USA; 3University of Georgia, Department of Poultry Science, Athens, GA, USA

This study sought to characterize *Histomonas meleagridis* infestation in peafowl with special focus on the genotyping profile of the agents. *H. meleagridis* is a flagellate protozoan organism that causes severe necrotizing typhlitis in chickens and turkeys as part of the condition known as “blackhead disease”. It typically uses the cecal nematode *Heterakis gallinarum* as a vector and reservoir for infection, but direct transmission has been both naturally observed and experimentally induced in turkey pouls. While it is commonly recognized that other gallinaceous birds are susceptible to *H. meleagridis* infection, there is only a single report in the veterinary literature describing the disease and its transmission by *H. gallinarum* in peafowl. In that report, transmission of *H. meleagridis* was accomplished by feeding young peafowl embryonated eggs of *H. gallinarum*, and resulted in high morbidity and mortality rates, indicating that peafowl are likely more susceptible to infection than chickens or pheasants and that it poses a significant concern for peafowl producers.

A review of the archived cases at the University of Georgia Athens Veterinary Diagnostic Laboratory and the California Animal Health and Food Safety Laboratory System yielded 4 cases (2 from each institution) of young (1 week old to 19 weeks old) peafowl with gross and histological findings characteristic of *H. meleagridis* infestation, including a bilateral, transmural fibrinonecrotic typhlitis and multifocal necrotizing hepatitis with intralesional trophozoites morphologically consistent with *H. meleagridis*. The 2 cases diagnosed at UGA also had concomitant necrotizing air sacculitis with intralesional trophozoites, and one of these 2 cases had pulmonary granulomas with intralesional *Aspergillus* spp. hyphae. Cases were further analyzed using immunohistochemistry and locus sequencing of extracted *H. meleagridis* DNA from the paraffin-embedded tissues.

Immunohistochemistry for *Trichomonas* spp., which cross-reacts with *H. meleagridis*, confirmed the diagnosis in all four cases. There was no evidence of *H. gallinarum* infestation in all 4 cases. Three cases were also confirmed by sequencing of extracted DNA using multiple sets of DNA primers, including a novel primer set designed for diagnostic sensitivity.

It was concluded based on these findings that infection in these cases likely occurred by ingestion of embryonated *H. gallinarum* eggs. The source of infection, based on isolate DNA sequences, was likely chickens with which these peafowl were comingled.

### Key Words
*Histomonas meleagridis*, peafowl, transmission, genotyping, immunohistochemistry
M100 Case report: Isolated masculinization of commercial leghorn hens in production Blayne Mozisek, Merck Animal Health, Austin, TX, USA

The investigation and clinical workup of poor production and shell quality with masculinization in an 80-week-old commercial layer flock will be discussed. The chief complaint within this flock was decreased production and poor shell quality primarily isolated to a single row of a modern, two story, commercial layer house. When examined the flock was three weeks post-molt and mortality was significantly increased. Grossly, birds exhibited signs of masculinization including aggression with varying degrees of comb and spur development. Upon necropsy, all affected birds showed excessive amounts of adipose tissue for their life stage. Follicular development was reduced and birds with the most significant masculine features had complete regression of the ovarian follicles. Fixed and fresh tissue as well as serum was collected. Histologic evaluation of reproductive tract revealed ovotesticle with the gonad parenchyma being testicular and having seminiferous tubules, intestinal cells, and rudimentary male accessory glands. The magnum and uterus were hypoplastic with normal anatomy, but only minimal to mild maturation. Virus isolation of fresh tissues collected from affected birds and sentinel birds was unsuccessful. Hemagglutination inhibition titers of specific infectious bronchitis virus serotypes were elevated. The vaccination history, late-life flock performance, and suspected cause will also be discussed.

Key Words: leghorn, intersex, ovotesticle, case report, masculinization

M101 In vivo test tube: the growing feather as a dermal test-site to monitor temporal, qualitative and quantitative aspects of innate and adaptive immune responses. Gisela Ert, Otfa Alamins, Hyoeonmin Jang, Kristen Byrne, Daniel Falconi, Mikaila Wilson, Zoraida Aguilar, Robert Denglewicz, University of Arkansas, Division of Agriculture, Department of Poultry Science, Fayetteville, AR, USA; Zystein, LLC, Springdale, AR, USA

We developed a method using the dermis (pulp) of growing feathers (GF) as a test-site to monitor cellular immune responses in vivo (US-Patent 8,216,551). Micro-injection of several GF with test-material [e.g. (recall)-antigens, adjuvants, immunomodulators, etc.] and GF-collection at various times post-injection, enables monitoring of local immune activities to test-materials. Using this minimally invasive procedure together with blood sampling we have the ability to examine immune activities to test-materials in poultry, both at the local injection-site and in the peripheral blood circulation. In a recent study we immunized 7-week-old male Light-brown Leghorn chickens intra-muscularly (i.m.) with 3 different formulations of test-antigen (T-Ag = mouse IgG; n = 6/treatment). Another group of chickens was immunized in the same manner at 7-weeks of age and again 4 weeks later (secondary immunization). We monitored antibody production (IgM, IgG) to T-Ag over 4 weeks following both the primary and secondary i.m. immunizations. To examine the local effector response to T-Ag in the same individuals, mouse IgG or vehicle (PBS) was injected into 20 GF per bird (10 uL/GF) at 10 days or 5 days post-primary or post-secondary immunization, respectively. Three GF were collected before (0h) and at various times (0.25 to 7 days) post-GF-injection. At each time-point, one GF was used to prepare pulp cell suspensions for immunofluorescent staining and leukocyte-population analysis by flow cytometry. The other two GF were either snap frozen for gene-expression (qRT-PCR) analysis or placed in buffered formalin for histological examination. Cell-population analysis of GF pulp-cell suspensions revealed temporal, qualitative and quantitative differences (P < 0.05) in leukocyte-infiltration between immunization treatments and primary/memory effector-responses. Analysis of plasma samples by ELISA also revealed temporal, qualitative, and quantitative differences (P < 0.05) in the humoral responses to T-Ag following the different i.m. primary/secondary immunizations. Minimally invasive, non-terminal procedures such as sampling of injected GF and blood provides for the first time insight into cellular and humoral immune activities in the same individual over time. The use of GF as an “in vivo test-tube” will find direct application in the development of vaccines and immunomodulators, as well as, in the assessment of immune system development and function in poultry. Funding: NIH-NIBIB, AES-Animal Health

Key Words: cell-mediated immune response, humoral immune response, leukocytes, antibodies, vaccine

M102 Genotypic analysis of S class genome segments of two novel avian reoviruses associated with tenosynovitis in chickens Vijay Durairaj, Erich Linnemann, Vanessa Gauthier, Alan Icard, Holly S. Sellers Poultry Diagnostic and Research Center, The University of Georgia, Athens, GA, USA

Reovirus induced tenosynovitis is primarily observed in meat type chickens and result in swollen hock joints and tendons. Increased incidences of tenosynovitis associated with avian reoviruses have been documented since 2011. The avian reovirus genome is segmented and comprised of 10 segments (L1-L3, M1-M3, S1-S4). The S1 gene encodes for three viral proteins namely P10, P17 and Sigma C, S2, S3 and S4 segments encode for Sigma A, Sigma B and Sigma NS proteins respectively. Genotypic characterization of the Sigma C from recent reovirus field isolates, from clinical cases of tenosynovitis, revealed two groups of novel reoviruses, namely variant group 1 and group 2. Group 1 variants were <50% similar to commercial U.S. vaccine strains, whereas Group 2 variants were 80% similar to vaccine strains. Progeny from commercial reovirus vaccinated breeders were not protected against challenge with Group 1 or Group 2 variants, suggesting that current commercial vaccines do not provide adequate protection against these variants. Thus new isolates of reoviruses should be evaluated for use in the next generation of vaccines. The main objectives of this project were to plaque purify representative isolates from Group 1 and Group 2 and genetically characterize these viruses. In this study, we report the results of genotypic analysis of S class gene segments of two variant avian reoviruses isolated and plaque purified from field cases of tenosynovitis. RT-PCR was performed with primers encompassing S1, S2, S3 and S4 gene segments. The extracted DNA was cloned and sequenced. RT-PCR products were cloned and sequenced. The sequences were analyzed and phylogenetic analysis was performed for all S class segments (S1-S4). P10 and P17 amino acid sequence analysis revealed that Group 1 variants were >86% similar to Australian isolate RAM-1 and Group 2 variants were >90% similar to Canadian isolate ARV-138. Sigma A amino acid sequences of Group 1 and Group 2 variants were 99% similar to each other. Sigma B amino acid sequences from Group 1 and Group 2 variants were >93% similar, while their similarity to turkey, duck and goose isolates was <79%. Sigma NS amino acid sequences of Group 1 and Group 2 variants were >98% similar to US isolate chicken/AR/SEP-843/05. Overall, genetic heterogeneity was observed in all S class gene segments

Key Words: Tenosynovitis, Variant avian reoviruses, Genotypic analysis, Sigma C, S class segments
M103 Dietary Threonine Requirement of Pekin Ducks from 1 to 14 Days of Age Based on Performance, Serum Immune Activity and Intestinal Mucin Secretion Qian Zhang\textsuperscript{1}, Qifeng Zeng\textsuperscript{2}, Paul Cotter\textsuperscript{3}, Todd Applegate\textsuperscript{1}, Purdue University, West Lafayette, IN, USA; \textsuperscript{2}Sichuan Agriculture University, Ya’an, China; \textsuperscript{3}Cotter Laboratory, Arlington, MA, USA

A study was conducted to establish the dietary threonine (Thr) requirement of Pekin ducks from 1 to 14 d of age. Experimental diets were formulated to contain 0.78, 0.84, 0.90, 0.96, and 1.02% Thr (0.74, 0.83, 0.88, 0.92, and 1.00% on an analyzed basis) and were fed to 8 replicate pens of 6 male ducks per pen. Body weight and feed intake from each pen were recorded weekly. At 14 d of age, breast meat, ileal digesta and serum were collected to determine breast meat yield, mucin secretion and serum immune parameters. The maximal Thr responses for BW gain (mg Thr intake/bird basis; \( P < 0.05 \) for linear broken line regression) were 25.27, 67.76 and 85.25 mg/bird at 0-7 d, 7-14 d and 0-14 d, respectively. As the average FI was 266.92, 661.71 and 927.67 g/bird at 0-7 d, 7-14 d and 0-14 d, the estimated maximal Thr responses for BW gain expressed as % dietary Thr basis were 0.95, 1.02 and 0.92% at 0-7 d, 7-14 d and 0-14 d, respectively. The maximal Thr response for breast meat yield (% dietary analyzed Thr basis; \( P = 0.09 \) for linear broken line regression) was 0.96% at 0-14 d. In the ileal mucin secretion was estimated to be highest when 0.90% (% dietary analyzed Thr basis; \( P < 0.05 \) for quadratic regression) dietary Thr were fed. Serum natural antibody titers and complement mediated lysis to human (HuO) and horse (Ho) erythrocytes were not affected by dietary Thr. However, the IgY natural antibody to rabbit (Rb) erythrocytes was significantly affected by dietary Thr in a cubic response (\( P = 0.03 \)). The complement mediated lysis of rabbit (Rb) erythrocytes by the alternate pathway was highest with 0.92 % Thr (% dietary analyzed Thr basis; \( P < 0.05 \) for linear broken line regression).

Key Words: Pekin duck, threonine, mucin, serum immune activity

M104 Efficacy of two adsorbents in ameliorating the toxic effects of aflatoxin in broiler chicks Tiffany Shannon\textsuperscript{1}, David Ledoux\textsuperscript{1}, George Rottinghaus\textsuperscript{1}, Daniel Shaw\textsuperscript{1}, Aleksandra Dakovic\textsuperscript{2}, Mirjana Stojanovic\textsuperscript{2}, Vera Dondur\textsuperscript{3}, University of Missouri, Columbia, MO, USA; \textsuperscript{2}Institute for Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia; \textsuperscript{3}University of Belgrade, Belgrade, Serbia

An experiment was conducted to determine the efficacy of two adsorbents in ameliorating the toxic effects of aflatoxin (AF) in broiler chicks. Adsorbent 1 (ADSB-1) was a raw clay product, whereas adsorbent 2 (ADSB-2) was a concentrated product manufactured from the raw clay product. One hundred and eighty-day-old male broiler chicks were assigned to 6 dietary treatments (6 replicate pens of 5 chicks per treatment) that included: 1) positive control basal diet (BD); 2) BD plus 0.50% ADSB-1; 3) BD plus 0.50% ADSB-2; 4) BD plus 2 mg AFB\textsubscript{1}, kg diet; 5) BD plus 2 mg AFB\textsubscript{1}, kg diet plus 0.50% ADSB-1; and 6) BD plus 2 mg AFB\textsubscript{1}, kg diet plus 0.50% ADSB-2. The addition of ADSB-1 and ADSB-2 to the BD at a level of 0.50% did not negatively affect \( P > 0.05 \) chick performance, organ weight, liver color, serum chemistries, or liver lesion scores. Feed intake (FI), body weight gain (BWG), and liver color were depressed \( P < 0.05 \) for linear broken line regression). The complement mediated lysis of rabbit (Rb) erythrocytes by the alternate pathway was highest with 0.92 % Thr (% dietary analyzed Thr basis; \( P < 0.05 \) for linear broken line regression).

Key Words: Aflatoxin, Adsorbent, Broilers, Liver lesion score

M105 Impact of dietary Black Soldier Fly prepupae meal on broiler performance Shurong Li\textsuperscript{1}, Fengchun Yang, Heather Burley, Paul Patterson, R. Michael Hulet The Pennsylvania State University, State College, PA, USA

Black Soldier Fly (Hermetia illucens) prepupae, can be considered as an alternative insect-based protein source for poultry nutrition because of its high protein (44% DM basis), methionine and lysine content (0.89%, 2.79% respectively, DM basis) comparable to meat and bone meal. The prepupae for this feeding trial was produced by inoculating fly eggs into nutrient trays comprised of mixtures of hen manure collected from manure belts at the Penn State Poultry Education and Research Center (PERC). After providing hen manure nutrients for approximately 12 days, the larva gradually turned to the black prepupae then crawled up a ramp to a self-collection tray. The prepupae were washed, dried then ground to pass through a 1-mm screen and then mixed to obtain a homogeneous meal. In the current study, Black Soldier Fly prepupae meal (FPM) contained 42.2% crude protein, 4.08 % moisture, 26.61 % crude fat, 0.59 % phosphorus and 6.09 % calcium (as is basis). Four dietary treatments with 0, 2, 4, and 6% FPM were formulated to meet Cobb 500 recommendations and fed as organic diets to evaluate their protein and amino acid contribution for broiler chicken growth performance. A total of 280 day-old Cobb 500 straight run broilers were randomly allocated to each treatment diet with 7 replicate battery cages per treatment (10 birds/replicate). Birds received a starter diet from 0-7 d of age and a grower diet from 8-21 d of age. Birds and feed were weighted weekly with cage as the experimental unit and at 21 d the birds were slaughtered and processed to determine carcass and parts yield. The data was analyzed as a one-way ANOVA with Tukey’s test for means comparison with a \( P \leq 0.05 \) level deemed statistically significant. For the entire experimental period, different inclusion levels of FPM had no significant effect \( P > 0.05 \) on body weight (BW), body weight gain (BWG), mortality or processing yields. Feed intake was reduced at 7-14 and 14-21 d and over the entire experimental period at the highest level of FPM (6%) compared to the corn/soy control and other dietary FPM levels (P<0.05). Feed to gain ratio follow a similar significant trend with birds fed the 6% FPM having a better FCR than the other treatments. In conclusion, the current study indicated that FPM was a beneficial nutrient supplement in broiler diets at a moderate inclusion rate and was only limited by its high ash and calcium content. Because of its favorable fat, energy, protein and amino acid profile, Black Soldier Fly prepupae meal might be a feasible dietary ingredient for organic poultry production.

Key Words: Black Soldier Fly prepupae meal, methionine, broiler, organic diets

M106 Effects of dietary amino acid density and tribasic copper chloride supplementation in Eimeria acervulina-infected chicks Samuel Rochell\textsuperscript{4}, Terri Parr\textsuperscript{4}, James Usry\textsuperscript{4}, Carl Parsons\textsuperscript{4}, Ryan Dilger\textsuperscript{1}, University of Illinois, Urbana, IL, USA; \textsuperscript{4}Micronutrients, Indianapolis, IN, USA

The objective of this experiment was to evaluate the influence of tribasic copper chloride (TBBCC) supplementation in diets varying in amino acid density on the growth performance, oocyst shedding, lesion scores, plasma carotenoid concentrations, and apparent ileal amino acid digestibility \( (\text{AIAAD}) \) in broiler chicks infected with Eimeria acervulina. Ross 308 male chicks (480 total) were housed in battery cages in an experiment that included 8 treatments in a factorial arrangement of 2 dietary AA densities \([1.00\% \text{ (LAA)} \text{ or } 1.20\% \text{ (HAA)}\] digestible Lys), 2 supplemental TBBCC indicate that both ADSBs were effective in reducing the toxic effects of AFB. Data also indicate that the raw product (ADSB-1) was just as effective as the concentrated product (ADSB-2).

Key Words: Aflatoxin, Adsorbent, Broilers, Liver lesion score

M107 Effects of dietary amino acid density and tribasic copper chloride supplementation in Eimeria acervulina-infected chicks Samuel Rochell\textsuperscript{4}, Terri Parr\textsuperscript{4}, James Usry\textsuperscript{4}, Carl Parsons\textsuperscript{4}, Ryan Dilger\textsuperscript{1}, University of Illinois, Urbana, IL, USA; \textsuperscript{4}Micronutrients, Indianapolis, IN, USA

The objective of this experiment was to evaluate the influence of tribasic copper chloride (TBBCC) supplementation in diets varying in amino acid density on the growth performance, oocyst shedding, lesion scores, plasma carotenoid concentrations, and apparent ileal amino acid digestibility \( (\text{AIAAD}) \) in broiler chicks infected with Eimeria acervulina. Ross 308 male chicks (480 total) were housed in battery cages in an experiment that included 8 treatments in a factorial arrangement of 2 dietary AA densities \([1.00\% \text{ (LAA)} \text{ or } 1.20\% \text{ (HAA)}\] digestible Lys), 2 supplemental TBBCC...
M101 The effect of feed processing of novel, low trypsin inhibitor, whole soybeans on the performance of turkey hens reared from 0-21 days

C. E. Evans1, J. L. Grimes1, C. R. Stark2, A. C. Fahrenholz1, D. Garlich1

1North Carolina State University, Raleigh, NC, USA; 2Kansas State University, Manhattan, KS, USA

Soybeans (SB) and corn are the major ingredients in poultry diets. However, unlike corn, SB must be extensively processed to reduce anti-nutritional factors such as heat sensitive trypsin inhibitors (TI). Recently non-GM SB have been selected for reduced levels of TI, potentially allowing their inclusion in turkey diets without further processing. The objectives of this study were to evaluate the novel low TI SB for its efficacy as a feedstuff for turkeys as well as to determine the optimal inclusion level & feed form of the diets. A total of 6 dietary treatments (TTR) were determined based on inclusion level of the novel SB (0%, 20%, & 40%) and feed form, either mash (M) or crumble (CR). The novel SB (w/hulls) & grains were roller milled to yield M TRT diets of 700 microns, while CR TRT diets were pelleted at 180°F prior to crumbling. All diets were iso-caloric & iso-nitrogenous. TTR were randomly assigned to 48 pens, each containing 10 female LW pouls (336), yielding 8 TRT replicates per diet. Pouls were raised from hatch to 21 d and allowed ad libitum access to feed & water. Feed intake (FI) & body weight (BW) were measured at 7, 14, & 21 d. Data were analyzed using JMP with means separated using LS means (P <0.05). Birds fed the novel SB (20% & 40%) as a CR exhibited greater BW (656.9 & 617.5±13.7g, respectively) compared to the same diet in M form (583.6 & 559.6±13.7g). In addition, the 20 & 40% novel SB diets as CR resulted in comparable BW to both 0% M & CR diets (651.5 & 659.6±13.17g). Overall, inclusion of the novel SB (M or CR) decreased BW, however, as the bird aged the effect was minimized. At 7 d, 20% novel SB TRT had 97% BW gain as compared to the 0% TRT (79.2 & 76.4±3.0g), while 40% novel SB TRT had 84% of the BW gain (66.5±3.0g). By 20, 20% & 40% novel SB TRT had 88% & 84% of the BW gain (151.7 & 143.7±4.1g) of the 0% TRT (171.5±4.1g), which increased at 21 d to 100 & 96% of the BW gain (341.3 & 320.5±6.0g) when compared to 0% TRT (340.5±6.0g). Thus it would appear that age improved the bird's ability to process the higher inclusions of the novel SB. Pouls receiving 20 & 40% novel SB TRT as M consistently had the lowest FI (321.1 & 315.0±6.8g from 14-21d), while the other diets resulted in similar performance. FCR reflected the same trend with the 0, 20, & 40% novel SB diets as CR resulting in the lowest FCR (1.39, 1.44, 1.38±0.06, respectively) and the 0, 20, & 40% novel SB diets as M exhibiting greater FCR (1.56, 1.64, 1.69±0.06). Based on BW & FCR we conclude that the novel, low TI SB is a viable ingredient for use in turkey diets. Its effectiveness as an ingredient is improved by feed processing, as shown through improved performance after pelleting. Further improvements may be possible by other actions such as the inclusion of enzymes.

Key Words: coccidiosis, Eimeria, copper, amino acid, digestibility

M102 Evaluation of Pennycress Meal as a feed ingredient for broilers

Rashed Alhornan1, Gene Pest1, Ronald Holser2
1Department of Poultry Science; University of Georgia, Athens, GA, USA; 2United States Department of Agriculture, Agricultural Research Service, Athens, GA, USA

Pennycress (Thlaspi arvense) is an annual winter plant found in North America that is being evaluated as a potential source of biodiesel. Pennycress meal (PM) is the by-product of pennycress seeds after oil extraction. The objectives of the present study were to evaluate the effect of PM inclusion and feed form on the live performance of starting broiler chicks (0-18 d). The diets were formulated to contain four levels of PM (0, 5, 10, and 15% of the diet) and provided in two forms (mash or crumbles), resulting in 8 dietary treatments (6 replicate pens/treatment). A total of 480 day-old Cobb 700 male chicks were randomly assigned according to treatment to 48 battery brooders each containing 10 birds. Feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) data were measured during the periods 0-10 d and 0-18 d of age and were subjected to two-way ANOVA using the GLM procedure of SAS software to determine the effects of PM inclusion, feed form and any possible interactions. Increasing the inclusion level of PM from 0 to 15% resulted in a linear decrease in FI during 0-10 d (P = 0.001) and 0-18 d (P = 0.016). There was no difference in FI (P > 0.05) due to feed form. There was no significant interaction between feed form and PM on FI. Increasing the inclusion level of PM resulted in a linear decrease (P < 0.001) in BWG during 0-10 d. BWG decreased at an increasing rate (P = 0.028) with increasing inclusion levels of PM during 0-18 d. Chicks fed the crumbled diets had increased BWG compared to those fed the mash diets during 0-10 d (P = 0.007) and 0-18 d (P = 0.017). A quadratic interaction effect of PM by form (P = 0.033) during 0-18 d was observed for BWG. There were no significant interactions of feed form by PM on BWG. Increasing PM levels depressed FCR linearly (P < 0.001) during 0-10 d. However increasing PM inclusion had no impact on FCR during the period 0-18 d. FCR was improved when feeding crumbled diets compared to mash diets during 0-10 d (1.195 vs. 1.151; P = 0.002) and 0-18 d (1.282 vs. 1.245; P = 0.015). Feed form by PM interaction on FCR was found to be not significant. No differences were found in mortality rates due to PM feeding (P = 0.533; Overall = 2.5%). The results indicate that feeding broiler starters PM up to 10% produced chicks similar to 0% PM, but 15% PM depressed growth; and the performance of chicks fed crumbled diets was superior to those fed mash diets.

Key Words: Pennycress, broiler, performance, crumbles, mash

M109 The use of low-tannin grain sorghum in broiler diets

Park Waldroup1, Samantha Shelton2, Deepthi Gadde1, Joel Thompson2, Susan Watkins1
1University of Arkansas Poultry Science Department, Fayetteville, AR, USA; 2University of Arkansas, Fayetteville, AR, USA

Use of grain sorghum in the past has been hampered by lack of pigment availability and by the development of high-tannin “bird resistant” varieties that reduce the nutrient value of the grain. The increase in the percentage of birds that are further processed has reduced the pigmenting demands, and sorghum growers in the United States have ceased producing the high-tannin varieties. Therefore, grain sorghum (milo) should be considered as a potential grain source for broiler diets. In the present study, a supply of grain sorghum grown in Arkansas was analyzed for CP, EE, ash, and crude fiber to adjust nutrient value. Diets were formulated for starter, grower, and finisher periods in which grain sorghum replaced 0, 20, 40, 60, 80, and 100% of the grain component of the diet. Each treatment was assigned...
to ten pens of 25 male broilers each (Cobb 500). Body weights and feed conversion were determined at 14, 28, and 41 d of age. At 42 d samples of birds had shank pigmentation measured and were processed with scald water at 130 F. Dressing percentage and parts yield were determined along with skin pigmentation. No significant differences were noted for BW, feed conversion, mortality, dressing percentage, or breast meat yield. As expected, shank and skin pigment scores were linearly reduced with each increment of grain sorghum in the diet. These results indicate that low tannin grain sorghum is a suitable replacement for part or all of the grain in a broiler diet when skin pigmentation is not a determining factor.

Key Words: broilers, grain sorghum, milo, pigmentation, alternative grain

M110 Evaluation of NSP enzymes for broiler diets Park Waldroup*, Changji Lu, Sarah Goodgame, Franco Mussini, Danny Bradley University of Arkansas, Fayetteville, AR, USA

Many NSP enzymes are offered for sale to the poultry industry, often with little or no published data to support their use. Fifteen enzymes presently offered for sale were obtained and evaluated against a negative and a positive control. The positive control diet was similar to that common in the poultry industry, while the negative control was 40 kcal/lb (89 kcal/kg) lower in energy. No attempt was made to verify the enzymes stated present by the manufacturer or to assess enzyme activity. In the first trial, twelve of the enzymes were added to aliquots of the negative control diet with each treatment fed to 18 replicate pens of five male chicks in battery pens to 18 d of age. In the second trial, 9 of the enzymes fed in the first study and three more additional enzymes were fed in the same manner. In the first study, none of the enzyme treatments differed significantly from the negative control in body weight while one enzyme treatment did not differ significantly from the positive control. In the second study, none of the treatments were significantly better in body weight than the negative control while one was significantly worse; all were significantly different from the positive control group. When enzymes common to both studies were compared, none were significantly different in BW than those fed the negative control and all were significantly different from those fed the positive control. In the first study, three enzyme treatments had significantly better FCR than those fed the negative control while one was not different from the positive control group. In the second trial no treatment was significantly better than the negative control group and all were significantly different from those fed the positive control. When enzymes common to both groups were compared, none was significantly different from the negative control group while all were different from those fed the positive control diet. In conclusion, when fed at their recommended level, none of the NSP enzymes evaluated had a consistent improvement in BW or FCR in starting broiler chick diets.

Key Words: broilers, enzymes, nonstarch polysaccharides, body weight, feed conversion

M111 Comparative performance of different broiler genotypes and morphometric analysis Park Waldroup*, Franco Mussini, Sarah Goodgame*, Changji Lu, Danny Bradley, Julia Dibner University of Arkansas, Fayetteville, AR, USA; Novus International, St. Louis, MO, USA

Intense genetic selection has brought about major changes in growth, feed conversion, breast meat yield, and many other structural and metabolic changes. This study was conducted to compare performance of a heritage strain cross with two major current strains and an experimental strain to evaluate not only growth and feed conversion but also to compare different organs and intestinal composition. A cross of NH x Columbian White Rock that has been maintained at the University of Illinois was compared to Ross 308 and 708 strains as well as a Ross Test Product. The NH x Col cross was the bird used to determine many of the nutrient requirements used in the industry today. One hundred and sixty two males of each strain were placed in battery brooders and fed typical starter, grower, and finisher diets. Every 7 days, two birds per pen were killed by CO2 inhalation. One was frozen for body composition determination and the other subjected to morphometric analysis. At 56 d all surviving birds were processed. Weights were taken of heart, spleen, proventriculus, breast, wing, and leg weekly, along with length of duodenum, jejunum, and ileum. Samples of each segment at 28 d were used to measure villus length and width. At 56 d dressing percentage, leg and wing yield were determined. As expected, BW and FCR were far superior for the modern strains. Tibia break force was significantly higher for the modern strains at 21, 35, and 42 d, indicating the emphasis placed on leg strength by geneticists. Heart weight as a percent of body weight was significantly higher for the heritage bird only after 21 d; no significant differences were noted for spleen, proventriculus, gizzard, or liver weights among strains. There was no significant difference in length of the duodenum at 49 d, but the modern strains had significantly larger jejunum and ileal segments than the heritage bird. When body weight was compared as a ratio of length of the intestinal segment, the modern strains had significantly greater BW than the heritage strains, although ileal nutrient digestibility at 28 d was similar for all strains. The modern strains had significantly greater villus height and villus surface area than the heritage strain. Overall, these data indicate that genetic selection for body weight gain, feed conversion, and breast meat yield has not come at the expense of nutrient digestibility or overall body health.

Key Words: broilers, genetic improvement, breast yield, morphometric analysis

M112 Evaluation of calcium levels in broiler grower diets with normal and extended levels of phytase Park Waldroup*, Sarah Goodgame, Danny Bradley, Franco Mussini, Changji Lu University of Arkansas, Fayetteville, AR, USA

The use of phytase has become almost universal in the poultry industry. As the cost of phytase has dropped concomitant with the increase in price of phosphate supplements, more producers are using higher levels of phytase, commonly known as “superdosing”. A question that has not been fully answered is the relationship of dietary Ca to the response to phytase, especially to the higher levels of phytase supplementation. A meta-analysis stated that it is important to determine the concentrations of Ca that are required for maximum response to specific levels of phytase. In the present study, diets fed included a positive control (0.35% NPP and 0.90% Ca) and also a 3 x 3 x 5 factorial arrangement with phytase levels of 500, 1000, and 2000 FTU/kg with a phytase of known activity (Quantum, ABVista) using phosphorus release factors of 0.10, 0.15, and 0.20% respectively (Target levels); values of 0.05% NPP above and below Target level, and Ca levels of 0.5, 0.6, 0.7, 0.8, and 0.9%. Each treatment was assigned to three pens of 5 male broilers from 14 to 35 d in two consecutive trials. Four basal diets were prepared including low NPP-low Ca, low NPP-high Ca, high NPP-low Ca, and high NPP-high Ca. After analysis for Ca and P levels, these four diets were blended as needed to provide the test diets. ANOVA indicated that none to the main effects or interactions had any significant effect on BW gain, FCR, or mortality. Both phytase level and Ca level had a significant effect on bone breaking force, with a significant interaction of phytase level and Ca level. Tibia breaking force of birds fed 2000 FTU/kg was significantly higher than that of birds fed 500 FTU/kg, with that of birds fed 1000 FTU intermediate. This suggests that the phosphorus release value assigned to the 2000 FTU/kg dosage was perhaps lower than it should be. However, feeding levels of 0.05% above or below the assigned values did not support this supposition. Rather, it appears that the higher phytase levels released a greater amount of Ca, thus supporting greater breaking strength. Birds fed the 500 FTU/kg phytase appeared to require 0.9% Ca for maximum bone strength, while birds fed the 1000 FTU/kg phytase appeared to require 0.8% Ca and birds fed 2000 FTU/kg appeared to require only 0.7% Ca for maximum bone strength. Thus, when using superdosing levels of phytase the Ca level of the diet can be reduced commensurately.

Key Words: Broilers, phytase, superdosing, calcium
M113 Microbial efficacy of a new water sanitation technology as compared to hydrogen peroxide and chlorine
Pramir Mahajan1, Samantha Cox2, Tyler Clark2, Susan Watkins1 1University of Arkansas, Fayetteville, AR, USA; 2U of Arkansas, Fayetteville, AR, USA

A bench top experiment was conducted to test three commercially available drinking water sanitizers for residuals and microbial reduction over time when used in water that contains a naturally occurring microbial population. Product A uses modified ambient oxygen to create hydroxyl ions and free radicals in water and works based on the Advance Oxidation Process concept. Product B was a 50% stabilized hydrogen peroxide and Product C was 5.25% sodium hypochlorite. Stock solutions were prepared for Product A at two different doses, 2ml and 4ml of the product, each respectively mixed with deionized water (CI = 0 ppm) to a volume of 128ml. For Product C, the stock solution was created by mixing 4ml of the product to a volume of 128ml also using deionized water. Next, 7.81ml of each stock solution was added to the uniformly blended microbial rich water (>4.47 log 10 units cfu/ml; CI =0 ppm) to prepare 1000 ml aliquots for each (1:128 dosing rate). Three replicates were prepared for each. Three replicates of test solutions for Product A were made by directly infusing the AOP gas at 1 liter per minute (LPM) main line divided into three sub lines diffusing each into 1000 ml of the microbial rich water. Water samples were pulled at 0 hr (pretreatment), and then at 15 min, 1, 6, 18 and 24 hours post treatment (PT) and plated for enumeration of aerobic bacteria (APC), and mold using 3M Petrifilm TM. Sanitizer residuals were measured at each sampling period. For the AOP technology, there were significant APC reductions (>2 log 10 cfu/ml) starting at 18 hours (P <0.05). The CI test solutions experienced a 1 log 10 reduction by 6 hours and remained there for the rest of the test. Product B tested at the higher rate reduced APC levels >1 log 10 at 6 hours and did not reduce further while the lower rate never reduced the APC greater than 1 log 10. Results indicate that continuous infusion of Product A was the most effective water treatment option for APC reduction at the tested dose.

Key Words: water, microbes, sanitation

M114 Incubation temperature profiles affect litter moisture in broilers
Albarna Sarsour1, Edgar Oviedo-Rondón1, Jenna Scott1 
1Prestage Department of Poultry Science, North Carolina State University, Raleigh, NC, USA; 2North Carolina State University, Raleigh, NC, USA

Incubation temperature profiles (INC) affect live performance and footpad dermatitis (FPD) incidence in broilers. In two experiments (Exp.) the effect of INC on litter moisture was evaluated. Two factorial arrangements of treatments were used. In Exp. 1 eggs from hens of 3 genetic lines with different FPD incidence were subjected to two INC. In Exp. 2 eggs from Cobb 500 hens were incubated under 3 INC and placed in floor pens with either new wood shavings or used litter. In both Exp. the first INC treatment maintained eggshell temperatures close to 38.0°C (S) for 21 d. The second profile (LIH) had low (36.9°C) eggshell temperatures for the first 3 d, and standard INC until the last 3 d when eggs were subjected to elevated (38.9°C) eggshell INC (H), as is observed in multistage machines. For Exp. 2 the third INC profile (SH) had S INC until the last 3 d when eggs had H INC. At hatch, 180 or 210 broilers per treatment combination, respectively, were placed in 15 pens with either new pine wood shavings or old used litter in Exp. 1, and with new or used litter in Exp. 2. Five litter samples per pen were collected at 13, 28 and 42 d in Exp. 1 and at 7, 13, 21 and 37 d in Exp. 2. Litter moisture was obtained after drying litter in a forced-air oven. Data was analyzed in two randomized complete block designs with a 3x2 factorial arrangement of treatments with incubation (S, LIH, SH) and either genetics (3) or litter type (new or used) as main factors and 15 replicates. In both Exp. INC consistently affected (P<0.001) litter moisture. In Exp. 1, litter moisture was one to two percentage points higher for the S treatment at 13 and 28 d of age, but at 42 d this situation reversed and pens containing broilers from the LH treatment had higher litter moisture. In Exp. 2, pens with chickens from the S INC had the lowest (P<0.001) litter moisture, which was similar to the LH INC at 37 d only. One interaction effect (P<0.001) was observed with genetics in Exp. 1 at 28 d, and interaction effects (P<0.001) with litter type were detected in Exp. 2. While higher litter moisture in Exp. 1 was associated with higher broiler feed intake and BW gain (P<0.05), this link was not evident in Exp. 2. In conclusion, incubation temperature profiles indirectly affected the litter moisture of broilers.

Key Words: Litter moisture, Incubation, Genetics, Litter type

M115 Effect of propolis supplementations on behavioral activities of heat stressed broiler chickens
Usama Mahmoud1, Mootaz Abdel-Rahman2, Madeha Darwish3, Todd Appelgate1, Heng-Wei Cheng4 1Purdue, Lafayette, IN, USA; 2Assiut University, Assitut, Egypt

Abstract
This experiment investigated effects of dietary supplementation of green Brazilian propolis on behavioral exhibitions of heat stressed broiler chickens. Five hundred and four 15-day old male Ross 708 broiler chicks were randomly allotted to six dietary treatments containing 0, 100, 250, 500, 1000 or 3000 mg kg-1 propolis. Each diet was fed to four replicates of 21 birds/pen. Heat stress was applied for 9 hrs/day at 32°C from 15 to 42 days. Three birds from each replicate were randomly selected and marked with livestock color for individually recording their activities by using direct observation instantaneous scan sampling technique (2hrs/day). The behavioral patterns of standing, walking, sitting, feeding, drinking, preening and feather pecking were recorded weekly for three consecutive days. The frequency of each behavior were presented as a percentage of total activities and analyzed by means of SPSS 22.00 Software. The data were tested for normality prior to analysis using a two-way ANOVA using the GLM procedure followed by multiple regression models. Results indicated that propolis at both 250 and 3000 mg kg-1 significantly (p<0.05) increased broilers’ mobility activities (walking, standing) but reduced panting. While, 100 mg kg-1 propolis significantly (p<0.05) increased broilers’ standing activity only. There were no treatment effects on sitting, preening, feeding, drinking, wing elevations and feather pecking activities. In conclusion, dietary supplementation of propolis treatment may be considered as a protective management practice in broilers by reducing the negative effects of heat stress, but it still needs further investigation to determine the affecting factors, such as the type and dose of propolis, and the time and duration of its application.

Key words: Broiler, Heat Stress, Propolis, Behavior

M116 Relationship among feed form, behavior and welfare, and growth performance using male broilers
Xianjiang Wen*, A.F. Liu, M.M. Beck, K.G.S. Wamsley, B. Sellers, X. Wang, W. Zhai 1Mississippi State University, Mississippi State, MS, USA

In a companion study, birds fed 75% intact-pellet diets had improved d 28 to 56 BW gain and d 57 carcass and breast weights, as compared to birds fed 55% intact-pellet diets. These birds were used in the current study to determine the relationship among feed form, behavior and welfare, and growth performance. A total of 144, 28-day-old male Ross × Ross 708 chicks were randomly distributed into 12 floor pens in 6 blocks after equalizing BW. Common diets that varied in feed form (intact pellet:ground pellet ratios of 75:25 and 55:45) were fed to birds in one of two pens in each block. Three chicks were randomly selected and marked from each pen. Behavior of birds was monitored for 60 min by video recording from 4 to 5 am, 9 to 10 am, and 2 to 3 pm each day at the 5th, 6th and 7th wk. Feather, footpad and hock burn score, as well as fluctuating asymmetry (FA) was evaluated at d 48. Body weights were determined at d 48 and 56 and carcass traits at d 57. A three-way ANOVA (PROC GLM) was
used to determine the significance of responses to feed form, bird age, time observation and their interactions. Partial correlation analyses were conducted among behavior, feather score, footpad score, FA, BW and carcass traits. Improved feed form (75% intact-pellet) decreased eating time (P=0.0004), increased walking time (P=0.010), and lowered fat pad weight (P=0.053). Moreover, longer walking time was associated with lower fat pad weight (P=0.024) and percentage of fat pad/BW (P=0.024). In addition, longer standing time was associated with heavier leg quarter weight (P=0.036). Longer resting time was associated with lighter leg quarter weight (P=0.049), but increased percentage of tender/BW (P=0.014) and tender/carcass (P=0.009). Feed form did not affect feather, footpad and hock burn scores, nor FA; however, longer walking time was associated with increased footpad lesion (P=0.007). Longer preening time was associated with decreased chest feather damage (P=0.015). Longer standing time and shorter eating time were associated with less vent feather damage (P=0.006; P=0.043). These data may in part explain observed performance benefits associated with improved feed form from the companion study via alteration of bird behavior and subsequent nutrient partitioning and growth.

Key Words: behavior, broiler, carcass traits, feed form, welfare

M117 Stress assessment by hematology - The requirements Paul Cotter' Cotter Laboratory, Arlington, MA, USA

The purpose of the presentation is to describe requirements needed for establishing stress by hematology. Since stress is included in welfare assessment of caged animals, a recognition scheme is necessary. A simple, hematology based premise, suggests a "tranquil hemogram" as a prerequisite. In its absence, stress exists. The following criteria give the requirements: 1. Total white blood counts (TWBC) (thousands/uL) (K), < 25 if TWBC > 25 < 50 “leukocytosis” exists; if TWBC > 50 “leukemoid” reaction exists; stress is established. 2. Lymphocytes: the majority in peripheral circulation are small “resting” types. If > 2 lymphocytes / 200 cell differential, are “reactive” (N/C ratio < 0.75), or if > 2 are frank plasmacytes, or if > 2 are “atypical”; stress exists. 3. Heterophils: absence of leukergy, classic, variant, and typical types are distinct types; and present in numbers ranging between, 5 – 10 K. More than 2 atypical heterophils / 200 cell differential indicates stress. 4. Basophils: > 5% of total granulocytes indicates stress. If > 2 basophils are atypical, reactive, toxic, or degenerate, stress exists. 5. Eosinophils are infrequent in normal chicken blood; higher frequencies are in ducks and geese. Circulating eosinophil meso or metamyelocytes in these species indicate a complex hemogram, a likely indication of stress. 6. Sentinel cells: cyanophils, coccyinocytes, large plasmacytoid lymphocytes, Mott cells; if found during a standard differential (200 cell) count indicate stress. If detected after a more extensive exam stress is likely. 7. Heterophil/lymphocyte ratios (H/L): at least 2 calculations are required. The first divides the sum of all heterophils by the number of small lymphocytes (H/L 1). The second divides the sum of all heterophils by all lymphocytes (H/L 2). 8. If the difference between H/L 1 and H/L 2 is > 10 %, stress exists. The values are derived from Lohmann LSL commercial layering hen data. It may be necessary to establish distinct value sets for other strains.

Key Words: Hematology, Stress, Welfare, Criteria, Sentinel cells

M118 Sustainability: Key parameters to measure ecological impact of the feed industry Franco Mussinii1, John Thomson2, Michael Binder3, Thomas Kaufmann4 'Evron Industries, Kennesaw, GA, USA; 2Evron Industries, Hanau, Germany

Increasing consumer awareness of the ecological impact products make on the environment have triggered discussions of the responsibility food producers have for the environmental footprint of their finished products. As a consequence, all the members of the production chain are developing programs to understand and minimize their ecological impact in order to become more sustainable. Though most companies have developed sustainability programs, these programs state actions but often fail to quantify how these actions modify the footprint of production processes on the environment.

To correct this, each step of the production process is studied to measure the different ways in which the process affects the environment. Life Cycle Assessment (LCA) uses three different indicators developed to properly measure this impact. Global Warming Potential (GWP), Eutrophication Potential (EP), and Acidification Potential (AP) accurately assess the environmental impact quantifying greenhouse gases emissions but also the eutrophication of lakes and rivers, and acidification of rain and fog through pH reduction by the transformation of air pollutants into acids. In this way an accurate, quantitative impact is obtained presented as Kilograms of CO2e (GWP1), Kgs of SO2e (API), and Kgs of PO4e (EP) per unit produced. A proper understanding of how these indicators are calculated is indispensable to identifying how changes in the production process affect the LCA, and consequently the environmental footprint.

Key Words: Sustainability, raw materials, Life cycle Assessment, Environmental footprint

M119 AMINOFootprint®: A novel tool to accurately measure sustainability progress in the poultry industry Franco Mussinii1, John Thomson1, Michael Binder2, Thomas Kaufmann4 1Evron Industries, Kennesaw, GA, USA; 2Evron Industries, Hanau, Germany

The topic of sustainability has grown in importance over the years to a point where most poultry and swine companies have included it among their core values. Consumers and customers constantly request actions from these companies to become more environmental friendly and modify their production processes to be more sustainable. Companies understand their responsibility and take measures in this direction but many times fail to quantify this progress.

In regard to feed production, Life cycle assessment (LCA) makes it possible to determine the impact that each feed ingredient has on the environment from cradle to grave, but it is very difficult to show how finished feed and variations in the feed ingredient origin and inclusion affect the environmental impact of animal feed. Evonik Corporation has developed a software tool to accurately calculate these variations and provide customers with a quantifiable proof of their progress. AMINOFootprint® calculates the ecological impact of finished feed based on certified LCA data of each ingredient along with its inclusion rate. This software takes into account the origin of each ingredient, since the impact will change based on variables such as origination point and mode or modes of transportation.

Results are expressed as three different, standardized key indicators of environmental footprint. Global warming potential (expressed as Kilograms of CO2e/MT of feed), Acidification potential (Kgs of SO2e/MT of feed), and Eutrophication potential (Kgs of PO4e/MT of feed) provide reliable data on how ingredients and changes in their inclusion rates can modify the impact animal feed has on the environment.

Key Words: Sustainability, global warming potential, acidification potential, acidification potential, animal feed

M120 Seasonal US broiler integrator performance history vs. coccidiosis control program: practical epidemiology and economics Linnea Newman1 Merck Animal Health, Summit, NJ, USA

US broiler integrators provided multi-year weight and feed conversion histories, as well as the coccidiosis control programs and the precise rotation dates during the same time period. The integrators represented birds slaughtered at ≤ 4 lbs. Performance data consisted of the weekly average weight and feed conversion ratio (FCR) representing approximately one million broilers slaughtered each week over a time period of 2 to 5 years. All of the integrators were in the US southern states, and the weekly performance was graphed against the weekly high temperature for the integration. Weekly high temperatures ranged from a low of 32°F in the winter to 99°F in the summer, with individual days reaching 104°F.
US broiler brooding and ventilation conditions vary by season of the year. The stocking density and number of flocks per year vary by the bird size at slaughter. To minimize fuel costs, ventilation is minimized and birds are brooded in the ½ house for the first 14 days during cold weather. The impact of these winter management changes is seen as a steady rise in FCR from fall through winter, peaking in the spring in the flocks weighing 3.5 to 4.0 lbs.

The pattern of rising FCR can be seen year after year. The magnitude of the FCR increase ranged from 8 points to 22 points for the 4 lb broiler. FCR steadily declined through the warmer months until it reached the lowest point in the fall of the year. The duration of the rise was 21 to 26 weeks. Therefore, a 14 point rise over 26 weeks would be an average increase of 7 points for half of the year: a highly significant economic impact to a small bird broiler integrator.

Three pieces of evidence point to coccidiosis as the cause for the seasonal pattern of rising FCR: clinical coccidiosis outbreaks (1 company), response to robenidine (2 companies), and the fact that the seasonal pattern could be broken by using a coccidiosis vaccine for 3 to 4 flock cycles before the winter season (3 companies).

The declining efficacy of anticoccidials means that we must recognize and understand the impact of stocking density, flock cycles per year, bird size, humidity and *Eimeria* population dynamics. Small bird integrators are the most impacted by seasonal performance decline due to higher stocking density and a higher number of flock cycles per year. Awareness of the seasonal effect may enable integrators to adopt management strategies aimed at limiting the adverse seasonal effect on performance.

**Key Words:** coccidiosis, *Eimeria*, FCR, Seasonal, Performance

**M121 Efficacy of a combination of *Bacillus subtilis* and *B. licheniformis* on the performance of broilers under intestinal stress**

Michael Sims1, Anee Berg Kehlet2, David Harrington3

1Texas A&M University, College Station, TX, USA; 2Chr. Hansen A/S, Hørsholm, Denmark

Recent pressure to reduce the use of in-feed antibiotics has left a requirement for alternative solutions. In periods of extreme intestinal stress a combination of direct fed microbials (DFM) and antibiotics might prove desirable. A study was conducted to evaluate the effect of a DFM comprising *Bacillus subtilis* and *B. licheniformis* with and without Flavomycin on broiler performance under conditions of intestinal stress.

A total of 2,475 chicks were allocated to 5 treatment groups, 35 chicks per pen (7 replicates/treatment). All birds were fed a basal corn-soy based diet. Treatments were: 1) Non-infected Control (nCON); 2) Infected control (iCON); 3) *B. subtilis* and *B. licheniformis* (BSBL); 4) Flavomycin (FLV); 5) BSBL and FLV. FLV was administered at 2 ppm and BL at 1.6 x 10⁹ CFU/g feed. At 7 days, old litter was introduced into each pen. At 31 days birds in treatments 2-5 were orally administered 1ml *Clostridium perfringens* (10⁹ CFU/ml). Performance was recorded at 42 days and NE lesion score determined at day 35. Data were analyzed by ANOVA.

At 42 days BSBL and BSBL+FLV had significantly heavier bodyweights (2.131 and 2.128 kg, respectively) than the other treatments. FCR did not differ significantly between treatments in any feeding periods. On Day 35 FCR in BSBL+FLV was numerically lowest (1.75), while on Day 42 FCR was lowest in uCON (2.016). All groups including nCON had NE lesions on day 35. BSBL+FLV had both significantly lower score than uCON (1.389) and numerically lowest score (0.833) of all infected treatments. Lesion scores in BSBL and FLV were 1.056 and 1.028, respectively. Overall mortality did not differ significantly between treatments, uCON had the lowest mortality (2.48%). EPEF was highest in the BSBL group (241) closely followed by UCON (240) and BSBL+FLV (237).

This study demonstrated that a combination of *B. subtilis* and *B. licheniformis* improved bird performance and EPEF by up to 5.0%. When the DFM combination was used with Flavomycin there was a synergistic effect resulting in improved lesion score and EPEF by up to 3.0% compared to Flavomycin alone.

**Key Words:** Bacillus, Flavomycin, Probiotic, Poultry, Performance

**M122 Improving turkey performance using a Bacillus-based feed additive**

Anee Berg Kehlet1, Krzysztof Kozlowski2, Vlastislav Machander3

1Chr. Hansen A/S, Hørsholm, Denmark; 2Uniwersytet Warmińsko-Mazurski w Olsztynie, Olsztyn, Poland; 3MTD, s.p., Ustraścice, Poland

Two feeding trials were conducted to evaluate the efficacy of a direct fed microbial (DFM) comprising *B. licheniformis* and *B. subtilis* in a ratio of 1:1 (1.28E+6 cfu/g) in female turkey diets.

Trial A consisted of 18 pens of 35 1-day-old Big 6 turkeys from day old until 56 days of age. The treatments were replicated in 6 blocks of 3 pens each. The treatment groups were AT1: Untreated control, AT2: Day 1-28 DFM, AT3: Day 1-56 DFM. Liveweight, feed conversion ratio and mortality were measured at day 1, 28 and 56. Data were analyzed by ANOVA and Scheffé test (P≤0.05). Trial B consisted of 20 pens of 15 1-day-old Hybrid Converter female turkeys. The treatments were replicated in 10 blocks of 2 pens each. The treatment groups were BT1: Untreated control, BT2: Day 1-84 Liveweight, feed conversion ratio and Productive Efficiency Index (PEI) were measured at day 1 and 84. Data were analyzed by ANOVA and GLM test (P≤0.05).

Both trials showed significant improvement of production parameters in birds fed diets containing DFM. In trial A at day 28 turkeys fed diets containing DFM had a significant higher body weight of 5.2% and 3.4% for AT2 and AT3 (1005.38 and 988.00 g respectively) compared to the control (955.81 g). At 56 days weight gain was numerically improved by 2.7% and 2.8% for AT2 and AT3 (4409.19 and 4416.00 g respectively) compared to the control group (4295.24 g). Furthermore a numerical improvement in the FCR between AT1 and AT3 of 4.5 points (1.901 and 1.856 respectively) was seen. There were no dead birds in any of the treatment groups during the course of the study. In trial B the final weight of turkeys fed the DFM was significantly improved by 4% compared to control group (7659 and 7363 g respectively). FCR did not differ significantly but a 4 point improvement in the DFM group compared to the control (1.90 and 1.94 respectively) was seen. The PEI was significantly improved in the DFM group compared to the control, 453 and 481 respectively, a 6% increase. In conclusion the probiotic feed additive shows a significant effect on production performance in female turkeys in two independent studies performed under commercial like conditions.

**Key Words:** Bacillus, Poultry, DFM, Turkey, Performance

**Metabolism & Nutrition IV**

**M123 Evaluation of a thermotolerant xylanase on broiler growth performance and ileal digestible energy**

Cody Flores1, Rocky Latham1, Patrick Biggs2, Jason Lee1

1Texas A&M University, College Station, TX, USA; 2BioResource International, Inc., Durham, NC, USA

This study evaluated the effect of a thermotolerant xylanase (XYL) on male broiler growth performance and ileal digestible energy (IDE). A randomized complete block design study included four treatments with 10 replicates of 44 male broilers per replicate for a total of 1760 broilers for a 41-d assay period. The dietary treatments consisted of a positive control (PC) based on corn/soy that contained DDGs, negative control (NC) diet (-150 kcal/kg ME), NC+10,000 XU/kg XYL (XYL10), and NC+20,000 XU/kg XYL (XYL20). All diets contained a phytase and were pelleted at 80°C. The dietary program consisted of 3 phases: starter (1-14 d), grower (15-27 d) and finisher (28-41 d). Growth performance was determined at the final weight of 2.8 to 3.0 kg. All groups included nCON had NE lesions on day 35. BSBL+FLV had both significantly lower score than uCON (1.389) and numerically lowest score (0.833) of all infected treatments. Lesion scores in BSBL and FLV were 1.056 and 1.028, respectively. Overall mortality did not differ significantly between treatments, uCON had the lowest mortality (2.48%). EPEF was highest in the BSBL group (241) closely followed by UCON (240) and BSBL+FLV (237).

This study demonstrated that a combination of *B. subtilis* and *B. licheniformis* improved bird performance and EPEF by up to 5.0%. When the DFM combination was used with Flavomycin there was a synergistic effect resulting in improved lesion score and EPEF by up to 3.0% compared to Flavomycin alone.

**Key Words:** Bacillus, Flavomycin, Probiotic, Poultry, Performance
14, 27 and 41 d. Ileal contents were collected from 5, 4 and 3 birds at 14, 27 and 41 d, respectively, and pooled on a per pen basis. All data were subjected to one-way ANOVA using GLM (SPSS) with means deemed significantly different at P<0.05. The 150 kcal/kg reduction in energy resulted in a decreased (P<0.05) body weight (BW) at 14 and 27 d between the PC and NC diets. Supplementing XYL20 improved BW at 14 and 27 d making it similar to the PC while greater than (P<0.05) the NC. Birds fed XYL10 had a BW that was greater than (P<0.05) the NC and similar to the PC at 27 d. At 41 d, BW gain (BWG) of birds fed XYL20 (2.871 kg) was significantly higher than the NC (2.797 kg) yet similar to the PC (2.856 kg), whereas the BWG of birds fed XYL10 (2.856 kg) were similar to both the PC and NC. The 41 d weight-adjusted FCR was different (P<0.05) for the PC (1.67) and NC (1.72) while the two XYL treatments were intermediate (both at 1.68). The reduction in metabolizable energy between the PC and NC was evident in the IDE between those two treatment at 14, 27 and 41 d with the NC showing an IDE that was 244, 166, and 256 kcal/kg lower than the PC (P<0.05). When XYL10 was supplemented to the NC, the IDE at 14 and 41 d was increased (P<0.05) 121 and 84 kcal/kg, respectively, while being similar to the PC. Birds fed XYL20 showed a similar response with an increase (P<0.05) in IDE of 138 and 166 kcal/kg over the NC that was also similar to the PC. Xylanase inclusion increased IDE which correlated to improvements in growth performance in male broilers fed a reduced energy diet.

**Key Words**: Xylanase, Broiler, Performance, Digestible Energy

### M124 Evaluation of NSPase inclusion in diets manufactured with high and low quality corn on male broilers

Hunter Walters*, UG1, Jake Pieniazek1, Blyn Brown2, Roy Brister3, Shivaram Rao4, Jason Lee1

Texas A&M University, College Station, TX, USA; 2DSM Nutritional Products, Parsippany, NJ, USA

The objective of the current study was to evaluate the efficacy of NSPase inclusion in diets manufactured with high and low quality corn on male broilers. Low quality corn was achieved with the inclusion of 20% corn screenings and formulations were made on an isonitrogenous and isocaloric basis. A total of 1,920 male broilers were assigned to 6 diets in a 2 X 3 factorial arrangement consisting of 16 replicates of 20 broilers: diet type (with corn screenings or without corn screenings) and enzyme inclusion. The enzyme inclusion factor included a positive control (PC), negative control (NC) (PC -110 kcal/kg in AME), and NC + NSPase supplementation. All diets were corn and soybean meal based and included LO-DDGS and meat and bone meal. Birds were fed a starter (d1-14), grower (d 14-27), and finisher (d 27-42) and all diets were pelleted at 70 C with a 25 second conditioning time. Average body weight (BW), mortality adjusted feed conversion ratio (FCR) and feed consumption (FC) were determined on days 14, 27, and 42 which coincided with dietary changes. Inclusion of corn screenings decreased (P<0.05) starter diet FC and thus negatively impacted (P<0.05) d 14 BW. Reduction of AME increased (P<0.05) starter diet FCR. A significant interaction (P<0.05) was observed on d 27 related to BW and FC between diet type and enzyme inclusion as benefits associated with NSPase inclusion were more pronounced in diets containing corn screenings. Addition of corn screenings increased grower and cumulative FCR (d 1-27) as compared to diets that did not include corn screenings. Similar to the starter diet, reduction of dietary AME increased (P<0.05) grower and cumulative (d1-27) FCR in the NC fed broilers as compared to the PC broilers. Inclusion of NSPase in the NC diet improved (P<0.05) FCR during the grower phase and through 27 d of age. During the finisher phase of production, broilers fed diets containing corn screenings exhibited a lower (P<0.05) FCR as compared to broiler fed diets without corn screenings. The reduction in dietary AME increased (P<0.05) observed FCR (d1-42), however, inclusion of NSPase in the NC diet reduced (P<0.05) FCR to a level comparable to the PC. In conclusion, the use of corn screenings did not impact final growth performance and the inclusion of NSPase reduced FCR when fed in reduced energy diets.

**Key Words**: corn screenings, NSPase, broiler, performance, energy

### M125 Evaluation of an enzyme composite on growth performance and ileal digestible energy

Austin Jasek*, Kolton Page1, Rocky Latham1, Nelson Ward2, Jason Lee1 Texas A&M University, College Station, TX, USA; 2DSM Nutritional Products, Parsippany, NJ, USA

The objective of this study was to evaluate the effectiveness of an enzyme combination on growth performance and energy digestibility in Ross 708 male broilers. The enzyme was a product comprised of NSP enzymes for cereal and leguminous protein sources, as well as debranching enzymes for NSPs and protease. The 17 d experiment was conducted in battery pens and consisted of three dietary treatments including a positive control (PC) diet, a negative control (NC) diet (PC less 77 kcal/kg AME, 0.10% aP, 0.12% Ca, 0.03% dIys, 0.03% dThr, and 0.01% dTSA), and 3) NC + enzyme composite consisting of (phytase and Victus®). Each treatment consisted of 12 replicates containing 15 birds per replicate (540 total broilers). The dietary program consisted of one dietary phase of crumbled starter feed pelleted at 75 C. The diet was composed of corn, soybean meal, DDGS (3%), wheat midds (3%), and an animal vegetable blend fat source. Body weights and feed consumption were collected on d10 and 17. On d 17, ileal contents were collected from all broilers and pooled within replicate. The PC treatment maintained higher (P<0.05) body weight as compared with the NC diet throughout the study indicating that the reductions in energy, aP, and amino acid concentration were sufficient to reduce body weight. The PC and NC diets produced similar mortality corrected feed conversion ratios; however, the NC fed broilers consumed less feed (P<0.05). The inclusion of the enzyme composite into the NC diet increased (P<0.05) body weight throughout the study as compared with the PC and NC fed broilers. Inclusion of the enzyme composite also resulted in lower (P<0.05) observed FCR throughout the study. Ileal digestible energy was reduced (P<0.05) in the NC diet as compared with the PC fed broilers when evaluated on d 17. Inclusion of the Victus® enzyme increased (P<0.05) ileal digestible energy to levels similar to the PC diet. These data confirm the efficacy of Victus® enzyme to overcome significant decreases in AME, aP and digestible amino acids imposed in the NC diet, while outperforming the PC-fed birds in body weight gains and FCR, over the 17-d period.

**Key Words**: Broiler, Energy, Enzyme Composite, Performance, Digestibility

### M126 Evaluation of multiple levels of phytase and non phytase enzyme inclusion on broiler growth performance

Tucker Allcom*, Mallori Williams1, Rocky Latham1, Milan Hruby2, Jason Lee1 Texas A&M University, College Station, TX, USA; 2Danisco Animal Nutrition, DuPont Industrial Biosciences, St. Louis, MO, USA

An experiment was conducted to determine the effect of two levels of phytase (analyzed average 700 and 1400 FTU/kg) and three levels of multienzyme product inclusion (low/medium/high) in low energy corn-soybean meal diets containing DDGS on broiler growth performance. The experimental design consisted of seven treatments including a reference control diet, and the remaining six treatments composing a two by three factorial of the varying levels of enzymes included in a reduced energy (-88 kcal/kg) diet. Each treatment included 10 replicates with 37 male chicks per treatment group (2590 total placement). Dietary program consisted of a three phase program, starter (5% DDGS), grower (10% DDGS), and finisher (15% DDGS). Broilers were weighed and feed consumption determined on days 15, 28, and 42. At the conclusion of the trial average body weight of each treatment was similar to the reference diet. One way analysis indicated that the individual treatment of high phytase x low multienzyme and high phytase x medium multienzyme, both reduced (P<0.05) cumulative FCR similar compared to the reference diet. Factorial analysis confirmed that 1400 FTU/kg of phytase reduced (P<0.05) starter FCR. Phytase inclusion at 700 FTU/kg reduced (P<0.05) finisher phase mortality. Low multienzyme inclusion fed broilers consumed elevated levels of...
Poult. Sci. 94 (E-Suppl. 1)

**Key Words:** broiler, performance, multienzyme, phytase, DDGS

**M127 energetic efficiency and body composition of broilers fed diets with exogenous enzymes during starter, grower and finisher** Justina Caldas\(^{1,2}\), Nirun Boomsinchai, Ethan Holt, Andrew Magnuson, Jinrong Wang, Judith England, Craig Coon University of Arkansas, Fayetteville, AR, USA

Diet composition and enzyme inclusion significantly influences body composition in broilers (Caldas et al., 2014) from which a lean carcass is the main trait desired by the consumer. The aim of the study was to determine the effect of adding exogenous enzymes on body composition and heat production (HP, kcal) through the use of DEXA (dual energy X-ray absorptiometry) and indirect calorimetry, respectively. Two diets were studied: T1 Negative control (NC); and T2 NC + Enzyme composite (phytase + xylanase + glucoinase + protease + pectinate); protease and pectinase were removed from the finisher. 2000 Cobb male chicks were fed the respective dietary treatments during 5-13 d starter; 14-28d grower and 32-49d finisher period. Birds were moved to the respiratory chambers 3 d before evaluation for adaptation. The evaluations were accomplished 2 times in starter, 3 times in the grower and 2 times in the finisher. The statistical analysis was achieved using JMP pro 11 (SAS, 2013). A CRD was used with 6, 9 and 6 replications in the starter, grower and finisher respectively. In the starter period the diet with enzyme composite increased body protein (150.2 vs 152.2 g/Kg) (p=0.0127)\(^{*}\) and decreased body fat (93.6 vs 79.2 g/Kg) (p=0.002)\(^{*}\). It also showed more HP (153.31 vs 152.2 g/Kg) (p=0.0127)\(^{*}\) because of the higher body protein composition as expected. In the grower the body composition showed a transition (previously showed by our group in Caldas et al., 2014), the 2 first parts (during d15-d22) the enzyme treatment had higher body protein content (p=0.11) and less body fat (p=0.19) and in the last period of the grower (d25-d28) the body composition switched to less protein (168 vs 163.6 g/Kg) (p=0.06) and more fat (72.6 vs 85.1 g/Kg) (p=0.08); it also showed less Heat Kcal/Kg\(^{*}\) because of the fat gain (p=0.0482)\(^{*}\) as expected. During the finisher the enzyme treatment produced higher body protein (176.6 vs 180.4 g/Kg) DM (p=0.0267)\(^{*}\) and decreased body fat (103.43 vs 95.2 g/Kg DM) (p=0.0091)\(^{*}\). Also the HP Kcal/Kg\(^{*}\) was higher because of the higher protein deposition (p=0.08); however HP (kcal/ kg feed intake) was lower (2438 vs 2180) (p=0.0154)\(^{*}\) because of the higher feed intake with the enzyme composite treatment (129 vs 159 g/d) (p=0.0298)\(^{*}\) with improved FCR (p = 0.0348)\(^{*}\) during the finisher period. The metabolic chamber and body DEXA data shows that body composition in broilers can be affected with the addition of exogenous enzymes. This study suggests the enzymes may be releasing more amino acids to allow higher body protein deposition at the same body weight and also improving the efficiency on energy utilization in the finisher period because of the lower heat production per kg of feed intake.

**Key Words:** Enzyme composite; indirect calorimetry; body composition

**M128 Evaluation of xylanase enzyme efficacy in broiler diets.** Marissa Kost\(^{1,5,6}\), A. C. Fahrenholz, J. Brake Prestige Department of Poultry Science, North Carolina State University, Raleigh, NC, USA

The effects of xylanase supplementation on feed intake, BW, and feed conversion ratio (FCR) of male broilers reared to 43 d of age were evaluated. A total of 2,304 Ross 344 × Ross 708 male broilers were provided 9 wheat-DDGS-corn-SBM based dietary treatments with 8 replicates each. The diets included a positive control (PC) reference diet, a negative control (NC) basal diet with a lower energy density, and 7 xylanase supplemented diets ranging in dose from 125 to 2000 IU added to the negative control (NC+Xyl 1-7). The NC and NC+Xyl 1-7 starter diets contained 1.5% total added fat [1% mixer + 0.5% Post Pellet Liquid Application (PPLA)], whereas the grower and finisher diets contained 1% total fat added in the mixer only. The PC starter diet contained 4.05% total added fat (1% mixer + 3.05% PPLA) and the grower and finisher diets contained 3% total added fat (1% mixer + 2% PPLA). All data were calculated and analyzed using PROC GLM to determine least squares means. Modified PDI values were determined for all treatments and all grower and finisher diets, with the exclusion of the crumbled starter diets. Modified PDI values for the PC, NC, and NC+Xyl 1-7 grower diets were 70.9, 69.0, 68.2, 67.5, 65.5, 70.1, 73.8, 72.8, and 71.0, and the finisher diets were 72.6, 75.0, 69.9, 52.2, 69.0, 70.3, 75.3, 72.7, and 72.4, respectively. Birds that received the NC diet exhibited numerically poorer cumulative FCR (8 points; P < 0.10) compared with those fed the PC diet, confirming the lower energy density of the NC diet. Further, the PC diet exhibited a significant improvement in FCR (P < 0.01) compared to the NC and all NC+Xyl 1-7 diets from both 14 to 35 d and 0 to 35 d of age. The mean ileal digestibility for the PC, NC, and NC+Xyl 1-7 diets calculated on a dry matter basis was 46.2, 50.9, 52.9, 53.6, 58.2, 56.4, 54.2, 50.5, and 46.0, respectively, and described a quadratic response (P<0.01). This may have been due to net negative energy values caused by the release of excess pentose molecules at the greater dosages in comparison to hexasose molecules, which compete for absorption in this particular formulation. However, improvements in digestibility did not correspond with improved FCR as compared to the PC diet. The overall FCR for the PC, NC, and NC+Xyl 1-7 were 1.64, 1.72, 1.69, 1.71, 1.69, 1.69, 1.68, 1.72, and 1.70, respectively. Evidently, energy derived from carbohydrates released from enzyme activity did not equate to the differences in dietary fat content. There were no significant differences in mortality. There were no significant differences in carcass traits.

**Key Words:** Broilers, xylanase, low energy diets, ileal digestibility, PPLA

**M129 Effect of adding phytase to broiler diets containing low phytate-low stachyose and normal phytate soybean meal on live performance, total phosphorus digestibility, and bone ash** Basheer Nusairat \(^{1,5,6}\), John Brake\(^{1}\), Adam Fahrenholz\(^{2}\), Saghai Marouf\(^{1,5,6}\) North Carolina State University, Raleigh, NC, USA; \(^{7}\)Virginia Polytechnic Institute, Blacksburg, VA, USA

This study evaluated the effects of phytase in diets containing normal phytate (NP) versus low phytate-low stachyose (LP-LS) soybean meal (SBM) on BW, feed intake, FCR, total phosphorus (P) digestibility, and bone ash of broilers grown from 22-35 d. A total of 216 Ross 708 female broiler chicks were assigned to 36 cages in 2 batteries with 6 birds per cage. From 1-21 d, a common corn-SBM starter diet was fed. From 22-35 d, a 2x3 factorial arrangement of SBM type (LP-LS and NP SBM) and phytase additions were used with 6 cages per diet. Phytase treatments were no phytase (CON), matrix phytase in which phytase was given a matrix value (MX), and on-top (OT) phytase in which phytase was not given a matrix value. Birds and feed were weighed at 1, 21, 28, and 35 d, and all birds were necropsied at 35 d to determine gizzard and proventriculus weights, ideal total P digestibility, and percentage bone ash. Data from 22-35 d were analyzed as a randomized complete block design. The BW gain was greater (P ≤ 0.05) in birds that consumed LP-LS SBM from 22-35 d (763 versus 733 g), which was reflected in an improved (P ≤ 0.05) FCR for the same period (1.93 versus 2.00 g:g). Feeding LP-LS SBM also produced a smaller (P ≤ 0.0001) gizzard (18.7 versus 20.3 g) compared to NP SBM, which may have reflected reduced digestive demand. Total P digestibility (58.4 versus 68.5%) and bone ash were both reduced (P ≤ 0.0001) when birds were fed LP-LS SBM, which reflected the altered dietary P in the LP-LS diet. Adding phytase either as MX or OT improved (P ≤ 0.0001) total P digestibility compared to the CON diet (65.6 and 68.6 versus 56.3%, respectively).

**Key Words:** Broilers, low phytate SBM, low stachyose SBM, phytase
M130 Effect of a heat-stable xylanase, alone and in combination, with a commercial phytase on broiler performance from day-of-hatch until 42 days of age Ilana Barash*, Jesse Grimes, Jim Garlich, Patrick Biggs, 1 North Carolina State University, Raleigh, NC, USA; 2 BioResource International, Inc., Durham, NC, USA

Higher prices and decreased availability of corn have increased interest in replacing corn with alternatives such as wheat or DDGS. This has also increased interest and use of exogenous carbohydrases in poultry feed to improve nutrient digestibility from these alternative sources. A study was conducted to evaluate the efficacy of an exogenous, heat-stable xylanase (Xylamax™, BioResource International, Inc.) in broiler chicken diets when supplemented in combination with a commercial phytase (Axtra® PHY TPT, DuPont). Eight wheat-based diets (60%) containing DDGS (10%) were fed to Ross 708 male broiler chicks from hatch until 42 d. The treatments were arranged in a 2x2x2 factorial of energy level (breeder recommended energy level or 200 kcal ME reduction), xylanase inclusion (0 or 20,000 XU/kg of feed), and phytase inclusion (0 or 500 FTU/kg feed). In diets containing phytase, available phosphorus and Ca were reduced 0.1%. Birds were housed in 96 litter-floor pens with each treatment replicated 12 times with 16 birds per pen in a curtain-sided house. Bird and feeder weights were collected at 14, 28, and 42d to obtain BW gain (BWG), feed intake (FI), and feed conversion ratio (FCR). Data were analyzed using JMP 10 with treatment means separated by LSMeans; treatment effects were considered significant at P<0.05. Higher (P<0.005) BWG (42d) was observed with the addition of xylanase (3233 vs. 3195 g) and phytase (3268 vs. 3161 g) when added individually compared to diets containing no enzymes. When xylanase and phytase were added in combination, BWG was higher than birds fed no enzymes or xylanase alone but were not different than the treatments receiving only phytase. FCR was improved (P<0.0001) with the inclusion of xylanase (1.76 vs. 1.81) and phytase (1.75 vs. 1.81) alone compared to the control. When birds were fed a diet containing xylanase and phytase, regardless of energy content, FCR was improved (P<0.001) to 1.73 versus birds receiving no enzymes (1.84). This exogenous xylanase improved broiler performance from hatch until 42d when included in a wheat-based diet alone and additional improvements were observed when added in combination with a commercial phytase.

Key Words: xylanase, enzyme, heat-stable, phytase, broilers

M131 Effects of intermittent wheat inclusion on broiler performance, gastrointestinal tract health, and footpad dermatitis during a 46 d production period Klint McCafferty*, Craig Wyatt, Kenneth Macklin, William Dozier, III 1 Auburn University, Auburn, AL, USA; 2 AB Vista Feed Ingredients, Marlborough, United Kingdom

Wheat may be used as a substitute for a proportion of corn in broiler diets when economically viable. Anecdotal evidence has suggested that switching wheat for a proportion of corn in a corn-soybean meal (CSBM) based diet within a single production period may negatively impact performance objectives. Compared with corn, wheat contains higher concentrations of soluble non-starch polysaccharides, which may increase digesta viscosity leading to the development of gastrointestinal tract (GIT) and footpad lesions. Therefore, an experiment was conducted to determine the effects of intermittent wheat inclusion on growth performance of male broilers, as well as on the incidence of GIT and pododermatitis (PD) lesions, during a 46 d production period. Male broilers (1.980; Ross X Ross 708) were placed into 60 floor pens (33 birds/pen) and were randomly assigned to 1 of the following 6 dietary treatments for the starter, grower, and finisher phases, respectively: 1) CSBM, CSBM, and CSBM; 2) wheat-soybean meal (WSBM), WSBM, and WSBM; 3) CSBM, CSBM + 20% wheat, and CSBM + 30% wheat; 4) CSBM, CSBM, and CSBM + 30% wheat; 5) CSBM + 10%, + 20%, and + 30% wheat; or 6) WSBM, WSBM, and WSBM + 30% corn. Broilers and feed were weighed at 13, 27, and 46 d of age in order to determine BW gain, feed intake, and feed conversion ratio. Additionally, broilers were scored for GIT lesions (5 birds/pen) at each weighing period and PD (25 birds/pen) lesions at 46 d of age. No overall treatment effects (P>0.05) on performance were observed at 46 d of age. Additionally, orthogonal contrasts indicated that broilers receiving treatment 1 had similar (P>0.05) BW gain and feed intake than those receiving treatment 2. Wheat-based diets had a higher (P<0.05) incidence of GIT lesions at 27 d of age, but treatment type did not affect (P>0.05) PD or GIT lesions at 46 d of age. These results indicated that wheat may be substituted for corn in broiler diets with limited negative effects on performance, gut health, and incidences of PD.

Key Words: wheat, corn, pododermatitis, broiler

M132 Effects of calcium concentration on true ileal phosphorus digestibility and true phosphorus retention determined using the regression technique in growing broilers Kurt Perryman, Helen Masey O’Neill, Mike Bedford, William Dozier, III 1 Auburn University, Auburn, AL, USA; 2 AB Vista Feed Ingredients, Marlborough, United Kingdom

A standard assay for the determination of P availability of feedstuffs has not been established. Proposed protocols indicate P availability values should be derived using regression, which negates the need to correct for endogenous P losses. However, very limited research has been published on the determination of true ileal P digestibility (TIPD) and true P retention (TPR) of corn. Furthermore, dietary Ca concentrations are critical when determining P availability, and the role of Ca concentration on P availability has not been assessed using these assays. Therefore, an experiment was conducted to determine the effects of dietary Ca concentration on TPR and TIPD of corn. Experimental diets were isocaloric and isonitrogenous and formulated to contain either 0, 25, 50, or 75% corn with dietary Ca concentrations of 0.95%, 0.13%, or variable Ca concentrations to ensure a 2:1 Ca:P ratio. A practical, corn-soybean meal diet (1.4:1 Ca:P ratio) was fed as a control. After receiving a common starter diet, experimental diets were fed from 19 to 26 d of age. After 48 h of dietary adaptation, a total of 960 Ross × Ross 708 male broilers were used in a 48 h balance assay. Ileal digesta was then collected from 8 birds per pen at 25 and 26 d of age. Broilers consuming the control diet had higher (P<0.001) BW gain, feed intake, digesta P, and excreta P and Ca than broilers consuming the corn titration diets. Digesta and excreta P increased linearly (P<0.05), while no linear or quadratic effects (P>0.05) were observed for ileal P digestibility or P retention with increasing dietary corn for all 3 dietary Ca concentrations. True ileal P digestibility and TPR were highest (P<0.05) for diets with 0.13% Ca (57.3 and 69.5%, respectively) compared with diets formulated with 2:1 Ca:P (41.2 and 37.8%, respectively) or 0.95% Ca (25.4 and 39.0%, respectively). These data demonstrated that the regression method may be applicable to estimate true P availability of corn, and that P availability was significantly influenced by Ca concentration of the diet.

Key Words: phosphorus, digestibility, calcium, broiler
**Metabolism & Nutrition V**

**T133 Effect of β-mannanase (Hemicell-HT) feed enzyme on post-molted layer performance in 11 white egg strains**

Mark Jackson1, Ken Anderson2, Elanco Animal Health, Fayetteville, AR, USA; 2North Carolina State University, Raleigh, NC, USA

The efficacy of β-mannanase has been tested in a number of layer trials. Improvements in egg production, feed efficiency, and early egg size have been observed. An experiment was conducted to evaluate the effects of β-mannanase in conjunction with the 38th North Carolina Layer Performance and Management Test using 11 white egg strains. Two cage density combinations of 73 in² (471 cm²) and 77 in² (497 cm²) were used. The Hemicell® and control diets were randomly allocated in a restricted manner so that each strain and density were approximately equally represented within the dietary treatment groups. A total of 5564 layers were molted at 69 wks of age. The post-molt hens were tested for 6, 4-week periods starting when the birds were 73 weeks of age. A completely randomized design was used with 6 periods, 11 strains, 2 diets (control and 0.4 lb/ton Hemicell-HT added on top), and 9 replications. Corn-soybean meal diets were provided over the course of the study. Across all strains, Hemicell significantly increased hen-day egg production and egg weight during the first 4-week period only (P<0.05). Across all periods and strains, Hemicell significantly (P<0.05) improved feed conversion (g feed/g egg) from 2.15 to 2.10 (a difference of 2.4%) and percentage grade A eggs from 94.33 to 95.21 (a difference of 0.88%). Egg income and feed costs were determined from feed consumption, enzyme cost, eggs produced, and the percentage of each egg grade using market prices at the conclusion of this study. Hemicell significantly increased egg income minus feed cost from 3.62 to 3.89 cents/bird housed (P<0.05). The experiment demonstrates that Hemicell can significantly improve live performance of post-molted layers as measured by feed conversion and percentage grade A eggs and can significantly increase net egg income (total egg income minus feed cost).

**Key Words:** Layers, B-mannanase, Feed efficiency, Grade A eggs, Economics

**T134 Canthaxanthin improves the productivity of the layer hen: A meta-analysis approach**

Murtala Umar Faruk1, Franz Roos2, Fernando Cisneros2 1DSM Nutritional Products, France, Village-Neuf, France; 2DSM Nutritional Products Ltd, Kaiseraugst, Switzerland

The major use of carotenoids in layer hen diet has been to enhance yolk colour as this greatly influences consumer purchasing behaviour. In addition, other functionalities such as antioxidant effect, enhanced reproduction and immune-modulation are attributed to carotenoids. In the present work, a meta-analysis approach was employed to evaluate the effect of the carotenoid canthaxanthin on egg production performance in layer hen. A data base was assembled with individual performance measurements of 633 cages in 41 trials, all of which were conducted according to a similar experimental protocol from 1997 to 2012. The age of the animals involved in the studies ranges from 21 to 65 weeks with a mean age of 44 weeks. A linear mixed model meta-analysis was performed on the cage-level data with the canthaxanthin dose defined as fixed effect and the trial as random effect. It was observed that the dietary canthaxanthin supplementation of layer hen diet improved production parameters. Each unit of inclusion of canthaxanthin (ppm) increased feed intake by 0.32%, egg production by 0.28%, egg weight by 0.17% and reduced FCR by 0.24% compared to control diet without canthaxanthin. Egg mass was significantly (P<0.05) improved by 0.47%.

These results reveal that in addition to yolk coloration, antioxidant effect, enhanced reproduction and immune-modulation, canthaxanthin can significantly increase egg mass, thereby enhancing the productivity of egg farms.

**Key Words:** Carotenoids, Canthaxanthin, Egg mass, Laying hens

**T135 The protective effects of lycopene on the spontaneous ovarian cancer through inhibiting the pathway of NF-kB pathway in laying hen model**

Kazim Sahin1, Engin Veniec2, Mehmet Tuzcu1, Cemal Orhan1, Cengizhan Mizrak2, Ibrahim Hanifi Ozercan3, Nurhan Sahin1, Bahaddin Yilmaz4, Omer Kucuk4 1Firat University, Elazig, Turkey; 2Poultry Research Institute, Ankara, Turkey, Ankara, Turkey; 3Firat University, Elazig, Turkey; 4Gazi University, Ankara, Turkey; 5Veterinary Control Institute, Elazig, Turkey; 6Emory University, Atlanta, GA, USA; 7Winship Cancer Institute of Emory University, Atlanta, GA, USA

Ovarian cancer represents the most lethal gynecological cancer, and the high mortality rate makes this malignancy a major health concern. Poor prognosis results from an inability to detect ovarian cancers at an early, curable stage, as well as from the lack of an effective therapy. Lycopene, one of the major carotenoids present in tomatoes, has been shown to exert antioxidant properties and to inhibit cancer cell proliferation. Laying hen, Gallus domesticus, is the only available animal that develops ovarian cancer spontaneously; however, detailed information on the prevention of lycopene in ovarian cancer is not available. We conducted a study to determine the role of lycopene-rich diet in the development of ovarian cancer in the laying hen model. Three groups of hens (104 weeks old) were fed for 12 months diets including 0 mg/kg (Group A), 200 mg/kg (Group B) and 400 mg/kg (Group C) lycopene. We found significantly decreased tumor incidence and size in the hens fed a lycopene enriched diet compared to control animals. We also found significantly increased levels of serum lycopene in the lycopene fed animals as well as significantly decreased malondialdehyde levels. NF-kB expression was significantly decreased and Nrf-2 and HO-1 were significantly increased in the ovarian tissues of lycopene fed animals. We conclude that lycopene could have a role in the prevention of ovarian cancer and that preventive effects may be mediated by anti-oxidant and anti-inflammatory effects of lycopene. Laying hen model is a very good model to investigate the efficacy of potential chemopreventive agents against spontaneous ovarian cancer. This model could be useful in future studies investigating other nutritional and botanical agents.

**Key Words:** lycopene, ovarian cancer, NF-kB, Nrf-2, laying hen

**T136 Curcumin prevents the development of spontaneous ovarian tumors through the Keap1-Nrf2/ARE signaling in laying hen model**

Kazim Sahin1, Mehmet Tuzcu1, Cemal Orhan1, Nurhan Sahin1, Hakki Tastar2, Osman Guler3, Ibrahim H Ozercan3, Omer Kucuk4 1Firat University, Elazig, Turkey; 2Gazi University, Ankara, Turkey; 3Veterinary Control Institute, Elazig, Turkey; 4Emory University, Atlanta, GA, USA

Early reports about ovarian tumor incidence in the White leghorn chicken showed that laying hens are subject to the spontaneous development of ovarian and oviductal adenocarcinomas, which are related to the extended maintenance of egg production in laying flocks. Clear advantages of the hen model compared with a typical animal model include spontaneous tumor formation without the need for an exogenous carcinogen. Curcumin, a natural polyphenol in the spice turmeric, exhibits antioxidant and antiinflammatory properties. We investigated the effects of curcumin supplementation on the development of ovarian tumors, oxidative stress markers, Nrf-2-Keap1 pathway in laying hen model. Two hundred seventy laying hens (104 weeks old) were assigned to 3 treatment groups. Birds were fed either a basal diet (Control) or the basal diet supplemented with 200 mg or 400 mg of curcumin per kilogram of diet. The animals were sacrificed after 12 months and the tumors were identified. Curcumin supplementation decreased the tumor incidence and size of tumors compared with control animals. The tumors in curcumin-fed birds were smaller than...
those found in control birds. NF-kB protein expression was significantly decreased and IkBα and Nrf-2 were significantly increased in the ovarian tissues of curcumin fed animals. The results indicate that curcumin supplementation with reduces the incidence and size of spontaneously occurring spontaneous ovarian cancer in the laying hens. Clinical trials are to be conducted to investigate the efficacy of curcumin supplementation in the prevention and treatment of ovarian cancer in humans.

Authors thank The Scientific and Technological Research Council of Turkey for supporting this study (TUBITAK-1130622).

Key Words: Curcumin, Ovarian cancer, laying hen

T137 Effects of dietary nonphytate phosphate and phytase treatment on first-cycle laying hen performance and bone ash to those of the PC (0.45% nPP) fed hens. nPP, 100 or 250 FTU of bacterial phytase were adequate to maintain egg production and bone ash to those of the PC (0.45% nPP) fed hens. In total, 432 24-wk old hens were divided into 12 experimental units (EU) of 6 hens (68 sq in/h) for each of the 6 treatments. Treatments included a positive control (PC) diet that contained 0.45% nPP, a negative control (NC) diet that was similar to the PC with the exception of a 0.31% reduction in nPP (0.14% nPP total) and the same NC diet with either an additional 0.10% nPP (0.24% nPP total or 100, 120 or 250 FTU of bacterial phytase/kg diet (OptiPhos®)). Feed intake was provided ad libitum for the first 8 wk before feed intake was limited to encourage equal intake across diets at intakes similar to expected industry. Hen-housed egg production (HEEPP) was determined over the 40 wk period. At wk 40, hens were euthanized for fat-free tibia ash percentage determination (2 hens/EU). Statistical analysis was carried out using ANOVA and repeated measures analysis for criteria with multiple sample collections. When significant differences were noted, Tukey’s Test was used to separate means for repeated measures analysis and Fisher’s LSD test was used for remaining comparisons. Reducing dietary nPP from 0.45 to 0.14% nPP resulted in a significant reduction in feed intake from 95.7 to 94.5 g/wk, respectively. The addition of either 0.10% nPP or phytase significantly reduced feed intake to that of the PC fed birds (95.2-95.5 g/wk), with the exception of the 120 phytase treatment that resulted in 94.9 g/wk feed intake still somewhat below the PC fed birds (P = 0.07). Phosphorus or phytase status of the diet had no significant effect on HEEPP over the 40 wk period as responses ranged from 59.5% to 91.3%, again with the exception of the 120 FTU fed hens that resulted in HEEPP of 86.9 that was significantly lower than all other treatments. Hens fed the NC diet did result in a significant reduction in fat-free tibia ash of 59.2% in comparison to the PC fed birds (59.8%), the 100 and 250 FTU phytase treatments (61.1%). The 0.24% nPP fed birds (60.6%) and the 120 FTU/kg fed birds (60.1) were intermediate. The response of the hens fed the 120 FTU/kg phytase is perplexing and unexplained by P deficiency as egg production was reduced in comparison to the NC fed hens. Overall, these responses indicate that hens fed diets with 0.14% nPP were deficient in phosphorous (reduced feed intake and bone ash, but not egg production) and that 0.10% supplemental nPP, 100 or 250 FTU of bacterial phytase were adequate to maintain egg production and bone ash to those of the PC (0.45% nPP) fed hens.

Key Words: Laying Hen, Phosphorus, Phytase, Performance, Bone ash

T138 The effect of adding magnesium oxide to pullet and layer diets on body weight, bone characteristics, egg production and manure moisture to those of the PC (0.45% nPP) fed hens. A 40-wk experiment was performed using Hy-Line W-36 laying hens to examine the effects of dietary nonphytate phosphorus (nPP) and phytase on laying hen performance and bone ash. In total, 432 24-wk old hens were divided into 12 experimental units (EU) of 6 hens (68 sq in/h) for each of the 6 treatments. Treatments included a positive control (PC) diet that contained 0.45% nPP, a negative control (NC) diet that was similar to the PC with the exception of a 0.31% reduction in nPP (0.14% nPP total) and the same NC diet with either an additional 0.10% nPP (0.24% nPP total or 100, 120 or 250 FTU of bacterial phytase/kg diet (OptiPhos®)). Feed intake was provided ad libitum for the first 8 wk before feed intake was limited to encourage equal intake across diets at intakes similar to expected industry. Hen-housed egg production (HEEPP) was determined over the 40 wk period. At wk 40, hens were euthanized for fat-free tibia ash percentage determination (2 hens/EU). Statistical analysis was carried out using ANOVA and repeated measures analysis for criteria with multiple sample collections. When significant differences were noted, Tukey’s Test was used to separate means for repeated measures analysis and Fisher’s LSD test was used for remaining comparisons. Reducing dietary nPP from 0.45 to 0.14% nPP resulted in a significant reduction in feed intake from 95.7 to 94.5 g/wk, respectively. The addition of either 0.10% nPP or phytase significantly reduced feed intake to that of the PC fed birds (95.2-95.5 g/wk), with the exception of the 120 phytase treatment that resulted in 94.9 g/wk feed intake still somewhat below the PC fed birds (P = 0.07). Phosphorus or phytase status of the diet had no significant effect on HEEPP over the 40 wk period as responses ranged from 59.5% to 91.3%, again with the exception of the 120 FTU fed hens that resulted in HEEPP of 86.9 that was significantly lower than all other treatments. Hens fed the NC diet did result in a significant reduction in fat-free tibia ash of 59.2% in comparison to the PC fed birds (59.8%), the 100 and 250 FTU phytase treatments (61.1%). The 0.24% nPP fed birds (60.6%) and the 120 FTU/kg fed birds (60.1) were intermediate. The response of the hens fed the 120 FTU/kg phytase is perplexing and unexplained by P deficiency as egg production was reduced in comparison to the NC fed hens. Overall, these responses indicate that hens fed diets with 0.14% nPP were deficient in phosphorous (reduced feed intake and bone ash, but not egg production) and that 0.10% supplemental nPP, 100 or 250 FTU of bacterial phytase were adequate to maintain egg production and bone ash to those of the PC (0.45% nPP) fed hens.

Key Words: Laying Hen, Phosphorus, Phytase, Performance, Bone ash

T139 The effect of four different feeding programs from rearing period to sexual maturity on protein turnover in parent stock broiler breeders

Karen Vignale1, Justina V. Caldas1, Judith England1, Nirun Boonisinchai1, Phiphub Sodssec2, Erik D Pollock1, Sami Dridi3, Craig N. Coon1

A study was conducted to evaluate the effect of four different feeding programs on muscular protein turnover in pullet parent stock (PS) breeder breeders. The four feeding programs based on body weight curves utilized for the study were as follows: Everyday feeding, skip a day feeding (Cobb Standard body weight curve), under feeding (body weight curve 20% under) and over feeding (body weight curve 20% over). Each pullet feeding program (Treatment) consisted of 150 day old pullets and were from 4 wk to 20 wk of age. Protein turnover was determined in PS pullets/breeders at 6, 10, 12, 16, 21, 25, 31, 37, 46, and 66 wk of age. A complete randomized design was used with a 4x10 factorial arrangement (four feeding programs, 10 ages), containing forty treatments with five replications, and each pullet represented a replicate. Analysis of variance was performed using JMP software. Five pullets/breeders at each age were given an intravenous flooding-dose of 15N-Phe (150 mM, 40% APE) with 10 ml/kg for protein turnover determination. After 10 min, birds were slaughtered and the breast muscle (pectotalis major) excised and frozen in liquid nitrogen for protein turnover and gene expression analysis. Excreta was also collected and frozen. Protein synthesis and degradation was determined via GCMS. Gene expression was measured using real-time quantitative PCR. There was an age effect regarding fractional synthesis rate (FSR). The FSR significantly increased from 6 week pullets to 10 and 12 week pullets (3.62 %, 10.65 % and 10.93 %, respectively; P. value = 0.01) and then decreased at 16, 21, 25 and 31 weeks of age (6.81 %, 8.67%, 4.69%, 5.77%, respectively), then increased significantly at week 46 and 66 (6.25 %/day and 11.76 %/day, respectively; P. value = 0.002). There was an age effect regarding fractional breakdown rate (FBR). FBR was also significantly higher for the pullets underfed when contrasted to the other treatments at 10 and 12 weeks of age (P. value = 0.03). FBR significantly increased from week 21 (5.70%) to week 25 (13.81 %, first egg) and 31(22.46%, peak egg production) (P. value < 0.001), then it significantly decreased at week 46 and 66 (5.44 %/day and 6.53%/day, respectively; P. value <
One factor important in poultry production is feed costs, currently standing at about 70 percent. Changes in the prices of key input such as corn and soybeans can be observed, therefore, it is necessary to define strategies that allow for better financial results. The purpose of this study was to compare feeding programs and evaluate their effects on the broilers' performance and economic indexes of male Cobb 500 Slow Feathering® broilers. 1,200 birds were subjected to a completely randomized experimental design with 5 treatments and 8 replicates with 30 birds per experimental unit. The feeding programs consisted of: Cobb 500™ Manual (2008); National Research Council - NRC (1994); Rostagno et al. (2005); Rostagno et al. (2011) and Rostagno et al. (2011) modified. Feed intake, body weight, weight gain, feed conversion, viability, energy consumption, caloric conversion, productive efficiency index, and carcass characteristics were evaluated in the period from 1 to 46 days of age. The gross trade margin was calculated based on Gameiro (2009) for economic analysis, considering the ingredients prices from 2007 to 2011. The results were evaluated based on a variance analysis, and the Tukey test (P<0.05) was used to compare treatment means. Considering the main performance characteristics, there were no statistical effects among the nutritional programs. NRC (1994) showed the worst breast yield (P<0.05) among the treatments. It is concluded that the feeding program based on the Cobb 500™ Manual (2008) showed the best trade gross margin (0.821 US$/kg), while NRC (1994) showed the worst (0.762 US$/kg). Therefore, the recommendations contained in the Cobb 500™ Manual (2008) should be used as a source of nutrients for egg production especially during the early laying period.

**Key Words:** Fractional breakdown rate, Fractional synthesis rate, Protein turnover, 15N phenylalanine, GC-MS

---

**T140** Evaluation of feeding programs on broiler performance and financial return

Douglas Faria1, Renata Trevisan2, Vanessa Nakagi2, Paulo Bravo2, Daniel Faria Filho1 1Faculdade de Zootecnia e Engenharia de Alimentos (FZEA) - Universidade de Sao Paulo (USP), Pirassununga, Brazil; 2FZEA/USP, Pirassununga, Brazil

One factor important in poultry production is feed costs, currently standing at about 70 percent. Changes in the prices of key input such as corn and soybeans can be observed, therefore, it is necessary to define strategies that allow for better financial results. The purpose of this study was to compare feeding programs and evaluate their effects on the broilers' performance and economic indexes of male Cobb 500 Slow Feathering® broilers. 1,200 birds were subjected to a completely randomized experimental design with 5 treatments and 8 replicates with 30 birds per experimental unit. The feeding programs consisted of: Cobb 500™ Manual (2008); National Research Council - NRC (1994); Rostagno et al. (2005); Rostagno et al. (2011) and Rostagno et al. (2011) modified. Feed intake, body weight, weight gain, feed conversion, viability, energy consumption, caloric conversion, productive efficiency index, and carcass characteristics were evaluated in the period from 1 to 46 days of age. The gross trade margin was calculated based on Gameiro (2009) for economic analysis, considering the ingredients prices from 2007 to 2011. The results were evaluated based on a variance analysis, and the Tukey test (P<0.05) was used to compare treatment means. Considering the main performance characteristics, there were no statistical effects among the nutritional programs. NRC (1994) showed the worst breast yield (P<0.05) among the treatments. It is concluded that the feeding program based on the Cobb 500™ Manual (2008) showed the best trade gross margin (0.821 US$/kg), while NRC (1994) showed the worst (0.762 US$/kg). Therefore, the recommendations contained in the Cobb 500™ Manual (2008) should be used as a source of nutrients for egg production especially during the early laying period.

**Key Words:** Fractional breakdown rate, Fractional synthesis rate, Protein turnover, 15N phenylalanine, GC-MS

---

**T142** Replacement of corn by sorghum at grower phase diets for broilers and the effect of an enzymatic blend containing protease, xylanase and phytase to improve nutrient utilization

Guilherme Aguilar Mateus Pasquali1, Rafael Gustavo Hermes2, Vitor Barbosa Fascina3, Monica Megui Aoyagi4, Amanda Lapa Silva1, Everton Moreno Muro1, José Roberto Sartori5 1UNESP, Botucatu, Brazil; 2DSM Nutritional Products, São Paulo, Brazil; 3DSM Nutritional Products, Mairinque, Brazil

The aims of this study were to evaluate the corn replacement by sorghum and, from the other side, if an enzymatic blend could improve the nutrient utilization by grower broilers. It were used 120 male Cobb-500 broiler chicks randomly assigned in a 2 x 3 factorial design to 6 dietary treatments and 5 replicates with 4 birds each one. Treatments: levels of corn replacement with sorghum (0, 50, and 100%) and inclusion (ENZ) or not (NC) of exogenous enzymes. Enzyme products were included at levels of 200 ppm (RONOZYM ProAct), 150 ppm (RONOZYM WX), and 100 ppm (RONOZYM HiPhos GT). Total excreta collection were performed from 25 to 35 days of age. Samples were analyzed to calculate the apparent metabolizability of dry matter (AMDM, %), crude protein (AMCP, %) and energy corrected by nitrogen (AMEn, %). Data were submitted to ANOVA in a 2x3 factorial arrangement and considered statistically different among treatments when P<0.05. It was not observed any interactions between factors at this phase. Corn replacement by sorghum did not affect (P>0.05) the AMDM and AMEn. However, total corn replacement by sorghum reduced (P<0.05) the AMCP compared to corn based diets (42.4 vs 57.3%), but it was not significantly different from 50% sorghum treatment (55.0%). The blend inclusion did not improved (P>0.05) the AMDM and AMCP, but it was able to improved (P<0.05) the AMEn when compared to NC (3,150 vs 3,206). It can be concluded that in the grower phase of broiler production is possible to replace corn by sorghum if an enzymatic blend is used aiming to not cause negative impact on nutrient utilization.

**Key Words:** feed form, pellet quality, bird strain, bird performance, processing

---

**T143** Sorghum inclusion, particle size and adding a protease affects broiler performance

Albarara Sarsour1, Edgar Oviedo-Rondón2, Thays Quadros2, Fabiana Luiggi1, Nadia Bassi1 1North Carolina State University, Raleigh, NC, USA; 2Universidade Estadual Paulista, Campus Jaboticabal, Jaboticabal, Brazil; 3Universidade Estadual Paulista, Campus Butucatuc, Butucatuc, Brazil; 4EMBRAPA, Suinos e Aves, Concordia, Brazil

Sorghum can replace corn but due to several factors that affect nutrient digestibility it generally has a lower nutritional value. Particle size is important for digestibility in poultry and with sorghum good results have
been shown with 400 µm or whole grain. Proteases that degrade kafirins could also improve sorghum starch digestibility. One experiment was conducted to evaluate the effects of sorghum inclusion levels, particle size and protease addition on chicken live performance from 1 to 21 d of age. Eighteen treatments were obtained from a 4x2 factorial arrangement of treatments with 4 inclusion levels of sorghum (25, 50, 75, and 100% replacement of corn), 2 particle sizes (400 or 800 µm), serine protease (0 or 500 g/t for 300 U/g; BioResource International), as main factors, plus 2 control treatments both with 100% corn ground to obtain 800 µm of particle size and with or without protease. A total of 720 Ross 708 day-old male chicks were placed in 144 Petersime battery cages with 5 chicks per cage. The individual BW and feed intake (FI) were recorded at 7, 14 and 21 d. FCR, BW gain, and uniformity were calculated at the end of each cage phase. Data was analyzed as a randomized complete block design with a 4x2 factorial arrangement of treatments with nested effects of sorghum level and 8 replicate cages per treatment combination. There was only one three-way interaction effect (P<0.05) on FCR up to 14 d. However there were several two-way interaction effects (P<0.05). From 1 to 21 d, sorghum at 25% inclusion showed the highest (P<0.001) feed intake, (1,444 g) and BW gain, 1,062 g (P<0.05). Sorghum at 25% and 50% inclusion had the best FCR similar to 100% corn (P<0.05). The best FCR from 1 to 21 d (1,305 g) was observed with 100% corn and protease, but it was similar to sorghum at 400 µm without protease (1,339 g) and at 800 µm with protease (1,329 g), and only significantly (P<0.01) better than corn 100% without protease (1,351 g). No effect (P>0.05) of treatments on BW uniformity was observed. In conclusion, sorghum can replace 25% to 50% of corn without reducing live performance, and coarse sorghum grinding while adding a serine protease had the best live performance results.

**Key Words:** Sorghum, Particle Size, Protease, Digestibility

**T144 Effects of the Level and Relationship of Calcium and Available Phosphorus on Starter Broiler Chickens**
Alejandro Diaz Alonso1, Sergio Gomez Rosales2, Maria De Lourdes Angeles2 1Vinimos Sa De CV, Guadalajara Jal., Mexico; 2Infiap, Ajuchitlan, Oax, Mexico

The objective was to evaluate the growth performance and tibia ash of chicks with diets supplemented with increasing levels of available phosphorus (AP) and adjusted or fixed to AP levels of Ca. One hundred and sixty eight male Ross 308 chicks from 8 to 19 d of age and allocated in holding crates, in groups of 2 chicks per crate were used. Birds were randomly assigned to 12 treatments under a factorial arrangement of six dietary levels of AP (0.13, 0.23, 0.33, 0.43, 0.53 and 0.63%) and adjusted or fixed levels of Ca (A-Ca and F-Ca diets). In the A-Ca series of diets, the Ca:AP relationship was kept at 2:1 over the increasing levels of AP. In the F-Ca series of diets with a plateau at an AP level of 0.5%. The feed conversion of AP. On the fixed diets, the Ca:AP relationship diminished from 7.69 to 1.59 from the lowest to the highest AP levels. Monodicalcium phosphate was used as a source of Ca and P in all diets. Diets were based on corn and soybean meal and were offered ad libitum. Chicks were weighed at the beginning and end of the experiment. The last day of the trial all chicks were killed to determine the tibia ash. For data analysis, there were 7 replicates per treatment. Comparing the optimal inclusion level of an E. coli and a Buttiauxella phytase in broiler diets. Luke Barnard1, Luis Romero2, Velmurugu Ravindran3 1Danisco Animal Nutrition - DuPont Industrial Biosciences, Marlborough, United Kingdom; 2Massey University - Institute of Vet, Animal and Biomedical Sciences, Palmerston North, New Zealand

A study was carried out using day old, male Ross 308 broilers, measuring ideal phosphorous (P) digestibility, with the aim of determining and comparing the optimal inclusion level of an E. coli and a Buttiauxella phytase. Optimum inclusion was determined based on the law of diminishing marginal utility. The study lasted 21d and comprised of 7 treatments, with 8 replicates and 8 birds per replicate. A starter feed, based on corn/soybean meal was fed to all birds from d0-7 (nPP = 0.40% and Ca = 0.90%), from d7, treatment diets containing a titanium dioxide marker were fed. Treatments consisted of a negative control diet (NC; nPP = 0.20% and Ca = 0.73%) and the NC diet supplemented with 250, 500 and 1500 FTU/kg feed of either Buttiauxella or E. coli phytase. Differences between treatment means were determined using ANCOVA with phytase source as the covariate, and non-linear regression was carried out using JMP 11.0. Optimum phytase dose was determined using the marginal decision rule, the value of the incremental P from phytase was assumed to be equal to the value of the same amount of P from DCP.

**Buttiauxella phytase** supplemented diets had significantly (P<0.05) higher P digestibility than E. coli supplemented diets. The following non-linear equations were determined for the data: 

\[ E. coli \text{ phytase } P \text{ dig } = (69.44+(-11.68*(0.998^{Y + \beta_1X})) \text{ and Buttiauxella phytase } P \text{ dig } = (90.0+(-31.73*(0.999^{Y + \beta_2X}))) \]

The optimal dose of Buttiauxella phytase (1468 FTU/kg) was higher than the E. coli phytase (597 FTU/kg). At 500 FTU/kg feed Buttiauxella phytase delivered 51% more profit than the E. coli phytase. Comparing the two phytase at the optimal dose calculated using this method, a further 178% profit could be achieved with the Buttiauxella phytase compared to the E. coli phytase. Buttiauxella phytase liberates more P and therefore more value than the E. coli phytase.

**Key Words:** broilers, Buttiauxella phytase, dose optimisation, profit maximisation, phosphorus digestibility

**T146 Response of Broilers Fed with Graded Levels of DL-2-Hydroxy-(4-methylthio)Butanoic Acid (HMTBA) form 15 to 28 days of age**
Raquel Araujo1, Ricardo Gonzalez-Esquerra2, Sergio Luiz Vieira2, Cesar Pontin2 1Novus do Brasil Com. e Imp. LTDA., São Paulo, Brazil; 2Departamento de Zootecnia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

This trial aims at developing information relevant to the use of SAA when feeding HMTBA as a synthetic Met source in the grower phase. Chicks were fed a common dietary program until 14d of age. At 15d, test diets were fed ad libitum until 28d of age (experimental phase). Thereafter, all birds were fed a common diet sufficient in AA and AMEn. 10 treatments with 9 floor pens of 26 birds each were used (2,340 male Cobb500 birds). Nine levels of SAA were obtained by blending a dilution and a summit corn/SBM/MBM diets formulated to have 3.15 MCal/kg and 1.15% DCP Lys and balanced with ideal ratios to Lys for other AA. A control corn/ SBM/MBM diet formulated at DCP Lys 1.27%, and ideal AA ratios, was used to test AA deficiency of titrated diets. The SAA level dose-response of broilers to SAA was calculated using the GLM procedure of SAS® (Y = β0 + β1X + β2X² where: Y= dependent variable; X = SAA level; β0 = regression coefficients; β1, β2 = Intercept).
Table 1. Performance of broilers fed graded levels of SAA from 15 to 28d of age*

<table>
<thead>
<tr>
<th>SAA Levels (%)</th>
<th>BW (g)</th>
<th>BWG (g)</th>
<th>Intake (g)</th>
<th>FCR (g:g)</th>
<th>Carcass 28d (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.60</td>
<td>1,540 a</td>
<td>1,062 a</td>
<td>1,657 a</td>
<td>1,560 a</td>
<td>1,091 d</td>
</tr>
<tr>
<td>0.66</td>
<td>1,596 b</td>
<td>1,113 b</td>
<td>1,651 a</td>
<td>1,483 b</td>
<td>1,147 cd</td>
</tr>
<tr>
<td>0.72</td>
<td>1,630 b</td>
<td>1,149 b</td>
<td>1,632 ab</td>
<td>1,421 c</td>
<td>1,187 bc</td>
</tr>
<tr>
<td>0.78</td>
<td>1,686 c</td>
<td>1,201 c</td>
<td>1,658 a</td>
<td>1,380 d</td>
<td>1,243 ab</td>
</tr>
<tr>
<td>0.84</td>
<td>1,684 c</td>
<td>1,198 c</td>
<td>1,620 ab</td>
<td>1,353 de</td>
<td>1,228 ab</td>
</tr>
<tr>
<td>0.9</td>
<td>1,693 c</td>
<td>1,211 c</td>
<td>1,626 ab</td>
<td>1,343 cf</td>
<td>1,228 ab</td>
</tr>
<tr>
<td>0.96</td>
<td>1,704 c</td>
<td>1,220 c</td>
<td>1,610 ab</td>
<td>1,319 fg</td>
<td>1,227 ab</td>
</tr>
<tr>
<td>1.02</td>
<td>1,715 c</td>
<td>1,230 c</td>
<td>1,633 ab</td>
<td>1,328 efg</td>
<td>1,242 ab</td>
</tr>
<tr>
<td>1.08</td>
<td>1,703 c</td>
<td>1,223 c</td>
<td>1,613 ab</td>
<td>1,319 fg</td>
<td>1,249 a</td>
</tr>
<tr>
<td>Control</td>
<td>1,703 c</td>
<td>1,220 c</td>
<td>1,597 b</td>
<td>1,299 g</td>
<td>1,252 a</td>
</tr>
</tbody>
</table>

Table 2. Level of SAA to maximize the performance of growing broilers

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Survey (SAA%)</th>
<th>SAA% at Max Y Response</th>
<th>Equation</th>
<th>P</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG (g)</td>
<td>0.82</td>
<td>0.831</td>
<td>Y= -1.87x³ +3.1087 x +0.2511</td>
<td>&lt;0.0001</td>
<td>0.29</td>
</tr>
<tr>
<td>FCR (g:g)</td>
<td>0.72</td>
<td>0.843</td>
<td>Y= 1.6955x² - 2.8593 x +3.0497</td>
<td>&lt;0.0001</td>
<td>0.39</td>
</tr>
<tr>
<td>Carcass (g)</td>
<td>0.78</td>
<td>0.851</td>
<td>Y= -1947.5x² + 3313.3 x + 951.5</td>
<td>&lt;0.0001</td>
<td>0.38</td>
</tr>
<tr>
<td>Breast (g)</td>
<td>0.78</td>
<td>0.863</td>
<td>Y= -1091.9 x² + 1884 x + 16.06</td>
<td>&lt;0.0001</td>
<td>0.46</td>
</tr>
</tbody>
</table>

It was concluded that SAA levels needed to attain maximum performance in finisher broilers were between 0.831 and 0.863% when using HMTBA in diets with 0.95 Dig Lys levels.

Key Words: Methionine, Broilers, Performance, HMTBA, Requirements

T147 Response of Broilers Fed Graded Levels of Methionine using DL-2-Hydroxy-(4-methylthio)Butanoic Acid (HMTBA) During the Finisher Phase

— Raquel Araujo1, Ricardo Gonzalez-Esquerra1, Sergio Luiz Vieira2, Cesar Pontin2 1Novus Brasil Com. e Imp. LTDA., São Paulo, Brazil; 2Departamento de Zootecnia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Guidelines for digestible Met + Cys (SAA) used have been developed with DL-methionine as the source of Met. The present trial series attempts at developing guidelines for SAA when using HMTBA as the Met source. The present trial studied the response of birds to HMTBA from 29 to 42d.10 treatments with 9 floor pens of 26 birds each were used (2,340 male Cobb500 birds). Chicks were fed a common dietary program until 28d of age. At 29d, test diets were fed ad libitum until 42d of age (experimental phase). Nine levels of SAA (from 0.52 to 1.00% in grades of 0.06%) were obtained by blending a dilution and a summit corn/SBM/MBM diets formulated to have 3.05 MCal/kg and 1.25% Dig Lys and balanced AA profile except for SAA. A control corn/SBM/MBM diet formulated at Dig Lys 1.35% and ideal AA ratios was used to detect AA deficiency of titrated diets. A total of 56 paired nutritionists from Latin America and South Africa were shown the performance means of key parameters plotted in graphs without treatment descriptions, ANOVA, trend-lines or grades on the X axis (levels of SAA used) and marked with an “X” for each parameter the level of SAA they would feed commercially based on the responses observed in the graphs. The SAA level dose-response of broilers to SAA was calculated using Proc GLM of SAS® (Y = β₀ + β₁X + β₂X² where: Y = dependent variable; X = SAA level; β₀ = regression coefficients; β₁ = Intercept).

*Tukey test (P<0.05)

T148 Response of Starter Broilers Fed Graded Levels of Methionine using DL-2-Hydroxy-(4-methylthio)Butanoic Acid (HMTBA) as Its Synthetic Form

— Ricardo Gonzalez-Esquerra1, Raquel Araujo1, Sergio Luiz Vieira2, Cesar Pontin2 1Novus Brasil Com. e Imp. LTDA., São Paulo, Brazil; 2Departamento de Zootecnia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Ten treatments with 7 floor pens of 30 birds each were used (2,300 male Cobb500) aiming at developing information relevant to feeding SAA when using HMTBA as the synthetic Met source during the first two weeks of life. Nine levels of SAA (from 0.61 to 1.17%) were obtained by blending a dilution and a summit corn/SBM/MBM diets formulated to have 3.05 MCal/kg and 1.25% Dig Lys and balanced AA profile except for SAA. A control corn/SBM/MBM diet formulated at Dig Lys 1.35% and ideal protein was used to test if the titrated diets were efficient in DigLys + Ideal protein. Test diets were fed from 1 to 14d of age, and a common dietary program was fed to all treatments thereafter, until 35d in order to study both: the influence of SAA in the starter period (1 to 14d), and the possible carryover effect in future phases. The dose-response of broilers to SAA was calculated using Proc GLM of SAS® (Y = β₀ + β₁X + β₂X² where: Y = dependent variable; X = SAA (%); β₀ = regression coefficients; β₁ = Intercept).

Table 1. Effect of feeding graded levels of SAA from 1 to 14d of age*

<table>
<thead>
<tr>
<th>SAA (%)</th>
<th>BWG_7d</th>
<th>BWG_14d</th>
<th>FCR_7d</th>
<th>FCR_14d</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.61</td>
<td>114 d</td>
<td>381 f</td>
<td>1.312 a</td>
<td>1.416 a</td>
</tr>
<tr>
<td>0.68</td>
<td>129 c</td>
<td>424 e</td>
<td>1.211 ab</td>
<td>1.313 b</td>
</tr>
<tr>
<td>0.75</td>
<td>131 bc</td>
<td>438 d</td>
<td>1.201 b</td>
<td>1.283 bc</td>
</tr>
<tr>
<td>0.82</td>
<td>137 ab</td>
<td>454 bc</td>
<td>1.174 b</td>
<td>1.281 bc</td>
</tr>
<tr>
<td>0.89</td>
<td>139 a</td>
<td>462 ab</td>
<td>1.170 b</td>
<td>1.261 bc</td>
</tr>
<tr>
<td>0.96</td>
<td>138 ab</td>
<td>463 ab</td>
<td>1.142 b</td>
<td>1.256 c</td>
</tr>
<tr>
<td>1.03</td>
<td>134 abc</td>
<td>453 bc</td>
<td>1.142 b</td>
<td>1.253 c</td>
</tr>
<tr>
<td>1.10</td>
<td>134 abc</td>
<td>452 bc</td>
<td>1.143 b</td>
<td>1.258 c</td>
</tr>
<tr>
<td>1.17</td>
<td>134 abc</td>
<td>449 cd</td>
<td>1.143 b</td>
<td>1.246 cd</td>
</tr>
<tr>
<td>Control</td>
<td>136 abc</td>
<td>466 a</td>
<td>1.110 b</td>
<td>1.197 d</td>
</tr>
</tbody>
</table>

*Tukey test (P<0.05); *Values in grams

Table 2. Level of SAA to maximize the response performance of broilers

Key Words: Methionine, Broilers, Performance, HMTBA, Requirements
T149 Profitability of the Response of Broilers to Graded Levels of DL-2-Hydroxy-(4-methylthio)Butanoic Acid (HMTBA) Fed as the Sole Source of Synthetic Methionine Ricardo Gonzalez-Esquerra1, Raquel Araujo1, Sergio Luiz Vieira1, Cesar Pontini2 Novus do Brasil Com. e Imp. LTDA., São Paulo, Brazil; 2Departamento de Zootecnia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Responses of broilers to graded levels of dietary Met+Cys (SAA) fed HMTBA were obtained in two trials (Trial 1: from 15 to 28d of age or grower; and Trial 2: from 28 to 42d or finisher). Live and carcass performance equations obtained were reported elsewhere in these proceedings, and were used to calculate HMTBA economic return in a dose-dependent manner. The following equation was used: Profit = Revenue – Feeding Costs - Farm Costs - Processing Costs. Each of these components are detailed in Table 1.

Table 1. Economic components used in poultry production

<table>
<thead>
<tr>
<th>FEEDING COSTS COMPONENTS</th>
<th>USD</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet cost 1_14d*</td>
<td>325.55</td>
<td>/MT</td>
</tr>
<tr>
<td>Diet cost 15_28d (Excluding HMTBA)*</td>
<td>304.37</td>
<td>/MT</td>
</tr>
<tr>
<td>Diet cost 1_28d**</td>
<td>320.63</td>
<td>/MT</td>
</tr>
<tr>
<td>Diet cost 29_42d (excluding HMTBA)**</td>
<td>297.82</td>
<td>/MT</td>
</tr>
<tr>
<td>Operational mill costs</td>
<td>13.10</td>
<td>/MT</td>
</tr>
<tr>
<td>Feed transportation cost to the farm</td>
<td>9.61</td>
<td>/MT</td>
</tr>
<tr>
<td>Average cost of HMTBA 100%</td>
<td>3.49</td>
<td>/kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FARM COSTS</th>
<th>USD</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm costs @ 28d*</td>
<td>0.64</td>
<td>/bird</td>
</tr>
<tr>
<td>Farm costs @ 42d**</td>
<td>0.80</td>
<td>/bird</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROCESSING COSTS</th>
<th>USD</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing Costs -Carcass @ 28d*</td>
<td>0.41</td>
<td>/bird</td>
</tr>
<tr>
<td>Processing costs -Carcass @ 42d**</td>
<td>0.62</td>
<td>/bird</td>
</tr>
<tr>
<td>Processing costs -Cuts @ 42d**</td>
<td>0.67</td>
<td>/bird</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTAL REVENUE COMPONENTS</th>
<th>USD</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live 42d**</td>
<td>1.03</td>
<td>/kg</td>
</tr>
<tr>
<td>Carcass @ 28d*</td>
<td>1.75</td>
<td>/kg</td>
</tr>
<tr>
<td>Carcass @ 42d*</td>
<td>1.61</td>
<td>/kg</td>
</tr>
<tr>
<td>Breast @ 42d**</td>
<td>2.79</td>
<td>/kg</td>
</tr>
<tr>
<td>Drumsticks @ 42d**</td>
<td>1.91</td>
<td>/kg</td>
</tr>
<tr>
<td>Thigh @ 42d**</td>
<td>1.45</td>
<td>/kg</td>
</tr>
<tr>
<td>Wings @ 42d**</td>
<td>2.46</td>
<td>/kg</td>
</tr>
</tbody>
</table>

*Trial 1; **Trial 2

The level of SAA(%) that maximized profits (PMax) was calculated using the Solver function of a dynamic table built in Excel® software using variables as in Table 1. Changes in PMax were tested in scenarios of high or low methionine prices and high and low salable products prices (±20% from those in Table 1). When one cost/price component was evaluated, the rest were kept at values in Table 1 (Mid).

Table 2. SAA(%) at optimal profitability (PMax) vs. optimal biologic performance

| **Key Words:** Methionine, HMTBA, Broilers, Profitability, Requirements |
|--------------------------|---------------------------------|

T150 Effect of a unique carrier-based organic acid blend (Salkil) on the performance of broiler breeders and their progeny Leon Broom1, Lúcio Araújo2, Cristiane Araújo2, Luciano Sá3, Ian Cockshott4, Emma Graystone5

The profitability of breeding operations is determined by broiler breeder performance. The antimicrobial effects of organic acids mean that their supplementation into the diets of poultry is recognised as an effective method of controlling microbial growth, leading to improved bird health and performance, and safer meat products. Moreover, organic acids improve nutrient digestibility, mineral availability and immune responses. The objective of this study was to evaluate the effects of a commercially available organic acid-based product (Salkil) on the performance of broiler breeders. At 25 weeks of age, 64 Cobb 500 broiler breeders were randomly allocated to one of two treatments, with 8 replicates of 4 birds per treatment. The treatments were standard breeder broiler diets with or without the addition of an organic acid blend (Salkil, 2kg/t). At 35 and 45 weeks of age, the birds were artificially inseminated and eggs were collected between the third and tenth day following insemination and incubated. Canding was performed 10 days after incubation for the detection of infertile eggs. One-day old male broilers from both treatment groups and both breeder hen ages were then followed through to 42 days of age, with all birds receiving the same starter, grower and finisher diets (i.e. no organic acid (Salkil) supplementation). In terms of breeder performance, organic acid supplementation improved fertility at 35 weeks (91.23 vs 86.28%, P=0.004) and 45 weeks (96.64 vs. 94.32%, P=0.038). Egg production and hatchability of fertile eggs were not different between treatment groups for either week 35 or 45. With regards to broiler performance, birds from organic acid supplemented breeders had better weight gain to 42 days from breeders of 35 (2910 vs 2837g, P=0.011) and 45 weeks of age (2934 vs. 2842g, P=0.024). Feed intake was not different. Salkil improved broiler feed conversion ratio at 45 weeks (1.74 vs. 1.80; P=0.033). The organic acid product improved broiler breeder fertility and the performance of their progeny. The magnitude of the responses observed would equate to a return on investment of up to 20:1, thus significantly improving profitability for either a breeder and/or broiler operation.

**Key Words:** Organic acids, Breeder, Broiler, Performance, Salkil

SCAD III

T151 Avian Pneumovirus (APV) - A new respiratory disease challenge in Poultry in India Pratap Rananavare1 Merck Animal Health, Summit, NJ, USA

India has a rapidly growing poultry population, but relatively little diagnostic information about the key diseases that cause losses in the largely non-integrated industry. Layers, broiler breeders and broilers suffer from problems of head swelling and respiratory noise, and in the case of birds in lay, production drops of 20 – 30% accompanied by some egg deformity. All flocks are vaccinated against Newcastle Disease and infectious bronchitis, and, in the case of production birds, also Infectious Coryza and Mycoplasma gallisepticum. The problem is often assumed to be Infectious Coryza and producers attempt to control losses with antibiotics, but flocks are non-responsive to the treatment. Avian pneumovirus (APV), also known as Swollen Head Syndrome (SHS) or turkey rhinotracheitis (TRT) was suspected, but nothing was known about the presence or prevalence of this virus in poultry flocks in India. None of the flocks are currently vaccinated with APV vaccine.
A serological survey was conducted in 119 flocks from different geographical areas of India (102 breeder farms, 17 broiler farms). The farms were selected based upon clinical presentation with the typical signs of head swelling, respiratory noise and/or production losses. Acute samples were collected and paired with convalescent samples two to three weeks later. The IDEXX APV ELISA kit was used to evaluate the serum samples. The survey revealed a 56% sero-prevalence for APV in breeding flocks and a 22.3% sero-prevalence in broiler flocks. The data is not yet confirmed with virus isolation due to the difficulty in obtaining appropriate samples under the field conditions in India. The serological evidence, however, supports the use of an APV vaccination program for breeders, and a decline in egg production.

**Key Words:** APV, Respiratory, Swollen head, Serology, India

**T152 Evaluation of different vaccination approach to control MPV, IBV, NDV and IBDV infections in broiler flocks- Polish experience in diverse field conditions** Piotr Szelczuzczuk, *Danuta Furmanek, **Tomasz Kruzynski, Joanna Nerc, ***Bartlomiej Stanczak MSD Department of Pathology and Veterinary Diagnostics, Faculty of Veterinary Medicine, Warsaw University of Life Sciences (WULS-SGGW), Nowowsyjonowska 159c, 02-776 Warsaw, Poland, *MSD Poland, Chlodna 31, 00-867 Warsaw, Poland, **Animal Pharma, Kosciuszki 43, 10-503 Olszyn, Poland, ***IDEXX Laboratories, Inc./PPH ESKULAP sp.j., Elsnera 6, 44-105 Glazice, Poland

Clinical problems associated with MPV (metapneumovirus) infection have been observed in broiler flocks in Poland for the last few years. Serological surveys confirm MPV challenge in the field. These results raise the question of whether avian pneumovirus (APV) immunization should be incorporated into the common vaccination schedule and, if so, what combination of vaccination viruses result in the best broiler performance. Three different vaccination regimens were observed, including two using MPV vaccine strain at one day of age.

Chicks were vaccinated with APV (Nobilis RHINO CV – MSD AH) and combinations of Newcastle (ND) and infectious bronchitis (IB) vaccines. The trial was run from April through July 2014 and involved 37 flocks/farms from all over Poland. Altogether, one million broilers were vaccinated and tested. Production parameters were evaluated along with serological monitoring of titres, using commercial ELISA test kits from IDEXX Laboratories Inc. (USA). 24,000 assays were completed. The best results were achieved in flocks vaccinated on one day of age with APV + Mass IB + CB ND (Nobilis Rhino CV + Ma5 + NDC2) followed by field spray on day 14 with LaSota ND and 4+91 IB (Nobilis ND CI30+ Nobilis IB 4/91). Flocks also received IBV vaccine (Nobilis D78) via drinking water between day 18 and day 21 (vaccination according to Deventer formula – software XchekPlus Idexx Laboratories Inc.)

Serological and production results will be presented

**Key Words:** metapneumovirus infection, vaccination programs

**T153 Protection of Ma5, DE07 and GA08 Live IBV Vaccines against a Highly Pathogenic GA08 Field Isolate in Broilers.** Ivan Alvarado¹, Alejandro Bandá, Lifang Yan², Obiageli Chukwulube², Floyd Wilson³

¹Merck Animal Health, Athens, GA, USA; ²Mississippi State University, Pearl, MS, USA

The synergistic protective effect of the Ma5, DE072 and/or GA08 live infectious bronchitis (IB) vaccines against a highly pathogenic GA08 field isolate was evaluated. Commercial broilers with maternal antibodies against infectious bronchitis virus were equally divided in 6 treatment groups and placed in positive pressure isolation units. At 1 and 14 days of age, four treatment groups were vaccinated with Ma5, GA08, Ma5+DE072 and Ma5+DE072+GA08 live attenuated vaccines. Two treatment groups, non-vaccinated/challenged and non-vaccinated/non-challenged, remained as controls. At 35 days of age, all the treatment groups, except the negative control group, were challenged by eye-drop with 10^4 EID₅₀ of a highly pathogenic GA08 strains isolated from a field clinical case in Mississippi. Typical clinical signs associated with bronchitis infection, such as lacrimation, head inflammation, tracheal rules and sneezing were observed in the non vaccinated and challenged birds. When all the vaccinated groups were compared with the non-vaccinated/challenged group, no significant differences in clinical signs were observed five days post-challenge. At 40 days of age, all the birds were humanely sacrificed and necropsied. Protection against the GA08 field strain was evaluated based on clinical presentation, ciliostasis scores, virus re-isolation and histopathology.

**Key Words:** Infectious Bronchitis, Ma5, DE072, GA08, Protection

**T154 Understanding ArkDPI vaccination failure when applied by hatchery spray cabinet** Brian Jordan¹, Eric Shepherd, Giselle Rossa, Erin Anderson, Debbie Hilt, Mark Jackwood The University of Georgia, Athens, GA, USA

Avian Infectious Bronchitis Virus (IBV) causes a highly contagious, economically significant upper-respiratory tract disease in chickens. Control of IBV is achieved by vaccinating chickens with live-attenuated virus of the predominant regional serotype. Chicks are spray vaccinated with IBV on the day of hatch, and are often vaccinated with multiple serotypes to induce broader protection. Previous work in our laboratory has shown that the Arkansas serotype vaccine (ArkDPI) does not provide adequate protection from challenge when applied by spray but when delivered by eye-drop administration it provides protection from challenge. We hypothesize that the ArkDPI vaccine virus is somehow damaged during spray application, making it unable to infect chicks. To test this hypothesis, ArkDPI vaccines from three different manufacturers were sprayed at 7, 14, and 21ml volumes with increasingly larger spray nozzles using a commercial spray cabinet. Six-week tissue culture plates were placed 7 cm above the bottom of the chick basket, mimicking the height of a chick, to collect samples at chick level after spray. Five plates were placed in each chick basket: one in each corner and one in the middle. All samples from each replicates including the working solution dilution and directly from the spray nozzle were analyzed by qRT-PCR. All samples from a single replicate were also analyzed by titration in embryonated eggs. Comparing working solution and spray nozzle samples revealed no consistent drop in titer for any volume, indicating that spraying did not destroy virus particles. There was not a significant difference in Ct values for any spray volume when comparing the working solution to the spray nozzle sample. Ct values and titers were consistent at all points tested in the chick box for all volumes also. There was an average drop of 1.4 log₁₀ EID₅₀ in titer at the level of the chicks. This effect may be due to the larger nozzle size for the 21ml spray system. In total, spraying 21ml of vaccine delivered more virus to the chick level. This also correlated to higher replication in chicks sprayed with 21ml of ArkDPI vaccine. This data shows that higher volumes ofArkDPI vaccine are needed for proper vaccination of chicks, but the cause for this is still unclear.

**Key Words:** ArkDPI, IBV, Spray Application, Volume, Titer

**T155 Combining recombinant and live vaccines in-ovo for infectious bursal disease protection** Elise Myers¹, Tom Inglis², Darko Mitevski³

¹Merck Animal Health Canada, Kirkland, QC, Canada; ²Poultry Health Services, Airdrie, AB, Canada

An experiment was conducted at a commercial broiler hatchery to determine if improved infectious bursal disease (IBD) protection could be achieved by using the combination of a recombinant IBD vaccine and live IBD vaccine administered in-ovo. Phase one of the study established a baseline for the two farms examined. Farm 1 had vaccinated with recombinant...
binant IBD vaccine only, and Farm 2 had vaccinated with recombinant in-ovo, followed by live IBD vaccine in the flock. An evaluation of current IBD control program efficacy was accomplished using bursal histology and serology. Bursas from 10 random healthy birds from 5 different farms were collected at 14, 21, and 28 days of age. Sera were collected from 10 birds at 1, 14, 21, 28, and 35 days of age. Results showed histologic evidence of lesions consistent with acute IBD in one flock. Bursas from the other flocks had evidence of nonspecific lymphocytic depletion and apoptosis in bursal follicles, not suggestive of IBD. Serological response was variable between flocks. Phase two of the study took place over three placement periods and examined 14 flocks. All flocks were vaccinated in-ovo with a combination of recombinant and a live IBD vaccine. Bursal tissue and sera were collected at the same frequency, handled, and evaluated in the same manner as in the baseline study. Flock serology performed at day of age suggested maternal antibody levels that were in alignment with company standard. Variable titres were present at all other sampling points. All 14 flocks sampled demonstrated non-specific lymphocytic depletion or bursal atrophy not consistent with IBD, and showed no other histologic lesions consistent with IBD challenge. These findings suggest enhanced protection against IBD challenge and the possibility of lower bursal damage, which is consistent with the hypothesis of this study. Further investigation into serological response is warranted. Prior to widespread use, confirmation of program efficacy should take place in multiple locations, as protection will likely be dependent on IBD virus challenge level, circulating strain, and level of maternal antibody conferred to progeny.

Key Words: recombinant, infectious bursal disease, vaccine, chicken, immune

T156 Comparison of early onset of protection given by Bursaplex® or Vaxxitek® against IBDV Kalen Cookson1, A. Avakian2, T. Barbosa3, J. Dickson1, J. Giambrone4, T. Villabos3. In the goal of this study was to compare their onset of immunity. Vaccination. Because these two vaccines work by different mechanisms, the goal of this study was to compare their onset of immunity.

Study Design: 240 SPF leghorns were selected at hatch from three in-ovo vaccine treatments: 1) Bursaplex®, 2) Vaxxitek® and 3) None. Four rooms were used for the challenge treatments—3 replicates of STC (classic) challenge and 1 rep of No challenge. Each room contained 3 Horsfall isolator units which housed the 3 replicate vaccine treatments. At 13 days of age, birds were individually weighed and IBDV challenge was given intracutaneously using 10^3.0 EID50 STC challenge. All birds were weighed again and necropsied at 17 days. Spleens were weighed and bursas were scored for edema and/or hemorrhage. IBD protection was measured using three criteria: 1) acute bursal lesions, 2) splenomegaly and 3) weight gain post challenge. Two-sided tests were used to establish statistical significance at the 0.05 level.

Results: Weight gain post challenge was significantly lower in non-vaccinated controls (21.0g) compared to Vaxxitek® (42.6g) and Bursaplex® (45.9g) groups. Protection from bursal lesions was significantly different between all three vaccine treatments with the highest protection (8.3%) followed by Vaxxitek® (78.3%) and then Bursaplex® (100%). Spleen to body weight ratios were significantly different between all three vaccine treatments, with the highest ratio seen in challenged controls (2.95), followed by Vaxxitek® (2.46) and then Bursaplex® (2.11). Spleenomegaly—defined as individual birds with Spl/BV > 2 StDV higher than the non-challenged control mean—was also significantly different between all three vaccine treatments, with challenged controls having the lowest protection (8.3%), followed by Vaxxitek® (76.7%) and then Bursaplex® (95%).

Discussion: The STC challenge was predictably hard on the 13 day old leghorn controls, resulting in >50% weight gain depression and >90% birds with acute bursal lesions and splenomegaly. Bursaplex® birds showed complete bursal protection from STC challenge, demonstrating that active immunity had been established by 13 days of age. Vaxxitek®, while showing significantly lower STC protection than Bursaplex® based on all three criteria, showed that it had established active immunity in about three-quarters of vaccinated by 13 days. Splenomegaly is a good indicator of active IBD viremia and correlated with birds having acute bursal lesions in this study.

Key Words: IBDV, Bursaplex®, Vaxxitek®, early, protection

T157 The impact of H9N2 avian influenza virus vaccine antigenic variation on virus infectious dose in chickens Yue Wang*, Erica Spackman USDA-ARS Southeast Poultry Research Laboratory, Athens, GA, USA

The H9 subtype of avian influenza virus is widespread in the areas of Asia and Middle East. Selection of effective vaccines that provide effective protection mainly depends on the antigenic match of the hemagglutinin protein (HA), between the vaccine and the field strain. To determine how the antigenic variations affect the vaccine efficacy, a vaccine-challenge study with different doses was conducted. Based on the antigenic cartography, three isolates from Israel: the current vaccine virus and two other antigenic variants were selected for the studies. Specific-pathogen-free (SPF) chickens were vaccinated with each of the three isolates separately and challenged either against the same isolate or the other two antigenically heterologous isolates at 10-fold serial doses from 10^2 mean embryo infectious dose (EID₈₀) through 10^8 EID₈₀ per bird. The control group of chickens was unvaccinated and challenged similarly. Pre-challenge sera were collected for hemagglutination inhibition assays to evaluate antibody titers. Virus shedding was quantitated by real-time reverse-transcription-PCR (rRT-PCR) of oral swabs. The mean infectious dose was calculated for each vaccine-challenge group. This study quantifies the differences in susceptibility to infection with H9 avian influenza virus based on antigenic variation between the vaccine and challenge virus.

Key Words: Low pathogenic avian influenza virus, H9N2, Poultry disease, Vaccination, Antigenic cartography

T158 Measurement of airborne influenza virus during hen slaughtering in an ABSL-3E bioBUBBLE® Kateri Bertran*, Kira Moresco, David E Swayne, Charles Balzli Southeast Poultry Research Laboratory USDA/Agricultural Research Service, Athens, GA, USA

Several avian viral diseases, including avian influenza, Newcastle disease, infectious bronchitis and laryngotracheitis, are transmitted via respiratory droplets or by contact with contaminated fomites. Using high pathogenicity avian influenza (HPAI) virus as a model, the objective of the present study was to standardize and optimize the air sampling method in a negative pressure containment enclosure (bioBUBBLE®) meeting the regulatory requirements for enhanced animal biosafety level 3 (ABSL-3E) facilities. Adult White Leghorn chickens were inoculated intranasally with 10^2 EID₈₀/0.1 ml of HPAI A/Vietnam/1203/2004 (H5N1). At 24 hours post-inoculation, oral swabs were collected to ensure infection and viral shedding, and all the birds were slaughtered following a simulated home slaughter protocol which includes the following steps (5 min per bird): kill, scald, defeather, eviscerate, and cleanup. Previously, this protocol generated airborne particles containing HPAI virus. A cyclone-type air sampler was used to collect large (>4 µm), small (1-4 µm), and fine (<1 µm) airborne particles. Virus isolation was performed on oral swabs and air samples. The following variables were tested: slaughter method (manual versus mechanical defeatherer), location of the cyclone samplers, cyclone samplers’ flow, bioBUBBLE® flow speed, temperature and relative humidity within the bioBUBBLE®, and running time of the cyclone samplers. The best setting conditions included: the use of one cyclone sampler at 3.5 l/min air flow; the bioBUBBLE® flow speed at 9 feet/min; the
slaughter of all birds in parallel, rotating them through the different steps; and constant temperature of 24±1°C and relative humidity of <80% within the bioBUBBLE®. Under these conditions, small and large airborne particles containing infectious HPAI virus were successfully recovered. The present study sets up the method to explore airborne transmission dynamics of avian influenza virus and other diseases.

Key Words: airborne, influenza, bio containment, ABSL-3E, transmission

T159 Mucosal immune response in broilers following vaccination with inactivated influenza and recombinant Bacillus subtilis
Olivia Faulkner1, Darrell Kapczynski2, Lisa Bielke1, Amanda Wollfenbender1, Vivek Kuttapan1, Luc Berghman1, Billy Hargis1 University of Arkansas, Fayetteville, AR, USA; 2Southeast Poultry Research Laboratory, USDA-ARS, Athens, GA, USA; 3Texas A&M University, College Station, AR, USA

Mucosal and systemic immunity were observed in broilers vaccinated with mannosylated chitosan adjuvanted (MCA) inactivated A/Turkey/Virginia/158512/2002 (H7N2) and administered with and without recombinant Bacillus subtilis to elicit heterologous influenza strain protection. Previously, mucosal immunity was significantly elevated after broilers were subcutaneously (SQ) injected with an experimental inactivated influenza vaccine followed by drinking water administration of MCA inactivated influenza on d4 and d14. Currently, inactivated recombinant Bacillus subtilis expressing full length high mobility box group 1 (HMGB1), truncated CD154, and multiple universal avian influenza antigenic proteins were combined with MCA β-propiolactone-inactivated H7N2 to vaccinate broilers. CD154 is the T lymphocyte expressed ligand for CD40 receptors on B lymphocytes and macrophages. HMGB1 binds to the receptor for advanced glycation end products to activate macrophage lineage cells. Vaccines were administered by SQ on day of hatch (DOH) and d14, followed by oral gavage on d4 and d14. Systemic immunity was measured by hemagglutination inhibition assay and mucosal immunity was determined using a nucleoprotein specific ELISA. Mucosal immunity was measured in the homogenates of ileal scrapings. Systemic immunity was measured in serum collected 7 and 14d after boost vaccination. Nucleoprotein specific mucosal antibodies were significantly higher than control broilers that received a combination of MCA, H7N2, and recombinant Bacillus subtilis SQ on DOH, and drinking water administration on d4 and d14 (P <0.015). H7N2 specific serum antibodies were highest (6.3±0.43 log) among vaccinates in broilers 14d after second vaccination in broilers that received SQ injection on DOH and SQ d14 (P<0.001). Mucosal immune stimulation using inactivated recombinant Bacillus subtilis and influenza suggests that protection from circulating influenza viruses can be achieved without a live vaccination.

Key Words: mucosal immunity, influenza, vaccination, broiler

T160 Optimizing Marek’s Diseases vaccination protocols with in ovo vaccination
Taylor Barbosa1, Tarsicio Villalobos1, John Dickson1, Aneg Lucia Cortes2, Nik Faiz2, Isabel Gimeno2 Zoetis Inc., Durham, NC, USA; 2North Carolina State University, Raleigh, NC, USA

Marek’s Disease is one of the major viral diseases in poultry, with great impact in productivity when birds are not well protected. Vaccination given in ovo has become common for broilers in many countries. However, for breeders and layers, where only females are used, there are still some questions on the benefits on the early vaccination. The present study compared vaccination protocols either in ovo or subcutaneous injection.

Study Design: 1100 embryos from a single flock of Cobb 500 were divided at ED18 in six groups according to the vaccination schedule. The rHVT-IBD+SB1 vaccines were given either in ovo (Group #1) or at hatch (Group #2). Group #3 received CVS-988 combined with rHVT-IBD+SB1 in ovo. Group #4 received CVS-988 in ovo and rHVT-IBD+SB1 at hatch and Group #5 received rHVT-IBD+SB1 in ovo then CVS-988 at hatch. Group #6 was kept as non-vaccinated controls. The Inovject system was used for in ovo vaccination at ED18 and subcutaneous vaccination was done at hatch. Only females were placed in isolator rooms in contact with two-week-old SPF shedder birds challenged with vv+MDV 648A strain. Groups #1 and #2 comingle into two rooms and kept separated from Groups #3, #4 and #5, which comingle in two other rooms. Non-challenge control birds were kept in a 5th room. Feather pulp samples were taken at 7 and 21 days of age. All birds were weighed at 7, 21 and 49 days of age. All mortality and survivors at 49 days of age were scored for MDV lesions.

Results: Body Weight (BW) gain at D21 was significantly higher for groups that received CVI-988 when compared to hVT+SB1 (p<0.05), with no differences between non-vaccinated and rHVT+SB1 only groups. At D49 Group #3 had the highest BW, with groups #1, #4 and #5 intermediate and the lowest BW was found on non-vaccinated controls which were no different than the group #2 (p<0.05). Group #3 had the highest protection index (92%) followed by group #4 (89%), group #5 (82%) and group #1 (78%). Group #2 had only 34% protection. All birds in the non-vaccinated group (#6) developed MDV tumors.

Discussion: The MDV challenge model used herein was able to produce 100% positive MDV lesions in non-vaccinated birds. Body weight gain and protection evaluations demonstrated the benefits of using an adequate CVI-988 vaccine for best protection. The time between vaccination and exposure to MDV has been described as important factor for protection. Our findings confirmed that the in ovo vaccination of female breeders improved the protection given by all vaccines tested. The difference was markedly important for the rHVT-IBD+SB1 combination. The results demonstrate the benefits of the in ovo vaccination for all birds susceptible to early exposure with either MDV strains.

Key Words: MDV, in ovo, subcutaneous, CVI-988, vaccine protection

T161 Comparison of protection using two CVI988 commercial vaccines against very virulent plus Marek’s Disease virus challenge
Tarsicio Villalobos1, Taylor Barbosa1, John Dickson1, Aneg Lucia Cortes2, Nik Faiz2, Isabel Gimeno2 Zoetis Inc., Durham, NC, USA; 2North Carolina State University, Raleigh, NC, USA

Marek’s disease (MD) vaccines are in most cases cell-associated and require special care in the handling, storage, and administration. Failures in the cold chain, improper thawing conditions, and reconstitution in inadequate diluents can severely reduce vaccine titers. Differences in the protection ability of CVI988 from different manufacturers have been reported. It is possible that higher dose of a less protective vaccine is necessary to achieve proper protection and lower PFUs might be needed to achieve the same level of protection when using a more protective vaccine. The present study aims to compared two commercial available CVI-988 vaccines at two dose levels and their ability to generate protection against very virulent plus MD virus.

Study Design: Cobb 500 eggs were vaccinated in ovo at the Zoetis Avian Research Center (ARC) by the Inovject System at 18 days of embryonation (E18) using two commercial available CVI988 vaccines (Vaccine 1 and Vaccine 2) at two doses levels. The high dose (HD) is a full dose as per manufacturer recommendation and the low dose (LD) is a diluted dose (2000 PFU/dose) in order to mimic titer loss in commercial conditions. On E21 chicks were hatched, vent sexed and female chicks transported to North Carolina State University (NCSU). Challenge was done by com mingled shedder birds that were previously infected with vv+MDV 648A strain. Body weights were recorded on days 7, 21 and 56. All mortalities were also necropsied for MD lesions. Samples of feather pulp were collected at 1 and 3 weeks of age. Any mortality during the first week of age was considered not related to the challenge virus.

Results: All hypothesis tests were conducted as two sided tests at the p<0.05 level of significance. For D56 challenged birds both Vaccine 1 and Vaccine 2 high and low doses weighed significantly more than non-vaccinated challenged. For challenged birds both vaccines high and low dose showed significantly lower MD incidence than non-vaccinated.. For the
challenged high dose Vaccine 1 showed significantly lower MD incidence than Vaccine 2. Vaccine 1 vaccinated non-challenged birds were found to have a significantly higher spleen to body ratio than Vaccine 2 and non-vaccinated on D7. No significant differences in DNA load or proportion positive were found by vaccine type or dose for D7 CVI988 or D21 oncogenic MDV.

Discussion: When vaccines are given at the manufacturer recommended doses, birds were better protected. The significant lower incidence of MD lesions on vaccinated birds with vaccine 1 at HD may be explained by the differences on CVI988 strain origin, passage levels and manufacturing process.

Key Words: MDV, in vo, CVI988, Vaccine protection

T162 Recombinant vaccine could control ND problem in high ND challenged area Husam Bakri1, Entisar Al-Hallaq2 ‘MSD-Animal Health, Dubai, United Arab Emirates; ‘MSD-Animal Health, Amman, Jordan

Newcastle Disease (ND) is a disease caused by a Paramyxovirus 1, in broilers, layers and breeders. It can cause respiratory disease but infections with very virulent strains may result in severe mortality and drop in production in the affected flocks. The disease is controlled by vaccination with live and/or inactivated vaccines.

ND is found in the Middle East (ME) region for long time but during last 3-5 years it became more aggressive, more prevalent with higher rates of mortality with average broiler mortality increases to more than 20%. Therefore, it was a must to find a solution for controlling the ND problem in highly challenged area and based on this new ND approach was tried by using recombinant vaccine-Innovax- to be sure that ND field challenges are covered accordingly to below vaccination program.

First dose at In-Ovo 18 days prior to hatching Clone 30 @ day 1

Titer were monitored at different ages through taking serum samples and analyzed using HI tests. In addition, different parameters were monitored such as mortality rate, body weight and feed conversion before and after implementation of the above vaccination program.

After implementation of the Innovax –ND recombinant vaccine no clinical signs due to ND were observed and there was a decline in mortality from 20% to 9%, increase in body weight at 34 days from 1.60 kg to 1.68 Kg, improvement in the FCR from 1.9 to 1.7 and increase in EPI vending relations to become 282 compared to 200. The laboratory results showed that the farm was challenged by NDV - but the birds were protected.

Therefore, it was concluded that vaccination protocol including ND vaccine Nobilis® Clone 30 (at 1 day of age) in combination with the Innovax-ND vaccine Nobilis® ND Broiler In ovo was able to induce a level of protection suitable for the local challenge.

The adaptation of the mentioned vaccination program against ND resulted in improved production parameters (lower mortality, better weights and lower feed conversion).

Key Words: ND, Middle East, Recombinant vaccine

Metabolism & Nutrition VI

T163 Effects of fusonisin on turkey and the efficacy of a mycotoxin deactivating enzyme Verena Starkl1, Sabine Masching2, Simone Schaumberger3, BIOMIN Holding GmbH, Austria, Herzogenburg, Austria; 3BIOMIN Holding GmbH, Austria, St. Pölten, Austria; 1BIOMIN Holding GmbH, Austria, Vienna, Austria

Several different fungi, predominantly from Fusarium spp., are known to produce fusonisins, a group of carcinogenic fungal metabolites. Fumonisin are highly prevalent around the world and are mostly identified in corn and corn products. A recent conducted multi-mycotoxin screening via Liquid Chromatography coupled with tandem Mass Spectrometry (LC-MS/MS) in Latin America found fusonisins in all corn samples present with an average concentration of 2,800 ppb and 1,100 ppb for fumonisin B1 and FB2, respectively. On a global basis, about half of all investigated samples (corn to finished feed) were positive for this group of Fusarium toxins. The high prevalence of fusonisins as well as the negative impact on poultry’s health and performance reveals the necessity on successful counteraction of these toxins.

A trial was conducted with the aim to evaluate the efficacy of a mycotoxin deactivating enzyme (FUM)®, in turkey diets to reduce the adverse effects of FUM on the different biomarkers evaluated. This fumonisin esterase catalyzes hydrolytic release of two tricarballylic acid side chains from the core chain of fumonisin B1 (FB1), which results in the much less toxic hydrolyzed fumonisin B1 (HFB1).

A total of 15 10 weeks old turkeys were obtained and divided in three experimental groups.

- A negative control without additive or contaminant was used to establish the baseline of the diet.
- A positive control diet contained fumonisins to detect detrimental effects caused by the mycotoxin.
- A test group received fumonisins and FDE to detect the effect of the additive.
apparent ileal digestible energy (AIDE). No interactions were found for SBM and Protease supplementation (P>0.05). Protease supplementation led to improvements (P<0.05) in AIDE for the two SBM (South=162 kcal/kg and North=80 kcal/kg). The same improvement was obtained to coefficient of digestibility of CP by 2.1% and 2.5%, respectively. Supplementation with Protease also led to improvements in the digestibility of essential and nonessential amino acids (P<0.05). Additionally, the coefficient of digestibility of CP and essential amino acids as Met, Lys, Thr, Trp, Val, Leu and Ile were higher with Protease supplementation, and with SBM of North region (P<0.05). Soybean meal effects varied with its origin supposedly due to differences in their indigestible composition and Protease supplementation improved the digestibility of energy, protein and amino acids.

Key Words: broiler, protease, soybean meal

T165 Evaluation of a thermostable xylanase in broilers fed different types of diets Fenglan Yan1, Mercedes Vazquez-Anon1, Drew Lichtenstein1, Jonny Lyon2; 1Novus International Inc., St. Charles, MO, USA; 2Verenium Corporation, San Diego, CA, USA

A floor pen trial was conducted to evaluate the effect of a newly developed hyper-thermostable xylanase (CIBENZA® XYLAXVERSE®, Novus International, Inc.) in broilers as affected by diet type. Three types of diets employed were corn soy (CS), corn soy DDGS poultry byproduct meal mixed (CSM), and wheat soy (WS) based diets. Within each diet type, there were 3 treatments: positive control (PC), negative control with 100 kcal/kg less ME (NC), and 1000 U/kg xylanase on top of NC, resulting 9 dietary treatments. Positive control diets were formulated to reflect Agri Stats average nutrient specifications for starter (0-18 d), grower (18-35 d) and finisher (35-43 d) phases. Diets were in pelleted form except starter diets which were crumbled after pelleting. Each treatment had 9 replicate pens. Body weight, feed intake, FCR, and mortality were determined at 18, 35, and 43 d. On d 42, one bird per pen was sacrificed to measure proventriculus, gizzard, pancreas weight and digesta viscosity. Carcass parameters were obtained on d 44 from 5 birds per pen. Data were analyzed with one way ANOVA and a P-value ≤0.05 was considered significantly different. Reduction of 100 kcal/kg in ME resulted in higher 0.43 d FCR in birds fed WS or CSM diet, and with xylanase supplementation the compromised FCR was improved to a level comparable to PC treatment. Xylanase reduced overall feed intake in broilers fed WS diet only. With 100 kcal/kg ME reduction, fat pad weight was decreased significantly in broilers fed WS diet by 21% and numerically in broilers fed CSM diet by 9%, and xylanase supplementation significantly increased fat pad weight by 25% in WS diet and by 17% in CSM diet to a level that was not different from PC birds, an indication of improvement in energy utilization with xylanase. The digesta viscosity in WS birds was higher than that in CS or CSM birds; xylanase reduced digesta viscosity in WS birds by 67%, which was equivalent to CS or CSM diets. In summary, the study demonstrated efficacy of the thermostable xylanase in broilers fed either wheat or corn based diets in terms of growth performance and processing parameters.

Key Words: xylanase, broilers, growth performance, processing, viscosity

T166 The use of carbohdrases on broilers diets including 10% barley leads to the same productive performance as a standard Corn-SBM based diet. Rafael Hermes1, Sebastiana C. C. Azevedo1, Joao Luiz Kill1, Vitor B. Fascina1, Douglas Haese2, Dalton P. Rosin1, Jose Otavio B. Borbara1; 1DSM Nutritional Products, São Paulo, Brazil; 2Univesidade Vila Velha, Vila Velha, Brazil; 3Centro de Tecnologia Animal - CTA, Vila Velha, Brazil

Animal feed industry are constantly looking for alternative ingredients for feed costs reduction. In Brazil the main cereal used for poultry production is corn, however barley are seasonably available by cheper price. Thus, this study aimed to evaluate the inclusion of 10% barley on standard broilers diets and if the use of carbohdrases can overcome the expected reduc- tion on animal performance by the use of this less digestible ingredient. It was used 480 male chicks randomly distributed in 5 treatments of 8 replicates (12 birds each one). Treatments were a positive control diet (PC) based corn/soybean meal; a PC replacing 10% of corn by barley (BRL); a BRL + xylanase (XYL, 250 ppm of RONOZYME WX); and a BRL + β-glucanase (BGL, 400 ppm of RONOZYME VP). Data were submit to analysis of variance and means were compared by Tukey test (P<0.05). At the end of the trial (42 days) it was measured the feed intake (FI), weight gain (WG) and feed conversion ratio (FCR). Barley inclusion significantly reduced (P<0.05) the FI (5.043kg), WG (2.836kg) and presented the worst FCR (1.78), compared to the PC diet (5.049kg, 3.023kg and 1.67, respectively). However, the inclusion of carbohydrases on barley diets, were able to overcome this productive losses and presented the same (P>0.05) results as the positive control, where: XYL = 5.166kg, 3.022 and 1.71; and BGL = 5.124kg, 2.977kg and 1.72 for FI, WG and FCR, respectively. The inclusion of barley may represent and feed reduction cost and the use of xylanase and β-glucanase could keep the same productive results as a standard corn/SBM diets for broilers.

Key Words: Barley, xylanase, gluana, carbohydrase, broiler

T167 A phytogenic feed additive with esters of short and medium chain fatty acids can replace in-feed antibiotics in broilers Jan Dirk van der Klis*, Leopold Jungbauer Delacon Biotechnik GmbH, Steyrregg, Austria

The use of antimicrobial growth promoters (AGP) as in-feed antibiotics is restricted in different parts of the world by existing or upcoming legislation. Positive effects of AGPs are based on 1) control of the intestinal microbial ecosystem, 2) improved intestinal health and 3) reduced intestinal inflammation. Feed additives developed to replace AGPs should reflect these modes of action. Therefore, a combination of a phytogenic feed additive (PFA, Biostrong® 510) based on essential oils, herbs, spices and saponins with esters of short and medium chain fatty acids (SMCFA) was evaluated. Two broiler challenge studies (successive inoculation with E. coli spp at about 9 days of age and Cl. perfringens 5, 6 and 7 days later) were done. Treatments in challenge study 1 were non-infected non-treated (NINT), infected non-treated (INT) and infected treated (IT) groups (8 replicates per treatment) with two dose levels of the SMCFA esters (2000 mg/kg and 3000 mg/kg). Stafac 20 was used as a positive control (PC). In challenge study 2, NINT, INT and IT groups (6 replicates per treatment) with SMCFA esters (700 mg/kg feed) alone and in combination with the PFA (150 mg/kg feed) were tested.

In challenge study 1, SMCFA esters improved lesions scores (P<0.05) and reduced NE related mortality from 11% to 5% and 3% (P<0.05) at 2000 mg/kg and 3000 mg/kg, respectively. Moreover, they improved feed efficiency (P<0.05) by 8.8% compared to INT birds, resulting in values similar (P>0.05) to PC. Results on lesion scores were confirmed in the second challenge experiment: SMCFA esters decreased necrotic lesion scores by 15% on Day 16, whereas the combination of PFA and SMCFA esters reduced these scores by 36% (P<0.05), from 2.0 in INT to 1.2 in IT. During the challenge period SMCFA esters alone or in combination with PFA improved FCR by 1.3 and 2.4%, respectively compared to INT.

The combination of PFA with SMCFA esters improved the resistance of broilers against necrotic enteritis and their feed efficiency during challenge in an AGP free diet.

Key Words: necrotic enteritis, health, performance, broiler

Poult. Sci. 94 (E-Suppl. 1)
T168 The efficacy of a xylanase vs. a complex of carbohydrases on the growth performance of turkey hens fed a wheat-soybean meal based diet from 0 to 84 days-of-age J.L. Grimes1, A.C. Fahrenholz1, I.B. Barasch1, C.E. Evans1, S. Gately2, N. Sriperm2, S.B. Essick1, R.B. Shirley2 1North Carolina State University, Raleigh, NC, USA; 2Adisseo USA, Inc., Alpharetta, GA, USA
This study evaluated the efficacy of a single xylanase (Belfeed; 48 g/MT) vs. a multi-enzyme carbohydrase (Rovabio Excel LC; 200 ml/MT) on the performance of Hybrid-Converter turkey hens from 0 to 84 days-of-age when fed on-top in a wheat-soy diet. The treatments included 1. a Control diet that was sufficed in all nutrients, 2. the Control diet plus the single xylanase, and 3. the Control diet plus the multi-enzyme carbohydrase. The phases included a Starter 1 (day-of-hatch to 21 days; crumble), Starter 2 (21-42 days; small pellet), Grower 1 (42-63 days; pellet) and Grower 2 (63-84 days; pellet). Using a randomized block design, each treatment was replicated three times within each of four blocks, and each replicate pen contained 25 day-of-hatch female poults. Data were analyzed using ANOVA and deemed significant at a p<0.05. Comparing the performance data of treatments within phases and across cumulative periods of the study, there were no statistical differences in body weight (BW), body weight gain (BWG), feed consumption (FC) or feed conversion ratio (FCR) between the three treatments in Starter phase 1 and 2. The same was observed in the Grower 1 and 2 phases for BW and BWG; however, significant differences in FCR were observed for the respective Grower 1 and 2 phases and their cumulative periods (i.e. 0 to 63 and 0 to 84 days, respectively). In Grower 1, feeding the Control and xylanase treatments resulted in a FCR of 2.11 and 2.12, respectively, while using the multi-enzyme carbohydrase resulted in a FCR of 2.05 (p=0.019); the total 0 to 63 day FCR were 1.90 for treatments 1 and 2, and 1.85 for treatment 3 (p=0.001). In the Grower 2 phase, hens fed treatment 1 had a higher FCR (2.66; p=0.002) vs. treatment 2 (2.56) and treatment 3 (2.55). Comparing FCR across the 0 to 84 day growout, treatment 1 had a FCR of 2.16, treatment 2 had a FCR of 2.14 and treatment 3 had a FCR of 2.10 (P<0.001). In conclusion, the on-top addition of the multi-enzyme carbohydrase resulted in a more consistent and significantly improved feed conversion response when compared to the nutritionally adequate Control and the single xylanase treatments.

Key Words: Turkey hen, Multi-enzyme carbohydrase, Xylanase, Rovabio, Wheat-soybean meal diet

T169 Fiber and nutrient retention responses of supplemental xylanase in broiler chickens fed wheat based diets are independent of the acclimatization period to test diets Elijah Kiracie1, Luis Romero1, Ravi Ravindran2 1DuPont Industrial Biosciences- Danisco Animal Nutrition, Marlborough, United Kingdom; 2Massey University, Palmerston North, New Zealand
Protocols for measuring efficacy of fiber degrading enzymes such as xylanase on the retention of fiber and nutrients rarely examine the impact of the duration of exposure to treatment diets. In the current study, we evaluated the effects of exposing broilers to xylanase-supplemented diets for 7 or 21 d on fiber and nutrient retention at 21 d of age. Six treatments, arranged in two levels of exposure to experimental diets (starting at 0 or 14 of age) by three levels of xylanase (0 or 2,500 or 5,000 xylanase units (XU)/kg feed) were used. Xylanase was added to a wheat-based diet with 500 phytase U/kg and 0.3% TiO2 as indigestible marker. Enzymes were provided by Danisco UK Ltd, Marlborough, UK. A total of 384 d old male broiler (Ross 308) chicks were divided into two groups. The first group was assigned on weight basis to 24 cages (8 chicks per cage) and allocated to the diets from d 0. Birds in the second group were reared on a commercial feed in the same environmentally controlled room for 13 d. On d 14, the birds were individually weighed and assigned on weight basis to 24 cages (8 chicks per cage) and allocated to the diets. Birds had free access to experimental diets and water. Feed intake and excreta output were recorded per cage from d 18 to 21. On d 21, six birds per cage were euthanized to access the ileal digesta. There was no interaction (P > 0.05) between acclimatization period and supplemental xylanase for the apparent ileal digestibility (AID) and apparent retention (AR) of fiber, nutrients and energy. The main effect of acclimatization was such that the birds exposed to diets for 7 d had higher (P<0.01) AID of energy than those exposed for 21 d. In contrast, birds exposed to diets for 21 d had higher (P < 0.05) AMEn and AR of neutral detergent fiber (NDF). Xylanase improvements (P<0.01) in the AID of energy and AMEn were dose dependent. The AID of energy of the birds fed the control and 5,000 XU/kg diets were 66.9 and 70.8, respectively. The corresponding values for the AMEn were 3035 and 3202 kcal/kg DM, respectively. The improvements in the AID of energy with xylanase supplementation coincided with linear improvements (P < 0.05) in the AID of nitrogen, fat and starch. Birds fed diets with xylanase had higher (P > 0.05) AR of dry matter, fat and NDF. In particular, birds fed 5,000 XU/kg diets retained 85% more NDF (36.2 vs. 19.6 g/kg DM) than the control birds. The results suggested xylanase responses at d 21 on the retention of fiber, nutrients and energy were independent of the duration (7 or 21 d) that the birds were exposed to the diets. The data also showed that longer exposure resulted in more retained fiber suggesting possible microbial adaptation.

Key Words: Acclimatization, broilers, nutrient retention, phytase, xylanase

T170 Effects of protease and glucanase on nutrient digestibility of soybean meal in broiler chickens Sergio Luiz Vieira1, Catarina Stefanelli1, Gabriela de Oliveira Santiago1, Natália Chaves Serafíni2, José Otávio Berti Sorbara2, Rafael Gustavo Hermes2 1UFRGS, Porto Alegre, Brazil; 2DSM Nutritional Products, São Paulo, Brazil
A study was conducted to evaluate the effects of different enzymes on soybean meal (SBM). A total of 280 Cobb 500 male broilers were placed in 40 battery cages, with 5 treatments and 8 replications of 7 birds each. Birds were fed the same diets to 14 d, and experimental diets were provided from 15 to 24 d. SBM had 46.7% CP, 3.9% crude fiber, and 1.6% fat. A Test diet (55.5% SBM, 40.8% corn starch, 0.96% dicalcium phosphate, 1.1% limestone, 0.15% mineral and vitamin premixes, 0.5% salt, 0.01% phytase (RONOZYM HiPhos) and 1% Celite) was prepared. Four enzyme products were individually added to the Test diet: Carbohydrate complex (RONOZYM VP with 100 Fungal β-glucanase Units/kg), Protease (RONOZYM ProAct with 15,000 PROT Units/kg), Commercial Protease PROT 1 and Commercial Protease PROT 2. Total excreta was collected from 21 to 24 d whereas all birds were slaughtered at 24 d for ileal content collection. Feed, excreta and ileum content were submitted to combustion using an IKA calorimeter as well as analysis of crude protein (CP), amino acids and dry matter to calculate their digestibility coefficients, apparent metabolizable energy (AME), and apparent ileal digestible energy (AIDE). An Anova with Dunnet test was conducted (5% significance). Supplementation with Carbohydrase complex, Protease and the Commercial product PROT 2 increased the AME, respectively of 51, 47 and 19 kcal/kg (P < 0.05). The addition of Carbohydrase complex and Protease led to improvements in the apparent ileal digestibility of CP of 1.5% and 2.5%, respectively (P < 0.05). The coefficient of digestibility of essential and nonessential amino acids increased with Carbohydrase complex and Protease supplementation (P < 0.05). Additionally, Protease supplementation improved the coefficient of digestibility of Met, Lys, Thr, Arg, Trp and Val, respectively in 2.7%, 2.2%, 2.9%, 1.3%, 1.9% and 2.2%. It is concluded that Carbohydrase and Proteases supplementation was efficient to improve the digestibility of energy, protein and amino acids.

Key Words: broiler, carbohydrase, protease, soybean meal
T174 The effect of exogenous phytase and xylanase on dietary energy and nutrient digestibility for broiler chickens Waseem Mirza1, Vasil PIRGOZLIEV2, PAUL ROSE1, Mike Bedford2 The National Institute of Poultry Husbandry, Harper Adams University, Newport, Shropshire TF10 8NB, Shrophire, United Kingdom; 2AB Vista Feed Ingredients, Woodstock Court, Blenheim Road, Marlborough Business Park, Marlborough, Wiltshire, SN8 4AN, UK, Marlborough, United Kingdom

The study was conducted to determine the effects on dietary N-corrected apparent metabolisable energy (AME), dry matter (DMD), nitrogen (ND) and P digestibility and growth performance when wheat-soybean mash diet supplemented with exogenous xylanase and phytase individually or in combination was fed to male 308 Ross broiler chickens from Poul. Sci. 94 (E-Suppl. 1)
T175 Effects of β-mannanase on nutrient utilization in young broilers fed diets containing variable levels of β-mannan Justina Caldas1, Jinrong Wang2, Karen Vignale1, Nirun Boonsinchai1, Andrew Magnuson1, Monticha Putsakum2, Judith England1, Craig Coo1 1University of Arkansas, Fayetteville, AR, USA; 2School of Agriculture and Cooperatives, Nonthaburi, Thailand

This experiment was conducted to determine the negative effects of β-mannan from soybean meal (SBM) and guar gum (GG) on live performance and nutrient metabolism and to determine the positive effect if β-mannanase is included. 504 Cobb male chickens were allocated to 72 cages for a 7-21 d study. 3 diets [low SBM (18%); high SBM (31%); and high SBM + 0.5% GG] were mixed to produce 9 diets. Nutrient digestibility, viscosity, glucose, insulin and IGF-1 were analyzed. A factorial design 3x3 was analyzed with JMP pro 11 (SAS, 2013); when ANOVA was significant means were separated by t-test or contrast analysis at p-value <0.05. β-mannanase improved FCR 7 points with inclusion of 400 ppm in high SBM diet (p-value = 0.018) and improved FCR 18 and 19 points with 200 and 400 ppm, respectively, in the high SBM + GG diet (p-value <0.001). Viscosity was decreased from 19.2 cps to 7 cps with both enzyme doses in the high SBM + GG diet (p-value <0.0001). Digestible energy was increased 200 Kcal/kg with 400 ppm β-mannanase in the high SBM diet and 220 kcal/kg with both levels of enzyme in high SBM + GG diet. Digestibility of amino acids was improved from 0.8% to 3.6% with β-mannanase in high SBM + GG diet (p-value = 0.02 – 0.05). Glucose levels were higher for 200 ppm β-mannanase compared to control (190 mg/dl vs 182 mg/dl) in the fasted state (p-value <0.036). Glucose levels in chicks in the re-fed state were lower for the high SBM and high SBM + GG diets (p-value <0.001). Insulin was higher for chicks fed test diets with 200 and 400 ppm added β-mannanase in the fed state at p-value = 0.019. Insulin was lower in the fasted state for chicks fed high SBM diets (p-value = 0.043). IGF-1 was increased in chicks in fed state that were fed high SBM and high SBM + GG diets. The contrast analysis shows higher values of IGF-1 with 200 and 400 ppm added β-mannanase in chicks fed high SBM + GG diets (p-values = 0.046 and 0.006, respectively) in the re-fed state. In conclusion, chicks fed high SBM and high SBM + GG diets with added β-mannanase significantly improved blood glucose and anabolic hormone homeostasis, FCR, digestible energy, and digestible amino acids compared to chicks fed same diets without β-mannanase.

Key Words: Phytase, Xylanase, Broilers, ME, P digestibility

T176 Protease supplementation and reduction of crude protein and methionine + cystine in diets of laying hens from 21 to 44 weeks of age Diana Suckeveri1, Douglas Enmyddio de Faria1, Daniel Faria Filho1, Leandro Félix Demuner1, Julian Andres Muñoz2, José Otávio Sorbara2, Rafael Hermes2, Vitor Barbosa Fascini1 1Faculty of Animal Science and Food Engineering, University of Sao Paulo, Pirassununga, Brazil; 2DSM Nutritional Products, Pirassununga, Brazil

This study was conducted to evaluate the effects of reduction of crude protein and methionine + cystine (RCPMC), and protease (PRO) in corn-soybean meal diets for laying hens, according to Hy-Line W36 Manual (2013), on performance and egg quality (EQ) characteristics. 168 hens from 21 to 32 (Phase I) and 33 to 44 (Phase II) weeks of age were distributed in a completely randomized design in a 3 x 2 factorial scheme (RCPMC x PRO), with 6 treatments and 7 replicates of 4 birds each. The enzyme was RONOZYME® ProAct (CT) included at 9000 PROT/kg and the matrix enzyme was valued once and twice, with or without PRO. Feed intake (FI), egg production (EP), egg weight (EW), egg mass (EM), feed conversion ratio per egg mass (FCREM) and per dozen (FCRoz) were evaluated at the end of each production period (28 days). 3 eggs per experimental unit were collected for internal EQ: Haugh Unit (HU), index yolk (IV), yolk percent (YP) and albumen percent (AP) and external EQ: specific gravity (SG), shell percent (SP) and shell thickness (ST). Data were subjected to analysis of variance and Tukey test (5%) using SAS® (2013), on performance and egg quality characteristics. 168 hens fed diets using PRO obtained greater results for SG and ST than diets without PRO. In the Phase II there were not differences among treatments for FI, EP, EM, FCREM, FCRDZ and internal EQ. There was interaction (P<0.05) of the effects of RCPMC and PRO on EW showing improvements results when included PRO with diet control and enhancing the nutritional matrix once. Hens fed diets using PRO promoted best results for SG, SP and ST than diets without PRO. In the Phase II there were not differences among treatments for FI, EP, EM and FCREM. For FCRDZ was significantly better using enhancing the nutritional matrix twice. For AP was significantly higher for control and enhancing the nutritional matrix once than twice. Hens fed diets using PRO obtained greater results for SG and ST compared with diets without PRO. In conclusion, the reduction of crude protein and methionine + cystine and ProAct supplementation promoted the same performance as the diet control and the use of ProAct improved eggshell quality.

Key Words: Avian, Egg quality, Enzymes, Nutrition, Performance

T177 Influence of a phytoogenic blend on nutrient digestibility and growth performance in broiler chickens Ganapatri Raj Murugesan1, Christine Hunger2, Carina Schieder2, Klaus Manner3, Jurgen Zentek3 1BIOIMEN America Inc., San Antonio, TX, USA; 2BIOMEN Holding GmbH, Herzogenburg, Austria; 3Freie University of Berlin, Berlin, Germany

Two experiments were conducted to evaluate the efficacy of a phytogenic blend containing matrix-encapsulated essential oils (PFA) on the apparent ileal nutrient and amino acid digestibility and growth performance of broiler chickens. Day-old Cobb-500 chicks were assigned to 16 floor pens based on body weight with 8 pens per group and 20 birds per pen from day 1-42 in experiment 1 and 1-21 days in experiment 2. The corn-soybean wheat based control diet was formulated to meet the breeder requirements, while the treatment diet was prepared by adding 0.01% of PFA with the control diet. Weekly body weight gain (BWG), feed intake and feed conversion ratio (FCR) were determined in both the experiments. In addition, apparent ileal digestibility (AID) of crude ash (CA), crude protein (CP),...
ABSTRACTS OF PAPERS

T178 Effect of Hemicell HT® enzyme on the immune system of chickens and their performance
Nannette Olmeda Geniec1, Fatemeh Alemi2, Kirk Klasing2, Elanco Animal Health, Aston, PA, USA; 3University of California Davis, Davis, CA, USA

A pilot efficacy study was conducted to determine the effects of feeding a commercially produced enzyme Hemicell HT on the immune responsiveness of chickens during their first 21 days of life. Three experimental diets were studied: Treatment A-Basal diet minus 40kcal/lb, Treatment B-Basal diet plus 40 kcal/lb, and Treatment C-Basal diet minus 40 kcal/lb plus Hemicell HT enzyme at inclusion rate of 100MU/ton. Chicks were provided experimental diets for 21 days. Pen weights, feeder weights and tissue samples from one bird/pen were taken at 7D, 14D and 21D. Performance data showed the most robust effect of Hemicell HT on gain and efficiency during the first and second week of the study. Histology results showed that the diets A and B had very similar intestinal morphology indicating that additional energy had no apparent effects on intestinal health. The effect of Treatment C was greatest on day 7, where an increase in the length of the villi and a decrease in the thickness of the lamina propria in the duodenum, jejunum and ileum were observed. Treatment C decreased the number of intra-epithelial lymphocytes in the cecum as well as heterophil in the blood on day 21. No treatment effect was found on acute phase proteins. Diets A and B had very similar levels of cytokine expression in all regions of the intestines, indicating that additional energy had no apparent effects on intestinal inflammation. In contrast, Treatments C showed an anti-inflammatory effect as indicated by decreasing IL-1 and IL-6 and increasing IL-10 mRNA. In conclusion, Treatment C demonstrated significant improvement compared to control diets A and B. Changes in histological indices and cytokine expression indicate decreased inflammation in the intestines by the inclusion of the enzyme in the diet. These results are consistent with the idea that a reduction of intestinal inflammation is the mechanism for improved performance when birds are fed Hemicell HT in the presence of mannan content in the diet.

Key Words: enzyme, mannan, immunity, cytokines, broiler

T179 Impact of dietary mannan-oligosaccharide (Bio-mos®) on productive performance, immune status and control of necrotic enteritis in broiler chickens
Mohamed Ahmed Tony1, Ahmed Abd El-Hadi2, Mohamed Mamdouh Hamoud1 1Department of Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, Cairo University, Giza, Egypt; 2Poultry Production Following Sector, Agrarian Reform, Giza, Egypt; 3Department of Poultry Diseases, Faculty of Veterinary Medicine, Cairo University, Giza, Egypt

The present study was conducted to evaluate the effect of different levels of mannan-oligosaccharide (Bio-mos®) as feed additive on productive performance, immune status and control of necrotic enteritis in broiler chickens. A total of 300 one-day-old broiler chicks were randomly distributed to different dietary treatments as hatched. All birds were reared on the same basal diets supplemented with Bio-mos® at 250 and 500 g/ton respectively. Feed and water were available ad libitum for 35 days experimental period. Feed consumption and live body weight were recorded weekly to calculate body gain and feed conversion. Birds were subjected to a vaccination program, including Newcastle Disease (ND) and Infectious Bursal Disease (IBD). Immune status was determined by hemagglutination inhibition test and ELISA assay. At day 16 of age 10 birds from each group were isolated and challenged orally with 1 ml containing Clostridium perfringens (107 cfu/mL) daily for 3 consecutive days. Post-challenge, lesion scores, mortalities and intestinal C. Perfringens levels were assessed. Feed intake and live body weight were improved significantly (P<0.05) and feed conversion was reduced in broiler chickens consumed diets containing Bio-mos®. The best feed conversion was recorded in T2 group. Bio-mos® significantly enhanced immune responses measured against vaccines. The log10 C. perfringens/g of intestinal contents was significantly reduced (p<0.05) in the Bio-mos® treated groups. T2 group showed the best results. Mortality was reduced in both treated groups in contrast to the control group. The present study revealed that the birds consumed Bio-mos® showed a reduction in the severity of lesion score. In conclusion, mannan-oligosaccharide (Bio-mos®) has positive effects on production performance, enhancing immunity and disease resistance in broiler chickens. Bio-mos® feed additive can be used as a safe alternative to antibiotics and attractive aid for prevention and control of Clostridium perfringens infections in broilers.

Key Words: Mannan-oligosaccharide, Bio-mos®, broiler chicken, performance, necrotic enteritis

T180 Performance evaluation of commercial broilers fed Algalmune™ ZPC10, a zinc polysaccharide complex containing beta-1,3-glucan derived from microalgae
Geoff Horst1, Robert Levine1, Karen Christensen2, Algal Scientific Corporation, Northville, MI, USA; 1,3-glucan derived from microalgae Geoff Horst1, Robert Levine1, Karen Christensen2, Algal Scientific Corporation, Northville, MI, USA; 1OK Industries, Fort Chaffee, AZ, USA

Beta glucan is a well-known immunomodulator that has been shown to reduce the effects of stress and disease in broilers. The objective of the current study was to evaluate the performance effects of a new feed additive containing beta-1,3-glucan derived from microalgae when included in the diet of broilers. The study was conducted at O.K. Foods' commercial research facility in a house containing 96 pens arranged in 8 blocks of 12 pens. Each pen was 4’1” square and contained 22 birds (males, Ross x Ross 708). Algalmune™ ZPC10, which is a zinc polysaccharide complex that contains 35% beta-1,3-glucan and 10% zinc, was incorporated into each diet at a rate of 125, 250, or 500 grams per metric ton of feed (g/MT). The control group received the standard diets without Algalmune™ ZPC. In total, seven different inclusion levels of Algalmune™ ZPC were examined in this performance study. In treatment groups 2, 3, and 4, a consistent level of Algalmune™ ZPC (125, 250, or 500 g/MT, respectively) was included in each diet from day 0 to day 49. In treatment groups 5 and 6, the starter diet contained 500 g/MT Algalmune™ ZPC and the dose decreased thereafter to 125 g/MT (treatment 5) or 0 g/MT (treatment 6) in the grower diet. Likewise, the starter dose in treatments 7 and 8 was 250 g/MT and decreased thereafter to 125 g/MT in treatment 7 or 0 g/MT in treatment 8. Performance was significantly affected by inclusion of various amounts of beta glucan. Treatment 2 (125 g/MT Algalmune™ ZPC for the full 49 days) demonstrated the largest improvement in performance relative to the control group (Treatment 1): the growth rate was 3.4% faster and the overall mortality-adjusted feed conversion ratio was 1.9% lower (3.4 points). When this FCR was standardized to a 7.5 lb bird, this treatment group showed a 4.3% improvement (7.8 points) relative to the control. Treatment 6 (500 g/MT in the starter only) showed a 0.5% improvement in adjusted FCR compared to the control, which equates to a 2.9% improvement (5.2 points) when standardized to a 7.5 lb bird. Likewise, Treatment

Poult. Sci. 94 (E-Suppl. 1)
ABSTRACTS OF PAPERS

243

T181 Unique Gasification Process for Litter Generating Energy and Fertilizer Jerod Smeek* DenYon LLC, Webster, IA, USA

DenYon Energy, LLC and Frontline BioEnergy, LLC are developing an advanced gasification system for the conversion of poultry litter into usable energy and soil amendments. A lab-scale demonstration system was built and tested using turkey litter and layer manure and demonstrated substantial process improvements over prior art. The system includes Frontline’s unique fluid bed gasifier that produces a combustible gas free of higher hydrocarbons (also known as tars), enabling the capture of feedstock nitrogen as ammonium sulfate, a nutrient rich char-ash material that is also a fertilizer/soil amendment, and clean, combustible fuel gas for conversion into thermal or electric energy. The use of a fluid bed enables excellent temperature control to greatly reduce the potential for clinker formation. Gasifier production of a fuel gas free of tars is a pre-requisite for ammonia scrubbing and use of the fuel gas in an internal combustion engine for electric power generation. The capture of feedstock nitrogen as ammonium sulfate is unique, as most litter thermal conversion systems oxidize the nitrogen with resulting NOx in the flue gas. The ammonium sulfate is a substantial revenue source, increasing revenue by as much as 80% over energy production alone. No residual wastes are produced and the combusted gas complies with emission regulations. Numerous tests, including a 10-day duration test, successfully demonstrated the production of a tar-free combustible gas and other fertilizer co-products with ‘clinker-free’ operation. DenYon is designing a prototype to demonstrate on-farm operation.

Key Words: litter conversion, gasification, energy, fertilizer

T182 Methods to evaluate efficacy of In-Ovo Marek’s vaccination Pieter Kuhne* MSD AH, in US Merck AH, Boxmeer, Netherlands

In-ovo vaccination is the delivery of vaccine(s) in: Amniotic fluid and/or in the Embryo around the 18th day of hatch. It is an: Accurate, Automated Mass application of vaccines, and, at the same time an Individual vaccine delivery. The aim is a Quick*, Careful*, and Safe* vaccine delivery of exactly one dose of vaccine to Amnion* and/or Embryo* of each hatching egg. The result is strongly depending on in-ovo vaccination equipment, and professional coaching of involved hatchery employees.

The reason for studying the efficacy of in-ovo vaccination is that; Limited knowledge is available and we would like to have more information on vaccine take. Missed egg stays life-long unprotected (HVT recombinant vaccines do not spread from bird to bird). Besides that it would be interesting to study differences between different equipment’s?

At present a few studies are known defining the injection location and vaccination efficacy.

We studied:

1) Efficacy study using vaccine virus re-isolation.

900 eggs from Parent Ross 308, 42 Weeks of age were injected in-ovo on the 18th day of hatch using Vinovo device. Vaccine used was Nobilis HVT CA126. From separate eggs 20 birds were injected SC at day of hatch. 60 hatched chicken from the in-ovo batch and 20 SC vaccinated chicks were placed in Isolators. At 14/15 days of age virus isolation from spleens of chicks was done.

2) Efficacy studies method: vaccine virus DNA detection (PCR)

3 batches of eggs were vaccinated in ovo with Vinovo. First batch (Trial 1; 15,000 birds) was placed in one house. The next two batches (Trial 2 and 3; 30,000 birds) were placed in two houses A and B. Feathers were collected from 45 broilers per house on day 21-22 of live. Feathers were to GD Deventer (NL) and tested in their qPCR HVT.

The results will show that, a high grade of right vaccine application and vaccine “take” can be achieved with the Vinovo in-ovo device. The PCR technique is less laborious and less expensive compared to the method of Virus re-isolation.

Key Words: Marek, vaccination, In-Ovo, PCR HVT, vinovo

Environmental Management III

T183 Comparative effects of in ovo versus subcutaneous vaccination and pre-placement holding time on post-hatch broiler performance E. David Peebles1, Taylor Barbosa2, Timothy Cummings2, John Dickson2, and Sharon Womack1 1Mississippi State University, Mississippi State, MS, USA; 2 Zoetis, Research Triangle Park, NC, USA

Effects of the in ovo or subcutaneous (sc) vaccination of HVT vaccine (trt) and 4 and 18 h pre-placement holding times (pht) on the performance of male broilers through 48 d of age were investigated. Aviagen 708 broiler hatching eggs (3,900) were either in-oovo-vaccinated at 18 d of incubation or chicks from eggs that were not in-oovo-injected were vaccinated sc at hatch, and chicks from each vaccination trt group were held for 1 of the 2 pht. In ovo injections (50 µL) were delivered by a commercial multi-egg injector and sc injections (0.2 mL) were delivered by an automatic pneumatic sc injector. Twelve birds were assigned to each of 15 replicate floor pens belonging to each of the 4 trt and pht combination groups (blocks). Mortality and BW gain were determined at weekly intervals, and feed consumption and conversion were determined in the 0-14, 14-28, 28-42, and 42-48 d age intervals. Data were subjected to 2 x 2 factorial analysis in a randomized complete block experimental design using a mixed model with trt and pht as fixed factors and block as a random factor. No interactive effects between trt and pht were observed for any parameter. However, a trt main effect was observed for 14-28 d feed consumption (P ≤ 0.05). Furthermore, phl main effects were observed for 0-14 d (P ≤ 0.007) and 14-28 d (P ≤ 0.01) feed consumption, and for 0-7 d (P ≤ 0.002) and 14-21 d (P ≤ 0.02) BW gain. The 14-28 d feed consumption of sc-vaccinated birds (113.1 ± 0.001 g) was lower than that of in ovo-vaccinated birds (115.1 ± 0.001 g), and the increase in pht from 4 to 18 h decreased feed consumption and BW gain in the 4 aforementioned respective time intervals. In conclusion, although an increase in pht decreased BW gain by reducing feed consumption through 28 d posthatch, in ovo injection did not negatively affect broiler performance through 48 d of age, whether or not broilers were held for 4 or 18 h prior to placement. Therefore, with regard to broiler performance, in ovo and sc injections were equally safe for the administration of the HVT vaccine.

Key Words: broilers, holding time, in ovo injection, subcutaneous injection, vaccination
T184 Minimizing reduction in average daily gain in broiler chicks following the use of anticoccidial vaccines through concomitant treatment with a lactic acid bacteria-based probiotic Matthew Faulkner1, Jacob Lumi2, Jose Vicente1, Ross Wolfenden1, pacificveggroup.com, Fayetteville, AR, USA; 1Pacific Vet Group, Fayetteville, AR, USA

Coccidiosis is a common poultry disease caused by several protozoal pathogens belonging to the *Eimeria* genus. Coccidiosis detrimentally affects the worldwide poultry industry through increased mortality, reduced feed efficiency, reduced body weight gain, and increased susceptibility to other enteric pathogens. In an effort to reduce coccidiosis in chickens, live coccidiosis vaccines may be used to protect against this disease. While effective at establishing immunity against *Eimeria* sp., the vaccines have been known to decrease early growth rate and leave chicks more susceptible to secondary bacterial infections within the gut. One potential way to ameliorate these effects may be to administer probiotic bacteria to vaccinated flocks. A hatchery applied, lactic acid bacteria-based probiotic, FloraStart® (FSC), which was selected through an *in vitro* and *in vivo* screening process, was used in these trials. FSC was applied to chicks to determine the effects on body weight gain when administered concurrently with a commercially available coccidiosis vaccine. Multiple *in vivo* experiments were performed and, in each experiment, the birds were weighed on day-of-hatch and days 7, 10, and 14 to determine weight gain compared to non-probiotic treated chicks. In all experiments, probiotic treated groups consistently had greater weight gain than non-probiotic treated groups at all time periods. Average weight of FSC treated groups on day 7 was 112.05 ± 1.07 g compared to 105.6 ± 1.9 g in non-probiotic treated controls P < 0.05. On day 14 the trend continued with an average weight of 294.3 ± 4.1 g in probiotic groups compared to 277.2 ± 4.11 g in controls. These results were repeated using multiple commercially available coccidiosis vaccines. These results indicate that administration of the probiotic FSC leads to increased body weight gain in chicks vaccinated against coccidiosis.

**Key Words:** probiotic, body weight gain, coccidiosis, broiler, coccidiosis vaccine

T185 Comparing the Bioactivity of two 25-OH-Vitamin D3 Sources (Bio-D™ and Hy-D™) with Commercial or NRC Diet Formulations for Early Turkey Growth Performance and Bone Mineralization R. Michael Hulet1, L. A. Kitto1, O. Gutierrez2, J. A. Lee3 Pennsylvania State University, University Park, PA, USA; 2Havepharma, Inc., Atlanta, GA, USA; 3Texas A&M University, College Station, TX, USA

Two commercial sources of 25-hydroxy vitamin D₃ (Bio-D™ and Hy-D™) were evaluated for their effect on turkey growth performance, serum Calcium and 25-OH-D₃, and bone mineralization. An NRC and Industry D₃ negative control diet with 65% of typical industry calcium levels and 0.12% deficient phosphorus diets (with added phytase) were supplemented with either 91.8 ppb HyD, 45.9 ppb Bio-D, or 91.8 ppb Bio-D. Seventeen hundred and twenty eight day-old turkey toms (Nicholas 500) were randomized into 96 pens with 18 pouls per pen. Blood samples (24 per treatment) were taken at 4 and 6 weeks of age to determine serum 25-OH D₃ and Calcium (Heartland Assays, Ames IA). At the conclusion of the study, the left tibia from 24 birds per treatment was collected at 42 days of age. Data were analyzed as a 2 x 4 factorial for vitamin D source and dose using the ANOVA procedure of SAS, with means separated using Tukeys procedure (p<0.05).

Serum 25-OH D₃ at 4 and 6 weeks for Bio-D levels of 91.8 ppb was significantly greater than for 91.8 ppb HyD or 45.9 ppb Bio-D supplemented birds. Bio-D and HyD levels of 91.8 ppb had significantly higher levels of serum Calcium at 4 and 6 weeks of age than for the negative control treatments. Significantly higher percent Ash was found between the NRC and Industry dietary levels as well as Bio-D having greater percent Ash at either 45.9 or 91.8 ppb when compared to HyD (91.8 ppb) or to the negative control. Feed conversion was significantly improved for the Industry dietary formulation when compared with the NRC-diet supplemented turkeys. Body weight gain at 42 days was significantly greater for the birds fed the control or HyD diet compared to the birds fed the Bio-D treatments.

**Key Words:** Turkey, 25-OH D3, Tibial Ash, Body Weight

T186 Application of a specifically selected probiotic at the hatchery improves seven day weight gain as well as mortality in commercial broiler chicks. Ross Wolfenden*, Matthew Faulkner, Anita Menconi, James Barton, Jacob Lumi, Jose Vicente Pacific Vet Group, Fayetteville, AR, USA

Early gut development in broiler chicks is stimulated by the establishment of healthy gut microbiota. In nature, hens provide these microbiota to their chicks, however, in the commercial setting hens and progeny are separated which prevents colonization by the normal flora. This retards intestinal development and can leave the chicks more susceptible to pathogenic bacteria. This can in turn decrease market weight and increase mortality. The first organisms to colonize the GI tract have a distinct advantage in becoming the primary residents. However, the most common environmental bacteria in the hatchery and farms often include species such as *Pseudomonas*, *Salmonella* and *E. coli* which may be pathogenic. In these studies a novel, hatchery-applied probiotic (PRO), FloraStart®, was evaluated to determine its effect on 7 day weight gain, uniformity, and mortality in broiler chicks. Chicks were treated with PRO, which is comprised of *Lactobacillus plantarum* strain TY036 and *Enterococcus faecium* strain MFF109, via spray in the hatchery prior to placement in commercial broiler houses. Treatment with PRO demonstrated a 0.47% decrease in flock mortality from 4.97% to 4.5%. Along with decreased mortality there was also a significant increase in 7 day body weight. Average 7 day weight from the FS groups was 147.0±5.6g as compared to 143.49±6.9 g the controls with P<0.05. Improved uniformity in these flocks was also observed. These results also corroborate previous laboratory studies conducted with PRO in neonates. These results indicate that treatment with PRO provides a unique opportunity to colonize neonatal broilers with beneficial microbes that have multiple beneficial effects including an increase in 7 day weight, decreased mortality, improved uniformity as well as early protection from pathogens.

**Key Words:** probiotic, 7 day weights, gut development, broiler performance

T187 The effect of sulfur inclusion in broiler diets on ammonia levels in poultry litter Ken Macklin*, Joseph Hess, James Krehling, Laci Mackay, Katrina English, Nathan Frazier Auburn University, Auburn, AL, USA

Controlling ammonia levels in commercial poultry houses is a major challenge faced by both the grower and the integrator. To date, the most effective method for controlling ammonia is the use of acidifying litter treatments. One problem with acidifying litter treatments is that they are only effective in controlling ammonia for the first 2-3 weeks of the grow out. After that time ammonia levels increase to levels that are as high or higher than untreated litter. Previous research performed at Auburn University had shown that when sulfur is directly fed to layers there was a reduction in ammonia from these bird’s excreta. It was the objective of this study to determine if a similar effect can be observed with broiler chickens. Eight hundred straight run broiler chicks were obtained, equally divided into 32 pens (25 chicks/pen) that contained clean pine shavings. The 32 pens were divided among four treatments so that each treatment had 8 pens. The treatments were: CON, which had no sulfur in the feed and the litter was not treated; S that had sulfur added to the feed at 5 pounds per ton with no litter treatment; SSB, which contained sulfur in the feed at 5 pounds per ton as well as sodium bisulfate being added to the litter at the rate of 50 pounds per 1000 ft²; and SB that consisted only of sodium bisulfite being added to the litter at the rate of 50 pounds per 1000 ft². On days 10, 23 and
37 feed and pen body weight was measured. Additionally ammonia measurements were taken on days 10, 23 and 37. At the termination of the trial (D 37) pododermatitis lesion were scored. Data was analyzed using GLM with P<0.05 and significant means separated using Tukey's test.

There was no difference in ammonia levels at times 10 and 23; however a trend was noted on day 23 that was further delineated on day 37. On day 37, S (11.99 ppm) had significantly lower litter ammonia levels then SB (22.11 ppm). The other two treatments were intermediate with SSB having ammonia readings of 13.49 ppm and CON having 18.57 ppm of ammonia. There was no difference in FCR; however there was one with final BW. Treatment SSB (2.61 kg) had significantly higher BW then treatment SB (2.45 kg). Treatments S and CON were intermediate with BW of 2.56 kg and 2.48 kg, respectively. Incidences of pododermatitis lesions were significantly higher in CON (11%) then in S (5%) and SB (2%). SB (9%) had significantly more lesions then SB. Results from this study imply that feeding sulfur at 5 pounds per ton can control ammonia levels. However it must be noted that this study was initiated on clean bedding and that further research needs to be performed to determine if these results can be maintained over multiple flocks on built up litter.

Key Words: litter, ammonia, sulfur, broiler

T189 Innovative Waste Management Case Study: Converting wastewater and organic waste into nutrient recovery, green energy and water reuse Laetitia d’Urset1, Robin Parduyns 1, Waterleau, Costa Mesa, CA, USA; 2Waterleau, Brussels, Belgium

Meat processing is energy intensive and produces large amounts of biowaste. Waterleau operates a Biowaste to Energy plant, producing 24,000 MWe/year from a mixture of 120,000 tons of manure, chicken litter, slaughterhouse and crops.

Slaughterhouse waste is protein rich and has a very high energy potential. However its high fat and protein concentration can be toxic to the anaerobic bacteria in the digester. Waterleau designed a smart process solution to decompose these types of industrial wastes. The same with manure contents which are mixed (50/50) with concentrated biowaste to achieve a high but acceptable N-level in the anaerobic digester.

Due to its animal waste content, the process includes a hygienization phase, before digestion (1 hour at 160°F). Two lines with a capacity of 60,000 tons per year each, include thermophilic and mesophilic anaerobic digestion, allowing operation with high levels of N. Digestion occurs in a wet AD CSTR reactor and post-digester. The generated biogas is valorized in a cogeneration unit (producing green electricity and heat), both are re-used on-site in the production processes. The remaining digestate is separated into a solid and a liquid fraction. The solid fraction is dried in a dryer producing 6,000 tons of organic fertilizer per year. The liquid fraction of the digestate undergoes an aerobic treatment to reduce the remaining organic pollution. After aerobic treatment, the effluent is sent to the evaporator. The non-volatile fraction consists of a Potassium rich fertilizer. The volatile Nitrogen rich fraction can be either turned into an ammonia solution, or in a 20% (NH4)2SO4 fertilizer.

Key Words: Wastewater treatment, Organic Waste treatment, Biogas generation & reuse, Nutrient recovery, Anaerobic co-digestion

T190 Enumeration of water quality indicator bacteria in broiler litter. Craig Coufali1, S Terrilly Gentry1, Daren Harrell2, Emily Martin1, Sheena Popham1, Scott Winkler1 1Texas A&M University, College Station, TX, USA; 2USDA-ARS, Temple, TX, USA

Many water bodies in the United States exceed the maximum limits for bacterial contamination established by regulatory agencies. In Texas, water quality standards are based on E. coli counts in water samples. Runoff from agricultural lands is often thought to be a source of bacteria to surface water bodies. Therefore, a study was conducted to determine the levels of E. coli, enterococci, and Clostridium perfringens in broiler litter.

Samples were collected from 12 broiler farms over a 1 year period. Farms sampled represented multiple companies and all broiler producing regions of Texas. Fifteen subsamples were collected in a grid pattern from 4 houses per farm and pooled in a manner to represent variation over the width and length of the houses. After pooling and thorough mixing, six composite samples were collected to represent litter sampled from under a feed line in the middle of the house, under a drinker line, along the north wall, on the cool pad end, across the middle of the house, and at the fan end of the house. E. coli was enumerated by EPA method 1603 and on Petrifilms to compare methods. Litter moisture content was significantly different within the houses (P<0.001), with the drinker line area having the highest (41%), followed by the fan end (33%), cool pad end (30%), middle (30%), north wall (27%), and feed line (20%) areas. Mean levels of total coliforms, E. coli (1603), E. coli (Petrifilm), C. perfringens, and enterococci were 3.67±0.35, 3.28±0.25, 3.01±0.28, 3.95±0.21, and 6.42±0.15 log CFU/g dry litter, respectively. Levels of total coliforms, E. coli (1603), E. coli (Petrifilm) and C. perfringens were positively correlated with litter moisture content (P<0.001, 0.004, 0.011, and 0.008, respectively) but enterococci levels were not (P=0.304). However, due to high variability in microbial counts and litter moisture at the different farms, only total coliforms (P<0.001) and E. coli (Petrifilm; P=0.047) levels were significantly different in litter collected from each the 6 sampling areas of the houses, with the water line, fan, and middle of the houses generally having higher levels of these bacteria.

Key Words: broilers, bacteria, litter, E. coli, C. perfringens

T191 Trend of Various Egg Quality Traits in Commercial Layers from Field Test Data Levent Turkmut1, Neil P. O’Sullivan2, Jesus Arango3, Petek Settar4 1Hy-Line International, Johnston, IA, USA; 2Hy-Line International, Dallas Center, IA, USA

Some egg quality trait trends were studied in Hy-line W36 and Hy-Line Brown (HYB) hens. Egg weight (EW, g), albumen height (AH, mm) and Haugh units (HU), shell color (CO, index value), and incidence (%) of internal inclusions (blood (BL) and meat (MT)) were studied in both lines. Incidence of shell speckles (SP) was an additional trait for HYB. Data of seventeen W36 and ten generation HYB field testing units were included in the study. Overall observation numbers were 38,739 in W36 and 18,737 in HYB. Observations included multiple locations per generation, and or were processed by up to six different egg quality lab stations. Egg samples were collected at four flock ages, including post molt for W36 (26, 38, 56 and 84 wk); while at three for HYB (26, 38 and 70 wk). Data were analyzed by variety and flock’s age using a linear model that included the effects of test (generation), location and station. An additional model used pooled data and included the additional effect of flock age. EW trajectory showed a slight increase in both lines. Regression coefficients (b1) for EW were of 0.1059 in W36 and 0.0713 in HYB. AH increased in both varieties. Regression coefficients (b1) for AH were 0.0633 in W36 and 0.0707 in HYB. BL incidence was not more than 1% in W36 and limited as 5% in HYB. Most of the spots (68%) were evaluated as grade 1 (i.e., 1 mm or less in diameter) in W36. The majority of the BL (78%) in HYB aggregated in grade 1. An average of 2% MT was observed in W36 and 93% of them were classified in grade 1 and 2; while, in HYB, the average MT was 9% and 76% of them classified in grade 1. CO increased along the test trajectory in HYB eggs. Regression coefficient (b1) for CO was 0.4346. SP incidence in HYB eggs was 0.20. The results herein demonstrate the progress that two commercial layer varieties have shown in egg quality traits as a response from a comprehensive and long term selection program.

Key Words: Egg quality, Egg weight, Haugh units, W-36, Hy-Line Brown
T192 Effect of air velocity on laying hen performance and egg quality
Joseph Purswell¹, Scott Branton¹, Brian Luck¹, Jeremiah Davis¹, USDA-ARS Poultry Research Unit, Mississippi State, MS, USA; 2University of Wisconsin, Madison, WI, USA; 3Mississippi State University, Mississippi State, MS, USA

Mitigation of heat stress is an important management concern for commercial poultry. Cooling is typically provided with evaporative cooling of incoming air mixed with forced convection. While the improvements in production efficiency with increased air velocity are well known for broilers, the effects have not been defined for laying hens. The objective of these experiments was to determine the effects of differing air velocities on laying hen performance and egg quality under simulated evaporatively cooled conditions. Two experiments were performed with commercial laying hens at two different ages. Laying hens were obtained from a commercial farm and placed into test pens and subjected to air velocities of 300 ft/min, 150 ft/min, or still air (< 50 ft/min) in an environmentally controlled room at 82°F and 82% RH to mimic an evaporatively cooled house. In Experiment 1, hens were placed in the test pens from 24 to 27 weeks of age; a total of eight replicate treatment units were used in this experiment. Egg production was measured daily and feed consumption was assessed weekly. In Experiment 2, hens were placed in the test pens from 39 to 48 weeks of age; a total of four replicate treatment units were used in this experiment. Egg production and feed consumption were assessed the same as in Experiment 1 and egg quality was measured twice a week. Egg quality measurements included egg weight, albumen height, Haugh unit, shell breaking strength, and incidence of shell and yolk defects. Hen-day egg production increased in both experiments with increased air velocity. Increased air velocity treatments (300 and 150 ft/min) significantly increased hen-day egg production rate when compared to still air (p < 0.0001) in both studies with maximum increases of 4.0% and 6.7% for Experiments 1 and 2, respectively. Feed intake was significantly depressed for still air treatments (p=0.0001) but feed conversion was not different in both experiments. Egg weight significantly increased in Experiment 2 (39 to 48 weeks of age) for all treatments, with maximum egg weight (59.7 g) resulting from 300 ft/min wind speed and minimum egg weight (55.4 g) resulting from still air. Variability in egg weight increased as air velocity decreased, and increased air velocity treatments yielded more eggs in the Extra Large and Jumbo size classes. Breaking strength was observed to significantly increase at 300 and 150 ft/min when compared to the still air treatment (p<0.0001). Haugh units decreased with increased air speed (p=0.0038), but remained within limits of AA quality requirements. No differences in incidence of interior defects were observed.

Key Words: ventilation, heat stress, housing design

T193 Resource use by hens in enriched colony cages
Richard Blatchford*, Joy Menc University of California, Davis, Davis, CA, USA

Egg producers are increasingly adopting enriched colony systems that contain resources including nests, perches, and a scratch area. However, little is known about how hens utilize these resources. As part of the Coalition for a Sustainable Egg Supply project, we investigated how hens (Lohmann LSL at 52 weeks) housed in 60-hen enriched colony cages on a commercial farm used the nest boxes, perches, and scratch pads provided in the cages, as well as feeding behavior. Focal cages (n = 27) were chosen from the back, middle, and front of the house. Nest use was determined by the number of eggs laid in the nest area. Behavior on the perches and scratch pad was observed in a subsample of 12 cages using instantaneous scan sampling at 1-min intervals for 30 min cage at 0800, 1200, and 1600 over two days. Feeding behavior was observed in a subsample of 18 cages using instantaneous scan samples at 10-min intervals from 0500 – 2200 h over one day. For feeding behavior analysis, cages were divided into 3 equal sections (each providing 122 cm feeder space), corresponding to the resources available in those sections: nest, perches, and scratch pad. The average number of hens feeding during each hour was analyzed using an ANOVA. Hens laid 97% of the eggs in the nest area. About 10% of the hens used the perches throughout the day, while 6% of hens used the scratch pad for dust-bathing and 2% of hens used the scratch pad for foraging. For feeding behavior, there was an interaction effect between time and cage section, with the feeders in the nest section (4.9 ± 0.71 hens) used less (P < 0.001) between 0700 and 1100 than those in the scratch pad (8.2 ± 0.25 hens) and perch (7.6 ± 0.46 hens) sections. These results indicate that hens use all of the resources provided in enriched colony cages, though the frequency of use varied. Understanding how hens use these resources will help in designing the most effective resources.

Key Words: enriched colony, hens, feeding behavior, nest, scratch pad

T194 National Poultry Improvement Plan Update
Denise Brinson USDA-National Poultry Improvement Plan, Conyers, GA, USA

The National Poultry Improvement Plan (NPIP) is a voluntary disease control program for the poultry industry in the United States. The objective of the NPIP is to provide a cooperative industry-state-federal program through which new diagnostic technology can be effectively applied to the improvement of poultry and poultry products throughout the country. Surveillance and testing of commercial establishments, live bird markets, and upland game birds allows the United States to certify to our trading partners that many classes of poultry originate from flocks that are monitored or are free of diseases such as salmonella, mycoplasma, and notifiable AI. This update will provide the current status of the NPIP program.

Key Words: NPIP, Poultry, Regulatory, poultry improvement

ABSTRACTS OF PAPERS
Metabolism & Nutrition VII

T195 Effect of Adding Worm Casting as a Source of Humic Acids on the Feeds of Broiler Chickens
Sergio Gomez Rosales¹, Maria De Lourdes Angeles Infaj, Queretaro, Mexico

Two experiments were done to evaluate the productivity, carcass yield and tibia ash content of broiler chickens fed diets added with worm castings (WC) as source of humic (HA) and fulvic acids (FA). In Exp. 1, 252 broilers from 11 to 49 d of age raised in floor pens, were randomly assigned to 3 dietary treatments: Tx1 = positive control diet added with an antibiotic growth promoter (BMD, 500 g/ton); Tx2 = diet formulated as Tx1 without the growth promoter; and Tx3 = diet formulated as Tx1 without growth promoter but added with 1% of WC. The WC was first dried 24 h at 55º C and had 9.12% of HA and 2.49% of FA. There were 6 replicate pens/Tx. At the end of the trial, 5 broilers from each pen were used for carcass measurements and tibia ash determinations. In Exp. 2, 120 broilers from 10 to 21 d of age were allocated in crates and randomly distributed to 5 dietary treatments: Tx1: positive control diet with recommended levels of nutrients; Tx2-Tx5 negative control diets with 0.2% lower levels of Ca and Avail. P than Tx1 and added with 0, 1, 2 and 3% WC, respectively. There were 12 replicate pens/Tx. At the end of the trial, all chicks were killed to determine the ash content of the tibia. Results of both experiments were subjected to ANOVA and in Exp. 2, linear regression analysis were performed. In Exp. 1, the final weight, feed intake and weight gain tended to be lower (P < 0.01) in Tx2. The mortality was higher (P < 0.05) in Tx2 (22.3%), intermediate in Tx3 (14.5%) and lower in Tx1 (9.1%). In Exp. 2, the final body weight, weight gain and tibia weight and ash content were greater in Tx1 (P < 0.01) compared to the other treatments. There was a quadratic response (P < 0.01) in the tibia ash regarding the increasing levels of WC, with a maximum improvement of 4% in Tx5 compared to Tx2. The results suggest that in broiler chickens from 11 to 49 d of age fed diets without an antibiotic growth promoter the addition
of WC could improve the growth performance and reduce the mortality while in broilers from 11 to 21 d of age fed a Ca and P deficient diet, the addition up to 3% WC did not benefit the productivity and improved the tibia ash content by 4%.

Key Words: Broiler chickens, Worm casting, Productivity, Carcass yield, Tibia ash

T196 Effect of Adding Different Dietary Levels of Distillers Dried Grains with Solubles (DDGS) on Productive Performance of Broiler Chicks Sherif Hassan1, Abdulaziz Al Aqil2 and Thamer Al-Jubair2

Using Distiller grains with solubles (DDGS) as a feed ingredient in poultry nutrition has lately been increased. This study was conducted to evaluate the effect of adding different dietary levels of DDGS on the productive performance of broiler chicks from 1 to 35 d of age. Two hundred forty one-d-old broiler chicks were randomly distributed among 3 treatment groups with eight replicates of 10 chicks each. Chicks were fed a broiler diet containing 0.0, 5.0, or 10.0% DDGS. Results obtained from the present study showed no significant differences in body weight, body weight gain, feed intake, and mortality rate among dietary treatments from 1-35 d of age. Feed conversion ratio and performance index were significantly better for chicks fed diet containing 5.0% DDGS than those fed diet containing 0.0% DDGS from 8 to 14 d of age only, but were no differences between chicks fed 10.0% and those fed either 0.0 or 5.0% DDGS. These results indicated that adding 5.0% DDGS into broiler diets showed a beneficial effect on feed conversion ratio with the best performance index of production without any detrimental effects on growth performance and carcass characteristics. Experimental diets were formulated to contain 0, 6, 12, 18, 24, or 30% LF-DDGS. Diets were formulated to be isocaloric and to meet or exceed minimum nutrient requirements. At day of hatch, 396 Ross x Ross 708 male broilers were obtained from a commercial hatchery and randomly allocated into 36 mini-pens (0.1 m²/bird) in a tunnel ventilated facility. Birds were fed common diets until d 28 and experimental diets were fed until d 42. Upon completion of the experimental period, all birds and feed were weighed to determine body weight, body weight gain, and feed conversion ratio. All mortality were recorded daily and feed conversion was adjusted for mortality. On d 43, after an overnight fast, 6 birds per pen were tagged, weighed and processed to determine hot carcass weight and abdominal fat pad. After a period of chilling, carcasses were deboned to determine breast and tender weights. Treatments were designed in a randomized complete block design with pen location in the building as the random blocking factor and all live performance and carcass data were analyzed via PROC GLIMMIX in SAS. Final body weight at 42 d was found to be significantly increased (P<0.05) for birds fed 18% LF-DDGS in a broiler diet when compared to birds fed either 24 or 30% LF-DDGS. Body weight gain, feed consumption and feed conversion were not affected but followed the same trend with performance maximized at 18% LF-DDGS. Carcass, abdominal fat pad, and breast debone weights were not affected but carcass yield was significantly greater (P<0.05) at 0 and 12% LF-DDGS with a significantly lower dressing percentage at 30% LF-DDGS added to the diet. Diets containing up to 18% LF-DDGS can be added to broiler diets in the finisher phase of production without any detrimental effects on growth performance and processing yields.

Key Words: Broiler chicks, Distillers Dried Grains with Solubles, Growth rate, Productive Performance

T197 Metabolizable energy of diets containing wheat DDGS supplemented with four levels of xylanase when fed to laying hens I.M Whiting1, V.R. Pirgozliev2, S.P. Rose3, A.M. Mackenzie4, A.M. Amerah5

There is little information available on the effects of exogenous xylanases in diets containing wheat distillers dried grains with solubles (DDGS) when fed to laying hens. The aim of this experiment was to examine the effect of four levels of a fungal Trichoderma reesei xylanase (Danisco Xylanase, Danisco Animal Nutrition, Wiltshire, UK) on dietary apparent metabolizable energy (AME) and nutrient availability when incorporated into laying hen feeds containing wheat DDGS. A basal feed was formulated to contain 11.69MJ/kg AME and 175g/kg crude protein (CP). Eight experimental diets were prepared by supplementing the basal feed with either 150g/kg or 300g/kg of wheat DDGS and adding Danisco Xylanase to both inclusion rates at 0, 1500, 2000 and 2500 xylanase units (XU)/kg. The birds received the experimental diets for eight days, from 22 weeks of age and each diet was replicated six times in a randomised block design. During the last four days of the study the excreta were collected and prepared for further analysis. Dietary AME increased with an increase in xylanase dose following a linear pattern (P=0.003), as an increase of 1000 XU improved dietary AME by 0.090MJ (y=12.49 (SE 0.017) + 0.090MJ) (SE 0.0100)* 1000XU). Dietary nutrient availability and egg production were not affected (P>0.05) by xylanase supplementation. The higher inclusion rate of DDGS was found to decrease (P<0.05) dry matter retention but improve (P<0.001) dietary NDF digestibility. These results indicate that feeding a high dose of xylanase improves dietary AME over an eight day feeding period. However, information on the use of xylanase at a high dosage in laying hen diets containing wheat DDGS for longer feeding periods would be advantageous.

Key Words: Xylanase, Wheat DDGS, AME, Layers

T198 Optimal inclusion rates of low-fat distillers dried grains with solubles (LF-DDGS) in male broilers aged 28 to 42 d of age E.J. Kim, J.L. Purswell, S.L. Branton ARS-USDA Poultry Research Unit, Mississippi State, MS, USA

The objectives of this study were to determine the maximum inclusion rates of LF-DDGS in broiler diets fed from 28 to 42 d of age in the finishing phases of production and the subsequent effects on live performance and carcass characteristics. Experimental diets were formulated to contain 0, 6, 12, 18, 24, or 30% LF-DDGS. Diets were formulated to be isocaloric and to meet or exceed minimum nutrient requirements. At day of hatch, 396 Ross x Ross 708 male broilers were obtained from a commercial hatchery and randomly allocated into 36 mini-pens (0.1 m²/bird) in a tunnel ventilated facility. Birds were fed common diets until d 28 and experimental diets were fed until d 42. Upon completion of the experimental period, all birds and feed were weighed to determine body weight, body weight gain, and feed conversion ratio. All mortality were recorded daily and feed conversion was adjusted for mortality. On d 43, after an overnight fast, 6 birds per pen were tagged, weighed and processed to determine hot carcass weight and abdominal fat pad. After a period of chilling, carcasses were deboned to determine breast and tender weights. Treatments were designed in a randomized complete block design with pen location in the building as the random blocking factor and all live performance and carcass data were analyzed via PROC GLIMMIX in SAS. Final body weight at 42 d was found to be significantly increased (P<0.05) for birds fed 18% LF-DDGS in a broiler diet when compared to birds fed either 24 or 30% LF-DDGS. Body weight gain, feed consumption and feed conversion were not affected but followed the same trend with performance maximized at 18% LF-DDGS. Carcass, abdominal fat pad, and breast debone weights were not affected but carcass yield was significantly greater (P<0.05) at 0 and 12% LF-DDGS with a significantly lower dressing percentage at 30% LF-DDGS added to the diet. Diets containing up to 18% LF-DDGS can be added to broiler diets in the finisher phase of production without any detrimental effects on growth performance and processing yields.

Key Words: Distillers dried grains with solubles, oil extracted, finisher phase, broilers

T199 Determination of AME of soybean oil industry by-products: acidulated soapstock, glycerin, lecithin and their blend Liliane Borsatti1, Sergio Luis Vieira, Silvana Rauber, Catarina Stefanello, Barbara Mallmann, Cesar Pontin Federal University of Rio Grande do Sul, Porto Alegre, Brazil

The poultry industry has a great demand for high-energy feeds and currently the availability of by-products of refined soybean oil are a great potential energy source in poultry diets. A study was conducted to determine AME of by-products from the soybean oil industry using 390 male broilers, 21 d of age, distributed in a completely randomized design of 4 fat sources and 3 levels of inclusion. Thirteen dietary treatments with six replications of five birds each were used. The fat sources used were: ASS (acidulated soybean soapstock), glycerin (GLY) and LEC (lecithin) as well as a blend containing 85% ASS, 10% GLY and 5% LEC (MIX). The proportions of fat sources in the MIX are similar to those in the crude soybean oil. The experimental treatments consisted of the addition of each supplemental fat source at the levels of 0% (100% of basal diet), 2% (98% basal diet + 2% energy source), 4% (96% basal diet + 4% energy source) or 6% (94% basal diet + 6% energy source). The total excreta collection was used for 72h. Data generated for AME was as follow: 7,153 kcal/kg for ASS, 3,916 kcal/kg for GLY, 7,050 kcal/kg for LEC and 8,451 kcal/kg for the MIX. The results showing the highest AME value for the MIX indicates that mixing ASS, GLY and LEC in proportions present in the original crude soybean oil are indicative of a better utilization of these 3
fat sources when used together, which may be due to a re-esterification into triglycerides.

**Key Words:** Metabolizable energy, Acidulated sopstock, Lechithin, Glycerin

**T200 Combinations of by-products from the soybean oil industry AME and plasma triglyceride of broilers** Lilian Borsatti*1, Sergio Vieira1, Heitor Rois1, Patricia Soster2, Pedro Ferzola1, Edgar Oviedo-Rondon1 1Federal University of Rio Grande do Sul, Porto Alegre, Brazil; 2North Carolina States University, Raleigh, NC, USA

The use of mixtures of saturated and unsaturated fat sources in poultry diets may exhibit synergism with higher AME values when diversified sources of saturated and unsaturated fats are fed together. A study was conducted to determine the AME and plasma triglycerides of mixtures of soybean oil by-products. A total of 390 21 d old male broilers were distributed in a completely randomized design of a 4x3 factorial having 4 lipid sources and 3 levels of inclusion. Dietary treatments (13) with six replications of five broilers were used: Mixture 1 (MIX 1) had 85% acidulated soybean soapstock (ASS), 10% Glycerin (GLY) and 5% Lecithin (LEC); Mixture 2 (MIX 2) had 80% ASS, 15% GLY and 5% LEC; Mixture 3 (MIX 3) had 75% ASS, 20% GLY and 5% LEC; and Mixture 4 (MIX 4) had 70% ASS, 25% GLY, and 5% LEC. Each lipid source had increases of 0%, 2%, 4% or 6% on a common basal feed. Total excreta collection was done for 72h. Birds (3 per replication) were sacrificed for blood collection and triglyceride analyses afterwards. Differences were found for AME and plasma triglyceride (P < 0.05). The MIX 2 showed the highest AME value (8,460 kcal/kg) when compared to MIX 1 (7,366 kcal/kg), however, these were not different from MIX 3 (7,516 kcal/kg) or MIX 4 (7,540 kcal/kg). Average triglyceride level of MIX 1 (78.5 mg/dL) was highest when compared to all other treatments (MIX 2, 3 and 4 respectively) provided 59.9, 65.1 and 65.4 mg/dL. It is concluded that the proportions of ASS, GLY and LEC in the MIX 2 led to increased AME. Proportions of free fatty acids, GLY and LEC in MIX 1, is closer to those found in crude soybean oil, which was the one that seemed to lead highest re-esterification of ASS, GLY and LEC into triglycerides.

**Key Words:** Soybean fat, Triglyceride, Metabolizable energy

**T201 Field observation: contamination of imported yellow corn with raw soybeans is an additional source of trypsin inhibitors contributing to the occurrence of outbreaks of rapid feed passage in broiler chickens.** Nelson Ruiz1, Nelson Ruiz1, Jorge Castillo1, Jhon Fredy Suarez1, Leonardo Naranjo1, Fabiola de Belalcazar1 1Hansen A/S, Hoersholm, Denmark

Commercial yellow corn contaminated with whole and/or fractions of raw soybeans is an additional source of trypsin inhibitors contributing to the contamination of yellow corn shipments with whole and/or fractions of raw soybeans is a factor to take into consideration when investigating a rapid feed passage outbreak in the field.

**Key Words:** Trypsin inhibitors, Yellow corn, Raw soybeans, Rapid feed passage, Broilers

**T202 Enterococcus faecium improves broiler performance when added to the drinking water** Anéé Berg Kehlet1, David Harrington 1Chr. Hansen A/S, Hoersholm, Denmark

It is well recognized that the gastrointestinal flora plays an important role in the health and well-being of poultry. Numerous studies have demonstrated the positive effect of beneficial bacteria delivered to the bird either in feed or via drinking water. A study was carried out to investigate the effect of *Enterococcus faecium* added to the water on zootechnical performance and carcass quality of broiler chickens. A total of 840 birds (Ross 308) were allocated to 2 treatments (T1: Control; T2: *E. faecium* (EF)) with 7 replicates/treatment and 60 birds/replicate. All birds were fed a standard wheat/corn/soybean meal diet. Feed and water were administered *ad libitum*. In T2 EF was added to the water in the following dosages: Day 1-7, 3E+11 CFU/1000 birds; Day 8-35, 1E+11 CFU/1000 birds and Day 36-42, 4E+11 CFU/1000 birds. Body weight, body weight gain and feed consumption were determined for each of the fattening periods (0-7, 8-21, 22-35, 36-42; 0-42 days of age). At the end of study 7 birds/treatment were fasted for 6 hours, slaughtered and protein content and cooking loss determined. Data were analyzed by ANOVA. Overall mortality in T2 was significantly (P<0.05) lower than the control group (9 and 28 birds, respectively). The mortality due to enteritis was six times lower in T2 compared to T1. The mean weights in T1 were significantly higher (P<0.01) than T2 in all the feeding periods and at day 42 the body weights were 12.8% (P<0.01) higher, 1766 and 1992 g for T1 and T2 respectively. The addition of EF did not result in significant differences on feed efficiency among the treatments but a numerical improvement in all feeding phases were observed. Administration of EF resulted in increased quality of the broiler carcass; cooking losses were significantly lower (P<0.05) in T1 (31.8%) compared to T2 (34.6%). Also, the protein content in the meat was significantly higher (P<0.05) in T1 (760.9 g/kg DM) than T2 (701.6 g/kg DM). Based on the results from this study it is evident that the administration of *E. faecium* via the drinking water had beneficial effects on broiler mortality, growth performance and meat quality.

**Key Words:** E. faecium, Probiotic, DFM, Broilers, Meat quality

**T203 Comparison of serum fluorescein isothiocyanate-dextran (FITC-d) levels in various gut inflammation models in broiler chickens** Vivek Kuttappan1, Rosario Galarrza-Seeber1, Amanda Wolfenden1, Karen Wedekind2, Jeffery Escobar2, Eduardo Vicia1, Juan Latorre1, Olivia Faulkner1, Guillermo Tellez2, Billy Hargis1, Mercedes Vazquez-Anon2, Lisa Bielke1 1University of Arkansas, Fayetteville, AR, USA; 2Novus International Inc., St. Charles, MO, USA

Gastrointestinal tract (GIT) inflammation in broilers has been induced by various methodologies previously in our laboratory, including feed restriction, raw soybean meal diets, and dexamethasone treated feed. Various studies with young chickens (< 2 weeks old) showed that these methods could result in disruption of tight junctions within the GIT, leading to increased leakage of orally administered fluorescein isothiocyanate-dextran (~4kDa; FITC-d) into circulation. Thus, measurement of serum levels followed by oral gavage of FITC-d is an effective means to evaluate gut health in broilers. The main objective of present study was to compare the effect of various gut inflammation inducers in 3-4 weeks old broilers on FITC-d leakage. Three week old broilers were maintained on the same developer diet from 22-25d of age. On d25, the birds were randomly assigned to different treatment groups (n=30birds/group): control,
feed restriction (FR; skip-a-day with 24h FR/day), dexamethasone (DEX; 0.29mg/kg of feed), and raw soybean (RSBM; 19.09% raw soybean meal in diet). Broilers were raised in shaving-bedded floor pens, except an additional treatment group (n=30) which was reared in wire floor pens from d25-29. Half of the birds in each treatment group (n=15/group) were weighed and orally gavaged with FITC-d (4.17mg/kg) ~2.5h before being euthanized on d27 or d29. Blood samples were collected from each bird and serum was analyzed to determine FITC-d levels. Lower (P<0.05) body weight was observed in the RSBM group on d27, and RSBM as well as FR groups on d29. Serum FITC-d levels were higher (P<0.05) in FR, RSBM, and DEX treatments when compared to control birds on both sampling days. Although chicks reared on wire did not show increased (P<0.05) gut leakage on d27, on d29 FITC-d serum levels were higher (P<0.05) than control, and similar (P>0.05) to levels of other inflammatory models tested can result in increased leakage of FITC-d after 4d of treatment. Furthermore, a single 24h FR leads to increased FITC-d leakage. Based on these models, further studies will be conducted to determine the effect of various proposed mitigation methods to improve gut health in broilers.

Key Words: dexamethasone, feed restriction, gut health, raw soybean meal, wire floor pens

T204 Performance of broiler chickens fed Bacillus subtilis in diets with reduced metabolizable energy

Anee Berg Kehlet*1, Greg Mathis2, David Harrington1 1Chr. Hansen A/S, Hørsholm, Denmark; 2Southern Poultry Research, Inc., Athens, GA, USA

Feed can account for up to 70% of the cost of broiler production. The role of any feed additive that potentially improves nutritional utilisation should be of interest to the poultry industry. Bacillus subtilis has been shown to improve ileal nutrient digestibility and production performance in broilers. It is hypothesized that the addition of B. subtilis to broiler diets with reduced energy levels will help improve broiler performance. A study was conducted to evaluate the effect of B. subtilis based probiotic to corn soy based broiler diets with reduced energy levels. A total of 2160 male Cobb 500 broilers were allocated to 6 treatments and reared on re-used litter over 42 days with ad libitum feeding.

<table>
<thead>
<tr>
<th>Treatment groups</th>
<th>Metabolizable energy (ME) level</th>
<th>% of recommended ME Kcal/lb (Starter/Grower)</th>
<th>Addition of B. subtilis*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>100%</td>
<td>1390/1412</td>
<td>100ME</td>
<td>100ME+BS</td>
</tr>
<tr>
<td>98%</td>
<td>1359/1381</td>
<td>98ME</td>
<td>98ME+BS</td>
</tr>
<tr>
<td>96%</td>
<td>1331/1353</td>
<td>96ME</td>
<td>96ME+BS</td>
</tr>
<tr>
<td>94%</td>
<td>1304/1326</td>
<td>94ME</td>
<td>94ME+BS</td>
</tr>
</tbody>
</table>

* B. subtilis 8 x 10⁶ CFU g/feed

At day 21, 100ME and 100ME+BS had the highest weight gain (WG) (1.58 and 1.56 lb, respectively) and lowest FCRs (1.47 and 1.44, respectively) of all treatments. By day 35, 100ME+BS had a significantly higher WG (3.67 lb) than all other treatments except 100ME (3.63 lb) while the FCR of both these treatments was lower than all other groups. At day 42, WG of each pair of 94ME and 100ME groups showed that inclusion of BS significantly increased WG and FCR (P<0.05); WG 5.07, 4.86, 4.67 and 4.49 lb for 100ME+BS, 100ME, 94ME+BS and 94ME, respectively and FCR 1.68, 1.73, 1.83 and 1.90 for 100ME+BS, 100ME, 94ME+BS and 94ME, respectively. At day 42 FCR in 98ME+BS was 1.76 (significantly lower than 100ME groups) while WG was 4.93 (not significantly different from the 100ME groups). There was a $0.01 saving in cost feed/kg live weight gain in favor of 100ME+BS compared to 100ME. When ME was 94%, the saving using B. subtilis was $0.016 cost feed/kg live weight gain. In conclusion, these results indicate that addition of a Bacillus-based DFM to diets with reduced energy levels has the ability to both overcome the performance loss associated with a lower quality diet and provide an economic benefit.

Key Words: Bacillus, Energy, Probiotic, Poultry, Performance

T205 Role of a candidate Bacillus subtilis direct-fed microbial on digesta viscosity, bacterial translocation and bone mineralization in neonatal poults fed with a rye-based diet

Guillermo Tellez2, Juan Latore3, Xochitl Hernandez-Velazco2, Jose Vicente1, Ross Wolfenden3,

BILLY HARGIS3 1University of Arkansas, Fayetteville, AR, USA; 2UNAM, Mexico City, Mexico; 3PVG, Fayetteville, AR, USA; 4UA, Fayetteville, AR, USA

Rye contains high concentrations of non-starch polysaccharides (NSP), leading to reduced digestibility. Since poultry have little or no intrinsic enzymes capable of hydrolyzing these NSP, exogenous carbohydrases as feed additives have been used to reduce the anti-nutritional effects of these polysaccharides. Previously, an in vitro study conducted in our laboratory showed that inclusion of certain Bacillus direct-fed microbial (DFM) candidates that produce exogenous phytase, lipases, proteases, cellulases and xylanases in high NSP diets significantly reduced both digesta viscosity and Clostridium perfringens proliferation. In the present study, rye-based turkey starter diets with or without the candidate Bacillus-DFM were administered ad libitum to day-of-hatch poults in two independent experiments. In either experiments, day-of-hatch turkey poults were randomly assigned to either a control diet (CON) or a DFM (10³ spores/gm) treated diet (n = 25 birds/group). At ten days-of-age, poults (exp. 1 and 2) were weighted and 12 poults/group were randomly selected and humanely killed. Liver samples were aseptically collected to evaluate bacterial translocation, and intestinal digesta samples were individually collected to evaluate viscosity, additionally both tibias were removed for assessment of bone parameters. In both experiments, the TRT group showed a reduction in the total number of coliforms in the liver as well as a reduced intestinal viscosity when compared to the CON group (P<0.05). Poults fed the Bacillus-DFM candidate had increased tibia diameter, breaking strength, ash content, calcium content, and phosphorus content when compared with CON poults. In summary, poults fed with a rye-based diet without DFM showed an increase in bacterial translocation and digesta viscosity, accompanied by a reduction in bone mineralization. These adverse effects mitigated by the inclusion of selected DFM candidates in high NSP diets.

Key Words: Turkey poults, DFM, rye, bone mineralization, digesta viscosity

T206 Feeding a Butiautella phytase and a 3-strain Bacillus direct-fed microbial (DFM) combination improves broiler performance

Luke Barnard1, Luis Romero1, Olayiwola Adeola2 1Danisco Animal Nutrition - DuPont Industrial Biosciences, Marlborough, United Kingdom; 2Purdue University, West Lafayette, IN, USA

A 35 d broiler experiment investigated the effects of a Butiautella phytase alone and in combination with a DFM, comprised of the spores of 3 Bacillus strains, on broiler performance. Male Ross 708 broilers were fed a common starter diet from 0 to 6d; on d 6 birds were allocated to treatment pens based on body weight (BW) and were fed treatment diets until d 35. There were 9 treatments with 8 replicates, a positive control (PC), and a 4x2 factorial of the negative (NC) diet supplemented with 0, 500, 1500 or 3000 FTU/kg phytase with or without the 3-strain Bacillus DFM (150,000 cfu/g). Diets were fed in 2 phases: a 6 to 21 d grower phase (PC: Ca = 0.9%, and nPP = 0.5%; NC: Ca = 0.65% and nPP = 0.23%) and a 21 to 35 d finishing phase (PC: Ca = 0.85% and nPP = 0.47%; NC: Ca = 0.65% and nPP = 0.23%). Feed intake, BW and feed conversion ratio (FCR) were recorded at each diet phase change and d 35. Data were analyzed by ANCOVA and significance indicated at P<0.05.

Phytase supplementation significantly increased BW (+9-11%) and decreased FCR (-3-6%) in all diet phases. Similarly, the DFM significantly reduced FCR in the 21 to 35 d and 7 to 35 d periods (-3%). The interac-
tion of Phytase*DFM tended to influence FCR over the 7 to 35 d period (P=0.076). In the absence of the DFM the response in FCR to phytase plateaued between 500 and 1000 FTU/kg, conversely, in the presence of the DFM FCR did not reach a plateau until more than 1500 FTU/kg was supplemented. In all cases DFM supplemented birds had lower FCR than birds not fed the DFM at similar phytase doses. The greatest numerical difference between diets supplemented with and without the DFM was at 3000 FTU/kg where the presence of the DFM resulted in an 8-point reduction in FCR compared with the same phytase level without the DFM.

In conclusion, feeding phytase in combination with this 3 strain Bacillus DFM improved bird performance vs. feeding phytase alone. The beneficial effect of the combination increased with phytase dose.

Key Words: Butiauxella phytase, 3-strain Bacillus DFM, combination, broiler, performance

T207 Effects on performance of lysine levels and nucleotide source combined with yeast (Saccharomyces cerevisiae) cell wall supplementation in broiler diets Melina Aparecida Bonato1,2, Lúcio Francelino Araújo2, Ricardo Luís Carmo Barbalo1, Edney Pereira da Silva1,2 1ICC Industrial Comércio Importação e Exportação Ltda., São Paulo, Brazil; 2Faculdade de Zootecnia e Engenharia de Alimentos - Universidade de São Paulo, Pirassununga, Brazil; 1ICC Industrial Comércio Exportação e Importação Ltda., São Paulo, Brazil; 2Faculdade de Ciências Agrárias e Veterinárias - Universidade Estadual Paulista, Jaboticabal, Brazil

This study evaluated the effects of nucleotide and yeast cell wall supplementation combined with two levels of lysine (in pre-starter diet) and growth promoting agent on broiler performance. For this, 1,344 one-day-old Cobb male chicks were distributed in a completely randomized design, with 8 treatments of 7 replications, with 12 broilers in each (12 birds/m3). The treatments were: T1 - Diet with lysine 1.25% + growth promoting agent (AGP) (0.3kg/MT zinc bacitracin and 0.6kg/MT anticoccidial agent); T2 - Diet with lysine 1.36% + AGP; T3 - Diet with lysine 1.25% (no AGP); T4 - Diet with lysine 1.36% (no AGP); T5 - T1 + nucleotide source (NU) (5kg/MT of yeast product [Saccharomyces cerevisiae], equivalent to 0.3kg/MT of free nucleotides, from 1-10 d) + yeast cell wall (YCw) (1kg/MT, [Saccharomyces cerevisiae] from 11-42 d); T6 - T3 + NU + YCW; T7 - T4 + NU + YCW; T8 - T2 + NU + YCW. The different levels of lysine among treatments were only in the pre-starter diets (1-10 d). Study criteria included body weight gain (BWG), feed intake (FI) and feed/gain (F/G) at 10 and 42 d. The data were analyzed using the SAS F test for orthogonal contrasts (P<0.05). The AGP supplementation in the diet of broilers improved (P<0.05) BWG (5.0 and 1.8%) and F/G (5.3 and 2.9%) at 10 and 42 d, respectively, versus no supplementation. For the diets supplemented with AGP, BWG and F/G were improved (P<0.05) at 10 and 42 d, respectively. The inclusion of AGP and nucleotide supplementation improved lysine utilization by birds in relation to inorganic sources. The purpose of this study was to evaluate the use of different levels of organic minerals copper (Cu), iron (Fe), manganese (Mn), selenium (Se), and zinc (Zn) in the diet of broiler chickens on performance and carcass yield in summer season (January to March), with environmental temperature ranged from 17 to 35°C, and relative humidity of the air from 43 to 95%. 1080 Cobb-500™ male chicks were used in a completely randomized design with 6 treatments and 6 replicates of 30 birds each from 1 to 42 days of age. The different levels of lysine supplemented with nucleotide and yeast cell wall were: T1 - Control - Inorganic Minerals Cu, Fe, Mn, Se, and Zn according to Rostagno et al. (2011); T2 - Organic Minerals; T3 - Reduction of 1/3 from T2; T4 - Reduction of 2/3 from T2, T5 - Increase of 1/3 from T2, and T6 - Increase of 2/3 from T2. Performance characteristics evaluated were feed intake (FI), weight gain (WG), body weight (BW), feed conversion (FC) and productive efficiency index (PEI). At 42 days, 20% of the flock were selected for evaluation of carcass yield and commercial cuts: wing, breast, thigh and drumstick. The excretion was measured by total collection during the period from 33 to 36 days. Data were analyzed by analysis of variance using PROC GLM of SAS. The comparison among treatments was performed by regression and between the sources of minerals (organic and inorganic) was used contrast. For performance characteristics, only the FI showed a positive quadratic effect (y = 249.24x2 - 543.27x + 4541.2) (P<0.05), with lower consumption for the treatment T2. There was no difference among diets for carcass yield and commercial cuts. In relation to excretion, it was reduced in 19, 35 and 28% for Cu, Fe and Mn, respectively with the organic source. It was concluded that organic minerals can be used at lower levels than current recommendations for inorganic minerals without affecting the performance and carcass yield of broilers in summer season and still reduce the pollution potential of excreta.

Key Words: birds, feed intake, microelements, mineral availability, nutrition

T209 B. amyloliquefaciens probiotic supplementation compensates reduction of energy and aminoacids in poultry diets Alvaro Ortiz1,2, Saksit Srinongkote2, Pilar Honrubia3, Juan José Mallo3 1FACULTAD DE ZOOTECNIA Y ENGENHARIA DE ALIMENTOS - USP, SP, Brazil; 2FACULTADE DE ZOOTECNIA E ENGENHARIA DE ALIMENTOS - Universidade de São Paulo (USP), Pirassununga, Brazil; 3FZEA/USP, Pirassununga, Brazil

The minerals in organic form are molecules of high bioavailability with better utilization by birds in relation to inorganic sources. The objective of the present study was to evaluate the efficacy of Ecobiol (Bacillus amyloliquefaciens CECT 5496; 1x109 CFU/g) to compensate the reduction of dietary energy and essential aminoacids in broilers from 0 to 35 days of age.

Eight different treatments were used. The experimental design is explained in the table. Four hundred and eighty (480) Arbor Acres Plus male broiler chicks were randomly allocated to the 8 treatments with 6 replications using 10 birds in a pen as an experimental unit (1 x 1m pen space). The test period covered starter (0-18 days of age) and grower (18-35 days of age). Feeds and water were provided ad libitum. Birds were maintained on the lighting program, house temperature and management according to the Arbor Acres Plus broiler management recommendation. Body weight of birds and leftover feed of each pen were measured on day 18 and 35. Dead and culled birds were recorded daily. At the end of each growing period, individual body weight was measured for flock uniformity calculation.

Body weight gain, feed intake, FCR, livability, flock uniformity and carcass yield was subjected to ANOVA as a 4 x 2 factorial arranged in a RCBD.

Key Words: Probiotic, Bacillus, Energy, Protein, Aminoacid
T210 Evaluation of performance, carcass characteristics, serum biochemistry and hematological parameters of broilers fed graded levels of raw cocoa bean shell based diets Martha Olumide*, Rob Goedegebuure, Renato Costa, Rasheed Hamzat, OJ Bamijoko, Rob Goedegebuure1 Department of Animal Science, University of Ibadan, Ibadan, Nigeria, Ibadan, Nigeria; 2Department of Animal Production & Health, Federal University, Dutsin-Ma, Dutsin-Ma, Nigeria; 3Federal College of Animal Production & Health, Moor Plantation, Ibadan, Ibadan, Nigeria; 4Department of Life Sciences, University College Center, South Suburban College, South Holland, USA., South Holland, IL, USA

Competition exists between man and his livestock for conventional feed ingredients like maize. This has cascaded the research for alternative ingredients. Large quantities of cocoa bean shell are produced and wasted annually by farmers and associated processing industries in Nigeria. Cocoa bean shell (CBS) is a waste from cocoa processing industries in Nigeria and it constitutes serious disposal problem. This trial is therefore focused on the use of graded levels of raw cocoa bean shell (RCBS) based diets on the performance, carcass, hematometry and serum biochemistry of broiler birds. A total of one hundred and fifty day -old Anak broiler chicks were randomly allotted to five dietary treatments with 30 birds per treatment, replicated thrice in a completely randomized design. The treatments were: A (0%CBS- control diet); B (5%RCBS); C(10%RCBS); D (15%RCBS); E (20% RCBS). All the birds were fed ad-libitum throughout the experimental period of eight weeks. The feed intake and weight gain were monitored. The carcass analyses, serum and hematometrical parameters studied were total protein, albumin, globulin, cholesterol, glucose, creatinine, red blood cell, white blood cell, hemoglobin and packed cell volume. Significant differences were observed in the feed intake, weight gain, feed conversion ratio and carcass parameters of birds fed graded levels of raw cocoa bean shell based diets compared to the control group. RCBS could effectively replace up to 10% maize in the diet of broiler without a deleterious effect on the birds.

Key Words: Competition, Graded levels, Cocoa bean shell, Carcass, Hematology

T211 A mixture of medium chain fatty acids slows down transmission of Salmonella between broiler chickens Manu De Laet*, David Hermans, Rob Goedegebuure, Renato Costa Nuscience Group, Drogen, Belgium

Poultry are a considerable reservoir of Salmonella spp. and a common source for human salmonellosis. The broiler industry suffers serious losses through contamination of broiler meat and elimination of infected birds. In the past, MCFA already proved their strength against Salmonella infections. Until now, the tested serotypes were Salmonella Java, Salmonella Typhimurium and Salmonella Enteritis. With this experiment, Nuscience wants to expand the application range.

Salmonella Heidelberg is the most often isolated Salmonella serotype in Brazil. For that reason, an infection trial was setup with a Brazilian field strain of Salmonella Heidelberg to assess the effectiveness of a mixture of medium chain fatty acids (Salbiotic) at different doses to control infection and transmission.

The experiment was carried out with 240 Cobb day-old chicks (4 pens/60 birds per pen). Birds received a mash starter, followed by a pelleted grower without antibiotics. There were 4 dietary treatments: control, 1 kg/MT Salbiotic; 2 kg/MT Salbiotic and 4 kg/MT Salbiotic. In each group, 6 birds were orally inoculated on day 3 with 5 x 10³ cfu of the isolated Salmonella Heidelberg field strain. At day 14 and 28, the following parameters were recorded: S. Heidelberg counts (cfu/g) in the ceca of 25 sentinels and the body weight of these birds.

At day 14, a decreased number of positive animals was observed in the highest Salbiotic dosage group compared to the control group (7/25 vs 22/25), as well as a significant decrease (P = 0.009) in the average cecal Salmonella counts (8.9 x 10⁸ vs 5.0 x 10⁸ cfu/g). At day 28, this effect could not be maintained because of the extremely high (experimental) infection pressure, leading to a delayed colonization peak.

Birds from the Salbiotic groups had similar or significantly higher weights than the control group. At day 14, the lowest dosage group had a significantly (P < 0.001) higher body weight compared to the control group (447.3 g/bird vs 407.7 g/bird). At day 28, there was an increasing trend (1585.1 g/bird for the highest dosage group vs 1546.9 g/bird for the control group), but no significant differences were observed.

In conclusion, Salbiotic at 4 kg/MT clearly slowed down Salmonella Heidelberg transmission from inoculated birds to non-inoculated contact birds after 14 days. This trial also indicates that growth can be improved by supplementing the feed with Salbiotic.

Key Words: Salbiotic, MCFA, Salmonella Heidelberg, transmission, improved growth

T212 Effect of feeding organic acids as antibiotic replacer to broiler chickens challenged with salmonella Alaeldin Abudabos’ King Saud University, Riyadh, Saudi Arabia

The present experiment examined the influence of three commercial organic acids, as an alternative to antibiotic, neoxyval, in-feed on the performance of broilers during pre- and post-challenge with Salmonella enterica subsp. typhimurium. Ten cages of birds received one of the following treatments: T1= positive control group, un-medicated, no bacterial challenge (+ve cont); T2=negative control, un-medicated, (-ve cont); T3=medicated with antibiotic (neoxyval), (NEOX); T4= supplemented with Gallimix, (GALI); T5=supplemented with FormaXOL, (FORMA); and T6=supplemented with Fyal, (FYS). The chicks in treatments T2 to T6 were challenged with (3 x10⁷ cfu/ml) of Salmonella enteritis subsp typhimurium on day 16. Isoaloricoic and isonitrogenous starter (0-14 days) and finisher (15-42 days) diets were fed to chicks as per recommended commercial practice in Saudi Arabia. The results revealed that unchallenged birds (+ve cont) consumed more feed as compared to those of other treatments (P<0.001). Furthermore, birds which had received NEOX, GALI, FORMA or FYS converted feed more efficiently as compared to -ve contrl indicating that organic acids used in this trial restored the performance equally to the antibiotic (NEOX) treatment. The three organic acids were efficacious at reducing the Salmonella in ileum however; FORMA and FYS eliminated the Salmonella totally from the ileum. Villus height but not the width was influenced positively by GALI and FYS (P<0.01).

In summary, the organic acids which were used in this trial reduced the cumulative FCR improved. The tested organic acids had a positive influence on the performance of broilers and could serve as a substitute to antibiotics.

Key Words: Broilers, Organic acids, Performance, Bacterial challenge, Salmonella enterica.
P213 Avian hepatitis E virus infection in a broiler-breeder flock in Jordan
Saad Gharabih1, Nadim Amarini, Jordan University of Science and Technology, Irbid, Jordan; 2Boehringer Ingelheim, Amman, Jordan

This study reports the first avian hepatitis E virus infection in broiler-breeders in Jordan. The infection was diagnosed based on case history, clinical signs, gross and histologic lesions including special stains, and RT-PCR. A 52-week old broiler-breeder flock was suffering from increased daily mortality and failure to achieve egg-production targets was examined south of Amman, Jordan. Dead and moribund chickens had prominently enlarged livers and spleens. Livers were congested, friable, and occasionally mottled. Red fluid and clotted blood was frequently found in the abdominal cavity. Histologically, the liver and spleen had multifocal areas of necrosis with accumulation of homogenous eosinophilic substance that gave apple-green birefringence on polarized light when stained with Congo red (amyloid). Histopathology excluded the presence of tumors and all bacterial culture attempts were negative. Avian hepatitis E virus was detected by PCR from fresh tissue samples by Istituto Zoono profilattico Sperimentale delle Venezie (Legnaro, Italy) confirming the diagnosis of big liver and spleen disease. There were no subsequent outbreaks in the area. Avian hepatitis E virus infection was previously reported in Canada, USA, Australia, New Zealand, United Kingdom, Italy, and Hungary. To the best of our knowledge, this is the first case of avian hepatitis E virus infection to be reported in the Middle East region.

Key Words: Avian hepatitis E virus, Big liver and spleen disease, Chicken, Middle East, Jordan

P214 Newcastle disease and infectious bronchitis IgA antibodies titering by ELISA test in tracheal swab and lachrymal fluid samples
Ruben Merino1, Patrick Dominguez2, Nadia Prado1, Viviana Urdaneta2, Iván Pineda3, Nancy López4, Teresa Olives41, Universidade Nacional Autónoma de México, México, Mexico; 2Universidad Nacional de Colombia, Bogotá, Colombia

Current immunological methods to detect and quantify mucosal antibody immune response in chicken are scarce and need to be easily available to generate useful and relevant data. The availability for reliable ELISA test to measure local mucosal post-vaccination immunity against the main respiratory viruses is still limited. In this study, a modified commercially available ELISA test was evaluated to titer IgA antibodies in both, tracheal swab and lachrymal fluid from broiler chickens vaccinated against Newcastle disease (ND) and infectious bronchitis (IB). Ten broiler chickens were vaccinated at 4 weeks old with a ND-IB commercial combined vaccine by both, the ocular and nasal routes, one drop each. Tracheal swab and lachrymal fluid samples were taken from all chickens at 1 and 2 weeks post-vaccination (wpv), blood serum was taken only 2 wpv. Lachrymal fluid was taken by sprinkling approximately 0.003 g fine sodium chloride crystals onto one eye while keeping the eyelids held open, tears were allowed to accumulate before being carefully collected by a pipette. All samples were immediately placed in 1.5 ml microfuge tubes and stored at -20°C. All samples were tested by ELISA. Serum samples were evaluated for anti ND and IB IgG antibody as described by the manufacturer (AffiniTech LTD, Bentonville, AR 72712). Tracheal swab diluted 1:2 and lachrymal fluid diluted 1:10 were tested with the same ELISA kit with a modification, anti IgG conjugate was replaced and chicken IgA binding to the coating antigen was detected with a commercial goat anti-chicken-IgA reagent conjugated to alkaline phosphatase and supplied at an antibody concentration of 1.0 mg/ml and diluted 1:1,000 (A30-103A, Bethyl Laboratories Inc., Montgomery, TX 77356). Antibody titer in all samples was calculated with the UniVET® software provided by AffiniTech. Serum antibodies for IB at 2 wpv were 822. IgA titers in swab samples were 6,303 and 8,347 at 1 and 2 wpv respectively; meanwhile they were 10,188 and 9,897 in lachryma. Circulating antibodies against ND at 2 wpv were 3,409. Swab samples results were 4,141 and 5,852 at 1 and 2 wpv; lachrymal fluid results were 6,718 and 6,302 at 1 and 2 wpv, respectively. Titers in swab samples against both antigens increased from 1 to 2 wpv, but remained almost the same in lachrymal fluid. Syntomic humoral immunity at 2 wpv against ND was apparently higher than against IB, however, local immunity was higher than the systemic one. In the other hand, IgA titers were higher in lachrymal fluid than in swab samples, despite they were diluted 1:10. Modification of a commercially available ELISA kit was suitable to detect and quantify IgA in tracheal swab samples and lachrymal fluid.

Key Words: Local immunity, IgA, ELISA, Newcastle disease, Infectious bronchitis

Karen Lopez1,2, David Halvorson3, Timothy Goldsmith4, Carol Cardona1, University of Minnesota College of Veterinary Medicine, St. Paul, MN, USA; 2University of Minnesota, St. Paul, MN, USA

The Secure Egg Supply (SES) Plan was developed through a collaborative effort between government, industry, and academic partners in order to facilitate continued movement of uninfected egg products in the event of a highly pathogenic avian influenza (HPAI) outbreak in the United States. Proactive risk assessments performed by analysts at USDA,APHIS, Veterinary Services, Center for Epidemiology and Animal Health serve as the bases for determination of permit requirements for movement of eggs and egg industry products from infected but undetected flocks. Entry and exposure assessments were performed for the following commodities: pasteurized and non-pasteurized liquid eggs, washed and sanitized shell eggs, nest run shell eggs, shells and inedible eggs, hatching eggs, day-old chicks and manure. To move eggs, producers must then complete a series of steps to be issued a permit by the Incident Commander’s designee. Producers are encouraged fulfill preparatory steps prior to an outbreak to expedite permit receipt when needed. First, traceability information (premises ID, GPS coordinates, etc.) must be made available. Next flock production parameters must be within normal limits. Product-specific biosecurity measures must be in place for premises, people, flock, pest control, equipment and egg-handling materials, feed and water, and manure removal. An epidemiological assessment must be found to be acceptable by the issuing official. Prior to movement and depending on product negative real time reverse transcription polymerase chain reaction (RRT-PCR) may be required on the one to two days preceding product transport. The SES Plan is currently in the implementation stage; partners in academia, industry and government are performing outreach activities to encourage adoption and modification of the plan by individual states and regions to best suit their industries’ needs.

Key Words: Secure Egg Supply (SES), HPAI

P216 Effect of diluting a commercial Newcastle disease recombinant vaccine on the protection of broiler chickens challenged with a virulent strain of Newcastle disease virus
Ignacio Osorio1, Alma Delia González2, Rodrigo Cascante2, Eduardo Lucio2, Rubén Merino1, Universidad Nacional Autónoma de México, México, Mexico; 2Investigación Aplicada S. A. de C. V., Tehuacán, Mexico

Currently, the design and production of vaccines have clear objectives: to reduce the adverse effects and enhance the immunogenicity, some recombinant vaccines of last generation have achieved these objectives. Different doses of a commercially available recombinant Newcastle disease (ND) vaccine (Genovax® N5, Investigación Aplicada S.A., Puebla, México 75700) were evaluated, a standard live virus (LaSota strain) was used as control. Five groups of 12 commercial broiler chickens, 21 days old, ND-antibodies free, were immunized with either, the recombinant (strain...
The APEC strains were present in young chicken, starting from one day all ages, and in farms with vaccinated poultry, but reached at higher ages. The ORT presence was showed both by ELISA and PCR in broilers of 42 C were found in layers of 31-36 weeks old, and the types B and C were AMPV type A was present in young turkeys of 61 days old, types A and subtype B) and mycoplasmosis with MG and MS applied to adults. The vaccination schemes were different from farm to farm but also depending on the age of poultry. They included in a non unitary manner: IBV, ILT, AMPV, ORT, MG, MS, and in addition, APEC strains associated with respiratory diseases in poultry (chicken and/or turkey): IBV, ILT, AMPV, ORT, MG, MS, and in addition, APEC strains were pathotyped by PCR assays. Samples were from chicken industrial farms (commercial) (parents, broilers, layers) and turkey farms, from 9 counties in the central and southern Romania. The vaccination schemes were different from farm to farm but also depending on the age of poultry. They included in a non unitary manner vaccinations for IB prophylaxis (mostly with strains derived from CR/FR/Qx pathotype) applied to youth and adults poultry, ILT, ART (AMPV subtype B) and mycoplasmosis with MG and MS applied to adults. For IBV there were recorded very high antibody titers in adult poultry, and PCR tests revealed the circulation of strains derived from CR/FR/Qx pathotype and the absence of Mass or It-02 strains for all chicken ages. ILTV was present in unvaccinated layers and broilers of 42 days old. AMPV type A was present in young turkeys of 61 days old, types A and C were found in layers of 31-36 weeks old, and the types B and C were concomitantly detected in broilers of 42 days old. The ORT presence was showed both by ELISA and PCR in broilers of 42 days old, and adult hens and turkeys of all ages. MG and MS were present in farms without specific vaccination, both in chicken and turkey of all ages, and in farms with vaccinated poultry, but reached at higher ages. The APEC strains were present in young chicken, starting from one day old, and also in sanitation control samples and, curiously, at a swan from a hunting area. The ELISA kits proved to be highly reliable to control the efficiency of vaccines, and in combination with PCR assays, to detect respiratory infectious agents in poultry.

Key Words: poultry, respiratory disease, ELISA, PCR

P218 Benefits medicating in drinking water stabilized Nancy Christy*1, Josue Sanchez2, Jorge Coss1, Gabriel Gomez 1, Boehringer Ingelheim, Mexico, Mexico; 1Boehringer Ingelheim, Queretaro, Mexico; 1Boehringer Ingelheim, Puebla, Mexico; 1Aler, Mex, Mexico
Several factors can affect the results expected after application of a vaccine and/or medicament as product quality, strength, storage and application method of the products according to the manufacturer’s recommendations. In the case of vaccination and/or medicament into the drinking water, which is a commonly used practice in the poultry industry, there is a factor of vital importance that the quality of water. In the case of supply through underground shaft, the problem is that usually contain large amounts of dissolved mineral salts that give hardness and altering the taste, the absorption and bioavailability of antimicrobials. To ensure proper operation of either a vaccine or an antimicrobial, the quality of water must comply with a pH around 7, hardness less than 300 ppm and be free of chlorine and iodine.
In a farm with 250,000 birds applied a water stabilizer, which yielded the appropriate pH, less than 300 ppm hardness and elimination of chlorine and iodine. The control group was previously medicated without applying water stabilizer. Since water was obtained under optimum conditions the medication was applied with antibiotics. We measured Minimum Inhibitory Concentrations (MIC) of each group for E. coli, Salmonella enteritidis, Staphylococcus aureus and Streptococcus uberis after 10 minutes, one hour and two hours after the medication. The results showed that by stabilizing the water, CIM is smaller and more uniform for the group when it stabilized the water, showing a statistically significant difference and saving money on medication.

Key Words: drinking water stabilized, water stabilizer, water quality, hardness

P219 Comparison of various levels of the direct fed microbial Opti-bac L on broiler chickens during a natural Clostridium perfringens exposure Marie Schirracher 1, Diego Paiva1, Christa Honaker1, Alamanda Calvert1, Audrey McElroy2 Virginia Polytechnic Institute and State University, Blacksburg, VA, USA; 2Texas A&M University, College Station, TX, USA

Due to consumer preference and industry regulations, alternatives to antibiotics are being evaluated for effectiveness against poultry diseases, such as necrotic enteritis. Probiotics are among the various products available to the commercial poultry industry for natural modulation of intestinal integrity in challenging environments. The objective of this study was to evaluate the effects of different dietary inclusion levels of Opti-bac L (Huvepharma Inc., Peachtree City, GA), a probiotic that contains Bacillus licheniformis, on broiler performance during a natural Clostridium perfringens exposure. Day-old Cobb males were randomly assigned to four treatments with 18 replications per treatment for 0-42 d. Birds were exposed to Clostridium perfringens through litter previously used by an infected seeder flock, and resulting necrotic enteritis was confirmed by posting of mortality. All diets were medicated and contained 10 grams per ton of Bacillus subtilis. Treatments were inclusions of Opti-bac L at: 0.00 (diet 1), 0.25 (diet 2), 0.50 (diet 3), or 1.00 lbs per ton (diet 4). Body weights (BW), feed intake and number of live birds per pen were recorded on days 0, 14, 35 and 42. For statistical analysis, PROC GLM procedure of SAS was used. No significant differences were observed for mortality or feed consumption. Feed conversion ratio (FCR) from 0 to 14 was significantly better in diet 3 compared to diet 4 (P < 0.0281). From day 15 to 35, FCR for diet 3 was significantly better than diets 1 and 4 but showed no significant difference from diet 2 (P < 0.0006). Cumulative FCR from day 0-42 for diet 3 was significantly better than diets 1 and 4 but showed no significant difference from diet 2 (P < 0.0001). Throughout the trial, BW and overall body weight gain (BWG) were significantly (P < 0.0004) lower for diet 4 compared to all other diets. The results indicated that while undergoing a Clostridium perfringens exposure
and resulting necrotic enteritis episode, there was a benefit in growth and FCR in broilers supplemented with *B. subtilis* and Optibac-L. The results also suggested that the 1.00 lbs per ton of Optibac-L resulted in reduced BW and BWG, while an intermediate amount (0.25 or 0.50 lbs per ton) of the probiotic provided an improved FCR.

**Key Words:** Bacillus, Optibac-L, Clostridium, Calsporin, broiler

P220 **Evaluating the pathogenicity of the infectious bronchitis virus Arkansas 99 vaccine** Frances Ashby\(^{1,2}\), Deborah Hilt, Mark Jackwood, Brian Jordan *The University of Georgia, Athens, GA, USA*

Avian infectious bronchitis virus (IBV) is a gammacoronavirus that causes an economically significant upper respiratory tract disease in chickens. Because of its prevalence and infectivity, all commercial poultry are vaccinated against IBV in a serotype specific manner. Of the 5 main serotypes used in the U.S., the Arkansas DPI (ArkDPI) serotype vaccine has been shown to provide adequate protection from challenge after spray application. The lack of protection can be correlated to poor infection and replication in chicks. The Arkansas 99 (Ark99) vaccine is the same serotype as ArkDPI, but was discontinued because it was perceived to cause a severe reaction in 1-day old chicks, which may have been due to the simultaneous use of B1 Newcastle virus (NDV) vaccine. Now, highly attenuated NDV vaccines like C2 and Clone-30, and HVT and Poxvirus based vector vaccines for NDV are available, potentially eliminating the previously observed severe vaccine reaction. The purpose of this trial was to determine the pathogenicity of Ark99 in the absence of other live viral vaccines and to measure the infection and replication rate of Ark99 compared to the current ArkDPI vaccines. To test this, a single dose (1 x 10⁶) of Ark99 vaccine was given to each of ten 1-day old broiler chicks via eye drop. The chicks were swabbed in the choanal cleft at 7, 10, and 14 days of age to measure vaccine virus replication by real time RT-PCR. At the same time points, respiratory signs indicative of a vaccine reaction were recorded. At day 14, chicks were euthanized and necropsied and tracheas were harvested to examine the pathogenicity of the vaccine, using the ciliostasis test. Determining the pathogenicity of the Ark99 vaccine in the absence of other live virus vaccines will give valuable information on the potential suitability of this vaccine for chicks.

**Key Words:** Arkansas 99, IBV, Broiler, Arkansas DPI, Vaccine

P221 **Identification and Analysis of Mycoplasma gallisepticum and Mycoplasma synoviae Strains Detected in The Colombian Poultry Between 2013 and 2014.** ANDRES RODRIGUEZ-AVILA\(^1\), JAVIER GOMEZ\(^2\), GERARDO QUIÑONES-CHOIS\(^1\), LAILA BERNAL\(^2\)

\(^{1}\)BioARA S.A., Guadas, Colombia; \(^{2}\)Universidad de la Salle, Bogota, Colombia

Avian mycoplasmosis is a disease of great importance in the Colombian poultry industry because of the negative impact associated with the decrease in the production of table and fertile eggs, in addition to vertical transmission to progeny, selection and increasing mortality of day-old chicks and low zootechnical performance in broilers. Because of the economic losses for the poultry industry, it is necessary to study the behavior of strains of Mycoplasma gallisepticum and Mycoplasma synoviae present in the Colombian poultry. Given this situation, the objective of this experiment was to determine the effects of different concentrations of these metals on the proliferation of *H. meleagridis* in vitro. An anaerobic 96-well culture screen methodology was developed. The tolerance level of turkeys determined the highest metal concentrations studied. Concentrations were halved 5 times for a total of 6 concentrations and there were 3 replications per treatment. The growth rate of *H. meleagridis* was measured by counting live protozoan cells using a Neubauer hemocytometer at 8 h intervals for 32 h. Cell counts were collected and analyzed and it was determined that FeSO\(_4\)-H\(_2\)O, MnSO\(_4\)-H\(_2\)O, and NiSO\(_4\)-H\(_2\)O, and NiSO\(_4\)-H\(_2\)O. The objective of this experiment was to determine the effects of different concentrations of these metals on the proliferation of *H. meleagridis* in vitro. For each metal, an inhibition trend after 24 h was observed, with NiSO\(_4\)-H\(_2\)O showing significantly increased cell counts. Therefore, these results show promise that other trace minerals may be effective in controlling *H. meleagridis* growth. Future research may be necessary to determine the effects of these metals in vivo.

**Key Words:** trace mineral, blackhead disease, Histomonas meleagridis, nitarsonex, cell screen

P222 **In vitro cell screen assay of nickel (II) sulfate and cadmium sulfate showed growth inhibition of Histomonas meleagridis** Anna Kenyon\(^{1,2}\), Miguel Barrios, Robert Beckstead *The University of Georgia, Athens, GA, USA*

Histomonas meleagridis, a protozoan parasite, is the causative agent of blackhead disease, also known as histomoniasis. *Histomonas meleagridis* causes morbidity in gallinaceous birds – up to 30% mortality of broilers, and 80-100% mortality in turkeys, resulting in substantial financial losses. Prior to their removal, blackhead outbreaks were controlled with the arsine-containing drugs: Roxarsone (4-hydroxy-3-nitrophenylarsonic acid), Carbarsone ([4-Carbamoylamino] phenyl arsenic acid), and arsanic acid (4 aminophenylarsonic acid). Currently, the only available drug is Nitarsone (4-nitrophlorarsonic acid), which is under review by the FDA with its potential removal pending. The withdrawal of reliable drugs has led to an increased interest in alternative treatments. ZnSO\(_4\), CuSO\(_4\)-H\(_2\)O, have shown growth inhibition of *H. meleagridis* and have chemical properties similar to FeSO\(_4\), MnSO\(_4\), CdSO\(_4\)-H\(_2\)O, and NiSO\(_4\)-H\(_2\)O. The objective of this experiment was to determine the effects of different concentrations of these metals on the proliferation of *H. meleagridis* in vitro. An anaerobic 96-well culture screen methodology was developed. The tolerance level of turkeys determined the highest metal concentrations studied. Concentrations were halved 5 times for a total of 6 concentrations and there were 3 replications per treatment. The growth rate of *H. meleagridis* was measured by counting live protozoan cells using a Neubauer hemocytometer at 8 h intervals for 32 h. Cell counts were collected and analyzed and it was determined that FeSO\(_4\) and MnSO\(_4\) did not effectively inhibit *H. meleagridis* at any concentration. NiSO\(_4\) at 2.5, 5, 10, and 20 ppm showed an inhibition trend after 24 h, while 0.625, 1.25 ppm, and control significantly increased. CdSO\(_4\) at 5, 10, and 20 ppm showed an inhibition trend after 24 h, while all other treatments showed significantly increased cell counts. Therefore, these results show promise that other trace minerals may be effective in controlling *H. meleagridis* growth. Future research may be necessary to determine the effects of these metals in vivo.

**Key Words:** hematolgy, stress, reactive cluster, leukergy, atypia

P223 **Sentinel Cells and Agglomeration in Circulating Blood are Indications of Stress** Paul Cotter* Cotter Laboratory, Arlington, MA, USA

The heterophil/lymphocyte (H/L) ratio is a widely used stress measure for poultry. High H/L ratios indicate stress but this calculation often ignores total white blood cell counts (TWBC) and atypical cells (AT). Low H/L’s have been found in the presence of high TWBC’s and high H/L’s can occur with a normal TWBC. By themselves, H/L’s or TWBC’s are insufficient indicators of the “blood picture”. Moreover, many H/L and TWBC are determined with a hemacytometer, a technique insensitive to AT’s. Here the purpose is to illustrate AT types and behavior that by themselves are automatically indications of a complex hemogram and so infer stress. Examples of thrombocytes, erythrocytes, lymphocytes, granulocytes, and other cells are provided. Thin films of blood, obtained from commercial hens, ducks, and turkeys, stained with Wright’s method are the source of the data. Emphasis is given to illustrations containing multiple AT’s in “reactive clusters” (RC) formations. The assumption is that RC’s represent the avian equivalents of “leukergy” a hematological phenomenon associated with inflammation and infection characterized by agglomeration of leukocytes.

**Key Words:** hematolgy, stress, reactive cluster, leukergy, atypia
Histomoniasis (Blackhead disease) is a serious concern for the turkey industry in the United States (US). At least 50 cases of histomoniasis were reported each year since 2007 in the US (2013 USAHIA Annual Meeting Proceedings) and mortality in the infected turkey flock can reach 100%. Therapeutic options for the control and prevention of the disease are limited. There is a need for research into the development of new animal drugs and other possible interventions, including vaccines and management techniques for the control and prevention of histomoniasis in turkeys. The purpose of this presentation is to highlight FDA’s interest in exploring with colleagues in academia, the pharmaceutical industry, the poultry industry and others, possible therapeutic interventions against histomoniasis in turkeys, leading to an approved new animal drug to fill this important therapeutic need.

**Key Words:** Blackhead disease, Histomonas meleagridis, Turkeys, Drugs, Regulatory

---

**P225 RESISTANCE PROFILE OF SALMONELLA TYPHI AND SALMONELLA PARATYPHI IN RELATION TO ANTIMICRIONAL AGENTS**

Vitor Franceschini1, Gustavo Savoldi, Ewerton Zanellato, Andre Grossi, Guilherme Severo, Erica Lucca

1Farmabase Saúde Animal, Campinas, SP, Brazil; 2Farmabase Saúde Animal, Jaguariuna-SP, Brazil; 3Instituto Federal do Triângulo Mineiro, Uberlandia-MG, Brazil

The objective of the study was to evaluate the susceptibility of different serotypes of Salmonella spp. in relation to the different antimicrobial agents used in industrial poultry farming. Ten isolates underwent the anti-biogram or Antimicrobial Susceptibility Test (AST), these isolates were: Salmonella Pullorum, Salmonella Gallinarum; Salmonella Heidelberg, Salmonella Schwarzengrund, Salmonella Mbundaka, and Salmonella Senftenberg. Antimicrobial susceptibility test was conducted by Disk Diffusion Method using Mueller-Hinton agar and incubation at 36-48°C for 18-20h. Antimicrobial agents tested were: Ciprofloxacin (5 µg), Enrofloxacin (5 µg), Norfloxacin (10 µg), and Fosfomycin (30 µg) for Salmonellas typhi, as these groups of Salmonella have a systemic action and the active ingredients have a local and systemic action and, in addition, the Neomycin (30 µg) for Salmonellas paratyphi, which have an action limited to the bowel. Results have showed that all isolates of S. Pullorum and S. Gallinarum were susceptible to the action of ciprofloxacin. All isolates of S. Pullorum were susceptible to norfloxacin and enrofloxacin. Isolated of S. Gallinarum were resistant to enrofloxacin and norfloxacin. All 40 isolates of Salmonella spp. were susceptible to ciprofloxacin and norfloxacin. Currently, prevalence studies point out the serotypes S. Heidelberg and S. Mbundaka with a high rate of occurrence in the industrial poultry farming. These serotypes have showed a high susceptibility to the action of neomycin and enrofloxacin-resistant isolates. According to the resistance profile observed in this study, it can be concluded that ciprofloxacin was the molecule with highest susceptibility against all types of salmonella tested. Further antibiotic tested have showed resistant isolates. Neomycin has showed complete susceptibility regarding two serotypes with high prevalence, which are S. Heidelberg and S. Mbundaka.

**Key Words:** Salmonella spp., Ciprofloxacin, antimicrobial, antibiogram, resistance

---

**P226 Evaluation of intestinal absorption, skin deposition and digestibility of xanthophylls in broilers challenged with Eimeria acervulina, E. tenella, and E. maxima**

Xochitl Hernandez-Velasco1, Nancy Frade-Negrete1, Benjamin Fuente-Martínez2, Manuel Quiroz-Pesina1, Ernesto Avila-Gonzalez1 Universidade Federal de Mato Grosso, Senftenberg, Germany

An experiment was conducted in broiler chickens from 21 to 49 days of age to evaluate the plasmatic level, deposition, and digestibility of xanthophylls (XA) from marigold flower after infection with Eimeria spp. 400 broilers were assigned to 4 treatments: 1) non-infected control; and treatments 2 to 4 were challenged with 8.32 x 10⁴ sporulated Eimeria oocysts (SE)/ bird. The birds were treated, and received 85, 108, 141, and 162 ppm of total dietary XA from d 35 to 49 for treatments 1 to 4, respectively. The experiment contained 4 replications (2 replications/sex) per treatment. No difference was detected in plasma xanthophylls (PX) or skin yellowness (b*) at 49 d between treatments. XA digestibility decreased by 15 units in the infected birds. Results suggest that XA digestion and absorption are similar between males and females. However, females have a greater ability for skin XA deposition. After a mild Eimeria spp infection, it is possible to achieve adequate b* levels if the infected birds are treated immediately and receive at least 62 mg of dietary XA/bird for 14 d.

This work was sponsored by the Support Program for Research and Innovation Projects in Technology (PAPIIT), Project IN203910-3, UNAM.

**Key Words:** Eimeria, intestinal absorption, broiler chicken, skin pigmentation, digestibility

---

**P228 DETERMINATION OF MINIMUM INHIBITORY CONCENTRATION (MIC) FOR HALQUINOL AND ITS ISOMERS 5,7-DICHLORO-8-HYDROXYQUINOLINE AND 5-CHLORO-8-HYDROXYQUINOLINE IN RELATION TO ISOLATES FOR ESCHERICHIA COLI, SALMONELLA GALLINARUM AND SALMONELLA ENTERITIDIS**

Alexandre Machado1, Marcia Milare2, Daniela Carneiro2, Sara Zoca2 Farmabase Saúde Animal, Campinas-SP, Brazil; 3Farmabase Saúde Animal, Jaguariuna-SP, Brazil

Halquinol is a controlled mixture of the isomers, 5,7-dichloro-8-hydroxyquinoline, 5-mono chloro-8-hydroxyquinoline and 7-chloro-8-hydroxyquinoline. As a non-antibiotic antimicrobial agent, it demonstrates a high level of activity against an extensive range of bacteria, Gram-positive, Gram-negative and fungi, as well against certain protozoans. British Pharmacopoeia of 1980 indicates the active ingredient Halquinol is composed by the following relation of isomers: 57 to 74% of the isomer 5, 7-Dichloro 8-hydroxyquinoline: 23 to 40% of the isomer 5-Mono chloro 8-hydroxyquinoline and maximum 4% of the isomer 7 - Chloro 8- hydroxyquinoline. However, total sum of isomers should be between 95 and 105%. Aiming at demonstrating that the adequate composition of isomers in the raw material directly reflects on the antimicrobial efficiency of the formulated product, it was conducted an evaluation study of minimum inhibitory concentration (MIC) of the active pharmaceutical ingredient (API) Halquinol singly and of the purified isomers 5,7-Dichloro 8-hydroxyquinoline and 5-Mono chloro 8-hydroxyquinoline, which present a biological activity. The isomer 7-chloro-8-hydroxyquinoline was not tested because it was considered an impurity in the raw material, being limited to the maximum of 4% in total concentration. Minimum inhibitory concentration was determined against the micro-organisms: Escherichia coli K88, Escherichia coli K99, Salmonella Gallinarum and Salmonella Enteriditis. The results found that active pharmaceutical substance Halquinol and purified isomer of 5,7-dichloro-8-hydroxyquinoline presented MIC values which were very close for the majority of micro-organism studied, reaching an interval of 2.0 to 7.1 µg/mL and 1.6 to 6.6 µg/mL, respectively. The purified isomer of 5-chloro-8-hydroxyquinoline pre-
resented higher values of MIC, in the range of 11.21 to 22.415 µg/mL. Such data enable the conclusion that the antimicrobial activity of the isomer 5,7-dichloro-8-hydroxyquinoline is superior to those of the isomer 5-chloro-8-hydroxyquinoline and that a raw material which meets the standards of British Pharmacopoeia of 1980, has an antimicrobial activity similar to those of the isomer 5,7-dichloro-8-hydroxyquinoline, as this isomer is in greater proportion in the raw material which meets the quality standards of British Pharmacopoeia, 1980. On the other hand, the Active Pharmaceutical Ingredient that does not meet this pharmacopoeia standard may present a reduced antimicrobial activity, as, in general, it will have a smaller quantity of the isomer 5,7-dichloro-8-hydroxyquinoline.

Key Words: Minimum inhibitory concentration, micro-organisms, Halquinol, isomers, Antimicrobial

P229 Outbreak of Marek's disease virus in game fowl (fighting cocks) and its analysis from the haematological point of view. A case report

Yasmin Martínez*GS Universidad Nacional Autónoma de México-Facultad de Medicina Veterinaria y Zootecnia, México, Mexico

This study presents the first report of an outbreak of Marek's disease (MD) in fighting cocks in this production unit. The unit to which belong both cases is close to fourteen fully-independent units engaged in the breeding and rearing of fighting cocks, all in the southeast of Federal District. The two cases occurred and were analyzed in late 2013 and early 2014, respectively. The presumptive clinical diagnosis was MD and it was confirmed by histopathology. According to the pathological lesions the cases were classified as MD in its acute presentation; both nervous, and classical-visceral16-21; respectively.

The Marek's disease virus (MDV) has been extensively studied; it is associated with high mortality in acute cases, as well as with major condemnations and downgrading at the end of the production cycle in the chronic presentation. Birds show significant immunosuppression, acquiring the risk of getting secondary diseases. Therefore is of great importance to determine if the infection is present in unvaccinated, clinically healthy live birds, since usually the diagnosis is performed after the presentation of clinical signs. It was decided to use complete blood count (CBC) testing as a complementary tool in the diagnosis of the 3 suspected birds. However, no conclusive results that indicate the presence of the infection were obtained.

Key Words: Marek's disease, fighting cocks, histopathology, immunosuppression, complete blood count (CBC)

P230 Evaluation of the effectiveness of vaccination against marke's disease (em) determined by the presence of hvt vaccine virus through endpoint per technique in game birds (Gallus gallus) Norma Patricia Ficachi GarciaGS, Nestor Ledesma Martinez UNAM, Mexico, Mexico

Due to the great clinical and economic importance of Marek's Disease (MD) in game birds, the most effective and used control method at field level is vaccination at day-old. However, it is very important to evaluate the effectiveness of the vaccination to ensure that the bird is indeed protected against field viruses. For this purpose, we carried out the detection of the presence of serotype 3 (HVT) vaccine virus of MD through endpoint PCR from feather follicle in game birds. Based on the results, were identified HVT positive birds that had been vaccinated and therefore the effectiveness of vaccination is confirmed. Also were identified birds that are negative for the presence of HVT and therefore are not protected against pathogenic viruses despite being identified as vaccinated. This is why the technique used in this study may be an alternative for the evaluation of the effectiveness of vaccination. Additionally HVT positive birds were found and these were reported as unvaccinated so this may be an indication of the excretion of the vaccine virus reported in the literature since they were in contact with the vaccinated birds.

Key Words: Marek's disease, game birds, PCR, vaccination, HVT

P231 Novel statistical approaches toward Salmonella surveillance in live and processed poultry

Maurice Pitesky* University of California Davis, Davis, CA, USA

Salmonella contamination of grow-out poultry destined for human consumption can occur from multiple sources in the broiler supply chain. Understanding specific on farm and processing risk factors that positively and negatively affect Salmonella prevalence at the processing plant is essential toward mitigating risk. This paper describes the construction of multiple logistic regression models coupled with conditional decision tree analyses tools designed to identify Salmonella risk. Initial single logistic regression generated odds ratios showed that positive bootswabs in the grow-out facilities were 11.1x more likely to be associated with positive Salmonella Rehant post evisceration. In addition, an optimized backwards logistic regression model was able to predict Salmonella rehant positives 72% of the time and Salmonella rehant negatives 90% of the time (R² equal to 0.62). Conditional decision trees are a novel approach toward risk analysis of multiple interventions in poultry production. Initial trees at three different processing plants showed that dipping stations had the most significant (p<0.0001) effect on Salmonella parts prevalence. Using the above described models in parallel offers a comprehensive approach toward evaluating risk of Salmonella in live and processed chicken.

Key Words: Salmonella, food safety, conditional decision trees, logistic regression

P232 Effect of thermal manipulation during fetal phase on adapatative capacity of broiler chickens

Viviane Souza MotaGS, Vitor Rosa de Almeida, Isabel Cristina Boleli São Paulo State University, UNESP, Jaboticabal, Brazil, Jaboticabal, Brazil

Thermal manipulation during critical periods of chick embryogenesis has been used to improve thermotolerance acquisition later in life. The aim of this study was investigated effects of temperature manipulation during fetal phase on response to high environmental temperature of broiler chickens. Control embryos (n=160) were incubated at 37.5°C through incubation. Thermally manipulated embryos were incubated at 37.5°C until embryonic day (ED) 12 and exposed to 36°C (low temperature, n=160) or 39°C (high temperature, n=160) from ED 13 onward. At d 2, 8, 15, 22 and 28 post-hatch (n=16 per treatment and per age), chickens were exposed to high temperature (5°C above the preferred ambient temperature) for 45 min. Chickens from incubation at low and control treatment increased the rectal temperature under heat stress from d 2 and increased the frequency of respiratory movements from d 21. However, incubation at high temperature limited the increasing in the rectal temperature under high temperature to grower phase (from d 22 of age) and delayed the increasing in the frequency of respiratory movements to last analyzed week (from d 29 of age), whose values were lower than reported for broilers from incubation at low and control temperatures. The results demonstrated physiological advantage of the continuous high incubation temperature during fetal development for broilers exposed to heat stress during the first three weeks of age.

Key Words: thermal manipulation, broiler chicken, thermal challenge, thermotolerance, fetal phase

P233 Nutritional Effects on Parent Stock W-36 and its Influence on the Sex Ratio and Development of Offspring

Zachary Lowman, Christopher Ashwell North Carolina State University, Raleigh, NC, USA

Past studies in birds have shown that there is a link between maternal condition, or resource availability, and the resultant sex ratio of offspring in avian species, both wild and domesticated. In the majority of cases, mothers will preferentially bias the sex ratio of their offspring to the sex that is most likely to survive in conditions in which nutritional resources are scarce or of poor quality; typically, this is the sex with the lower mature body weight, thus lower nutritional requirements, in sexually dimorphic
species. This study analyzed how three diets of differing caloric and protein concentrations influenced the sex ratios of a commercially utilized avian species, the Hy-Line W-36 laying hen. As expected, development of both parent and filial generations was significantly affected by diet or egg composition, respectively. Sex ratio bias was significantly different only between CL offspring compared to the control, but there was a similar trend in the opposite direction for CH offspring. Results suggest that contaminating availability of either high- or low-nutrient density food resources does not predominate hens to bias the sex ratio of their offspring; however, a sudden change in diet, particularly to one of lower protein concentration, may influence such a change, suggesting linkage with the production of stress-related hormones. Further trials are needed to assess the efficacy of diet alteration prior to reproductive maturity as a means of sex allocation manipulation.

**Key Words:** embryonic lethality, genetics, Athens Canadian Random

**P234** Identification of recessive mutations that cause early embryonic deformities in the Athens Canadian Random bred line maintained at the University of Georgia Jason Payne, Clayton Wing, Robert Beckstead The University of Georgia, Athens, GA, USA

In an attempt to preserve the genetics of the 1950’s broiler chicken, the University of Georgia has maintained an Athens Canadian Random bred (ACRB) chicken flock since 1958. These birds are a genetic derivative of the Ottawa Meat control strain that was the industry standard of the time. This ACRB flock has been maintained through random breeding practices. Though randomly mating prevents directional selection, persistence of recessive mutations can be maintained in the flock. The objective of this study was to determine the presence of deleterious mutations within the ACRB line that result in early embryonic abnormalities. Pedigree information allowed for the identification of 215 potential siblings. Siblings were crossed by artificial insemination and eggs were collected, labeled, and incubated for 5 days. An average of 9 embryos per cross were removed from the eggs and dissected away from the extra embryonic tissues, washed in PBS, placed in 10% buffered formalin for preservation, and visualized under a dissection microscope. Based on the phenotypic screening for morphological deformities, 13 crosses resulted in deformities of the head/face (1), brain (1), hind limb (1), eye (1), spine (2), dwarfing of the trunk (3), or developmental delay (4) in Mendelian ratios. Genetic stocks, such as the ACRB, provide a valuable resource for identifying genetic lines that may act as a model for the study of embryonic development in the chicken and suggests that industrial or other lines may be a fertile ground for identifying mutations that affect the development, growth and production of chickens. Future studies are focused on the identification of other lines that contain embryonic lethal phenotypes and the identification of the genes associated with these phenotypes. The aim is to provide a better method to screen for and identify individuals with deleterious mutations to improve the health and production of chicken flocks.

**Key Words:** embryonic lethality, genetics, Athens Canadian Random

**P235** Effect of In Ovo injection of vitamin D on hatchability, ash content, mineral composition and bone strength of chicks Thays Quadros1, Karina Duarte1, Carla Domingues1, Rafael Marques1, Elaine Santos1, Diana Castilblanco1, Sarah Sagvili1, Juan Alva1, Otto Junqueira2
1Faculty of Agriculture and Veterinary Sciences, Jaboticabal, Brazil; 2Faculty of Agriculture and Veterinary Sciences, Jataí, Brazil

Vitamin D acts on bone metabolism since embryo development. This study evaluated the In Ovo injection of vitamin D as cholecalciferol at the eighth d of embryo development on ash content, bone mineral composition, and bone strength of chicks at hatching. An experiment was conducted with 600 Cobb 500 fertile eggs from 43-wk-old broiler breeders. Eggs were distributed in a completely randomized design with five treatments: 1. control (no injected eggs); 2. Eggs injected with 100 µl of olive oil only; 3. Eggs injected with 1.2µg vitamin D (48IU)/100 µl of olive oil; 4. Eggs injected with 2.4 µg vitamin D (96 IU)/100 µl of olive oil, and 5. Eggs injected with 3.6 µg vitamin D (144 IU)/100 µl olive oil. On the eighth d of incubation they were injected with different concentrations of vitamin D diluted in olive oil in the yolk sac and after injection the hole was sealed with a sticker. The eggs that failed to hatch were recorded, respectively to calculate hatchability. Tibiotarsus and femurs were subjected to analysis of calcium, phosphorus, ash and bone strength. Data was analyzed in a completely randomized design with 5 treatments and 120 eggs per treatment. The hatchability results were not significant (P = 0.2202), the percentages found for hatching rate were 91.23, 87.18, 89.47, 86.84, 82.61% respectively for treatments 1; 2; 3; 4 and 5. No effects of treatments (P>0.05) were observed on calcium, phosphorus and bone ash. It was concluded that In Ovo injection of vitamin D did not affect any of the variables evaluated.

**Key Words:** In ovo, cholecalciferol, bone, embryonic development, chicks

**P236** Effects of the in ovo injection of organic zinc, manganese, and copper on the hatchability and bone parameters of broiler hatchlings Tiago Oliveim, Elizabeth Kim1, Anna Caixeta1, E. David Peebles1
1Universidade Federal de Lavras/ Mississippi State University, Starkville, MS, USA; 2USDA, Starkville, MS, USA; 3Mississippi State University, Starkville, MS, USA

Effects of the in ovo injection of commercial diurnal containing supplemental microminerals (Zn, Mn, and Cu) on hatchability and hatching chick quality variables in Ross × Ross 708 broilers were examined. On 17 d of incubation (do) the eggs were subjected to 1 of 4 treatments (TRT) using a commercial multi-egg injector. Treatments included non-injected (TRT1) and diluent-injected (TRT2) control groups. Those in treatment 3 (TRT3) received diluent containing 0.181, 0.087 and 0.010 mg/ml of Zn, Mn and Cu, respectively, and those in treatment 4 (TRT4) received diluent containing 0.544, 0.260 and 0.030 mg/ml of Zn, Mn and Cu, respectively. All injected treatments received 150 µl of diluent. A total of 1,872 eggs were distributed in 3 incubators, with 26 eggs assigned to each of 4 pre-specified treatment groups of each 6 replicate tray levels in each of 3 incubators. Hatchability of fertile eggs set (HF) was determined on 20.5 and 21.5 doi. On 21.5 doi, HF and mean hatching chick weight (MHW) were determined. One bird from each of the respective 24 treatment replicate groups was randomly selected, and weighed. Subsequently, the selected birds were necropsied for the extraction of their livers and tibiae. The tibiae were weighed (g), and their length and width were measured. Fresh and dry bone weights were calculated as percentages of BW and the dried tibiae were subjected to bone breaking strength (BBS) analysis. The broken bones and dry livers were weighed and ashed for determination of percentage of bone ash (PBA) and liver ash. Injection TRT had no significant effect (P = 0.56) on HF at 20.5 doi. However, there was a significant injection TRT effect (P = 0.04) on HF at 21.5 doi. The HF of eggs at 21.5 doi in TRT4 was significantly lower than that of the non-injected control group, with TRT3 being intermediate. Furthermore, there was no significant TRT effect on MHW. There were no significant TRT effects noted for fresh and dry tibia weights, tibia length and width, tibia length to weight ratio, BBS, or liver ash content. However, a significant TRT effect (P = 0.004) was found for PBA. Embryos from eggs that received TRT4 had a significantly higher level of tibia ash in comparison to all other TRT. In conclusion, although TRT4 negatively affected HF, the injection of solution with the high microminerals has the potential to improve bone mineralization.

**Key Words:** enrichment, incubation, microminerals, mineralization, tibia
P237 Parental sex effect of parthenogenesis on egg weight in mated Chinese Painted quail Courtney Wade\textsuperscript{1,2}, Holly Parker, Aaron Kiess, Chris McDaniel Mississippi State University, Mississippi State, MS, USA

Parthenogenesis (P), embryonic development in unfertilized eggs, occurs in poultry. In virgin quail, correlation analysis revealed that parthenogenesis size increases as initial egg set weight increases. Additionally, in mated hens, P negatively impacts hatchability. Perhaps elevated egg set weight is a causative factor for decreased hatchability in hens exhibiting P. Egg set weight in birds exhibiting P may influence embryonic mortality and other hatchning failures in mated hens. Also, it is unknown if in the hen, her mate or both impact egg set weight in mated Chinese Painted quail. Therefore, the objective of this study was to determine if selection for P in the hen, her mate or both influences egg set weight for eggs that hatch as well as eggs that ultimately yield various hatchning failures. Females and males used in the current study consisted of 2 genetic lines of birds, one selected for P and one not selected for (P, controls, C). A 2 hen (C and P) x 2 male (C and P) factorial arrangement of breeding pair treatments was utilized to determine the impact of P on egg set weight for eggs that hatched as well as those that failed to hatch. Hatchning failures were classified as infertile, P, early embryonic mortality, or late embryonic mortality. The 4 breeding pair treatments were as follows: C hens with C males (CC), C hens with P males (CP), P hens with C males (PC), and P hens with P males (PP). Daily, eggs were collected, labeled and weighed prior to incubation at 37.5°C for 18 d. All eggs that didn’t hatch were broken to determine hatchning failures. Egg set weight for eggs that hatched was greater (P<.05) when the hen or male exhibited P as compared to eggs from C birds. However for infertile eggs, a hen by male interaction revealed that set weight was higher in PP when compared to PC, CP and CC eggs. For eggs that yielded early and late embryonic mortality, set weight for both hatchning failures was greater in P as compared to C hens. In conclusion, it appears that egg set weight is heaviest when eggs are from P hens regardless of hatchning failure. More interestingly, not only P hens, but also P males appear to influence set weight of eggs that hatch, perhaps by altering embryonic development.

Key Words: Parthenogenesis, hatchability, egg weight, fertility, embryonic mortality

P238 The effects of Bac-D\textsuperscript{TM} when used as a water additive in broiler chicks supplemented with probiotics Chelsea Phillips\textsuperscript{1,2}, Zack Lowman, Christopher Ashwell North Carolina State University, Raleigh, NC, USA

The primary goal of commercial poultry companies is to produce the largest birds possible with the least amount of input while also maintaining the health and welfare of the birds. In the past antibiotics have been used to enhance growth rates in poultry, however in light of current social beliefs the use of antibiotics in poultry is being heavily scrutinized; therefore alternatives such as probiotics are being investigated. Lactobacillus spp. are a commonly used bacteria in formulating probiotics, and the addition of Lactobacillus to broiler diets has demonstrated increased growth rates, stimulated immune systems, and reduced pathogen loads in the GI tract. However, previous research has shown that when rooster semen is directly exposed to Lactobacillus, sperm quality is reduced. Therefore, the objective of the current study was to determine if oral administration of Lactobacillus increases the concentration of Lactobacillus in semen and the cloaca. A total of 30 roosters were used, 15 roosters gavaged with 1X PBS as the control and the other 15 roosters gavaged with 10\textsuperscript{8} cfu/mL of Lactobacillus acidophilus for 14 consecutive days. Sperm was collected on a 3 d interval, and cloacal swabs were collected on a 2 d interval, beginning on the first day prior to oral administration. Sperm and cloacal swabs were serial diluted, and 100 \mu L of each dilution was plated on MRS agar plates. All plates were incubated for 48 h at 37°C under anaerobic conditions and counted. All Lactobacillus counts were log transformed. Because natural levels of Lactobacillus were present prior to oral gavage, log transformed counts prior to bacterial gavage were subtracted from log transformed counts for each day of gavage providing the log increase or decrease in counts due to gavage. Seminal Lactobacillus counts were higher (P<0.036) on days 1, 9 and 15 than on day 5. The main effect of treatment (P=0.026) for cloacal counts indicated that roosters gavaged with Lactobacillus yielded higher counts than the controls. However, cloaca samples also demonstrated a treatment by day interaction trend (P=0.082), where Lactobacillus was higher in the Lactobacillus gavaged roosters than the controls only on days 3, 5, 13, and 15. In conclusion, the addition of Lactobacillus to the breeder male diet over extended periods may increase concentrations of Lactobacillus in the cloaca. If Lactobacillus reaches high enough concentrations in the cloaca, then sperm quality may be impacted which could lead to poor fertility within the breeder flock.

Key Words: Lactobacillus, Probiotics, Roosters, Fertility, Sperm

P239 Impact of oral Lactobacillus gavage on seminal and cloacal Lactobacillus concentrations in roosters Juliana Hirai\textsuperscript{1,2}, Melissa Trippelt, Christopher McDaniel, Aaron Kiess Mississippi State University, Mississippi State, MS, USA

The use of antibiotics in poultry is being heavily scrutinized; therefore alternatives such as probiotics are being investigated. Lactobacillus spp. are a commonly used bacteria in formulating probiotics, and the addition of Lactobacillus to broiler diets has demonstrated increased growth rates, stimulated immune systems, and reduced pathogen loads in the GI tract. However, previous research has shown that when rooster semen is directly exposed to Lactobacillus, sperm quality is reduced. Therefore, the objective of the current study was to determine if oral administration of Lactobacillus increases the concentration of Lactobacillus in semen and the cloaca. A total of 30 roosters were used, 15 roosters gavaged with 1X PBS as the control and the other 15 roosters gavaged with 10\textsuperscript{8} cfu/mL of Lactobacillus acidophilus for 14 consecutive days. Sperm was collected on a 3 d interval, and cloacal swabs were collected on a 2 d interval, beginning on the first day prior to oral administration. Sperm and cloacal swabs were serial diluted, and 100 \mu L of each dilution was plated on MRS agar plates. All plates were incubated for 48 h at 37°C under anaerobic conditions and counted. All Lactobacillus counts were log transformed. Because natural levels of Lactobacillus were present prior to oral gavage, log transformed counts prior to bacterial gavage were subtracted from log transformed counts for each day of gavage providing the log increase or decrease in counts due to gavage. Seminal Lactobacillus counts were higher (P=0.036) on days 1, 9 and 15 than on day 5. The main effect of treatment (P=0.026) for cloacal counts indicated that roosters gavaged with Lactobacillus yielded higher counts than the controls. However, cloaca samples also demonstrated a treatment by day interaction trend (P=0.082), where Lactobacillus was higher in the Lactobacillus gavaged roosters than the controls only on days 3, 5, 13, and 15. In conclusion, the addition of Lactobacillus to the breeder male diet over extended periods may increase concentrations of Lactobacillus in the cloaca. If Lactobacillus reaches high enough concentrations in the cloaca, then sperm quality may be impacted which could lead to poor fertility within the breeder flock.

Key Words: Bac-D, Probiotic, Body Weight

P240 Antimicrobial resistance and biofilm formation in E. coli strains isolated from poultry carcasses in retail stores in several location in Mexico Margarita Fernanda Gómez Meza\textsuperscript{1}, Cecilia Rosario Cortés Universidad Nacional Autónoma de México, México, Mexico

The aim of this study was to determine whether strains of E. coli isolated from broilers bought in supermarkets in different states of the Mexican Republic could form biofilms and if this characteristics is related with antimicrobial resistant. Thirty-seven E.coli strains isolated from chicken carcasses purchased at supermarkets were analyzed. Antimicrobial sensitivity was evaluated through antibiogram technique using discs impregnated with ceftriaxone, florfenicol, sulfachlorpyridazine, enrofloxacin, fosfomycin, lincomycin, sulfamethazole trimethoprim, doxycycline, colistin, oxytetracycline, gentamicin and ampicillin. The biofilms formation test was performed in triplicate to obtain the average and standard deviation of the three readings . An increased resistance was observed for lincomycin and oxytetracycline, whereas gentamicin had the best results. Regarding the resistance by State, sulfamethazine trimethoprim were the less effective compound for strains isolated from Puebla1, DF and Chiapas, whereas lincomycin had the same behavior in Tlaxcala, Querétaro and Puebla2. In the other hand, the states with higher overall antibiotic resistance were Tlaxcala and Queretaro. Conversely, the most sensitive strains were those from Chiapas and Puebla. A biofilm forming strain was considered when
their readings were equal or higher than positive control. Chiapas was the State where more positive strains were found (42% positive) followed by Puebla and Queretaro (20, 25%, respectively). Taking together these results we observed that five of the biofilms forming strains were among most resistant strains, meanwhile, five strains with the lowest values for the biofilm formation ranked among those with greater antibiotic sensitivity. Since the bacteria are more resistant to antibiotics and disinfectants, its removal becomes more complex and can cause transient disease or irreversible damage to the consumers.

In Mexico, the consumption of chicken has increased in the last decade. However, poultry carcasses can be contaminated at every stage from the farm to the consumer’s tables. The microbiological safety of meat products is a particular problem, in fact, the World Health Organization states that, to prevent infection, control measures must be applied at all stages of the food chain, from agricultural production on the farm to processing, manufacturing and preparation in commercial establishments and homes. Although most of the meat products must be properly cooked before consumption, the presence of E. coli in meat puts consumers in a risky situation, as there may be cross-contamination with hands, utensils, surfaces, products not receiving the proper sanitation before consumption. A major problem in the food industry is represented by the survival of pathogens due to an insufficient disinfection of surfaces and instruments in contact with food; this is attributed to the presence of biofilms. The aim of this study was to determine whether strains of E. coli isolated from broilers bought in supermarkets in different states of the Mexican Republic could form biofilms and if this characteristic is related with antimicrobial resistance. Thirty-seven E.coli strains isolated from chicken carcasses purchased at supermarkets were analyzed. Antimicrobial sensitivity was evaluated through antibiogram technique using discs impregnated with ceftriaxone, florphenicol, sulfachlorpyridazine, enrofloxacin, fosfomycin, lincomycin, sulfamethazine trimethoprim, doxycycline, colistin, oxytetracycline, gentamicin and ampicillin. The biofilms formation test was performed in triplicate to obtain the average and standard deviation of the three readings. An increased resistance was observed for lincomycin and doxycycline, whereas gentamicin had the best results. Regarding the resistance by State, sulfamethazine trimethoprim were the less effective compound for strains isolated from Puebla1, DF and Chiapas, whereas lincomycin had the same behavior in Tlaxcala, Queretaro and Puebla2. In the other hand, the states with higher overall antibiotic resistance were Tlaxcala and Queretaro. Conversely, the most sensitive strains were those from Chiapas and Puebla. A biofilm forming strain was considered when their readings were equal or higher than positive control. Chiapas was the State where more positive strains were found (42% positive) followed by Puebla and Queretaro (20, 25%, respectively). Taking together theses results we observed that five of the biofilms forming strains were among most resistant strains, meanwhile, five strains with the lowest values for the biofilm formation ranked among those with greater antibiotic sensitivity. Since the bacteria are more resistant to antibiotics and disinfectants, its removal becomes more complex and can cause transient disease or irreversible damage to the consumers.

Key Words: poultry carcasses, contamination, biofilms, Escherichia coli, antimicrobial resistance

P241 Effect of bone residue inclusion and poultry species on fat oxidation in rendered meals for pet food Sara Cutler1 Kemin Industries, Des Moines, IA, USA

Chicken and turkey meal have become increasingly popular as some pet food manufacturers have successfully marketed by product meals as being a lower quality ingredient. It has been observed over the years that chicken and turkey meal are more difficult to stabilize with antioxidant than their corresponding by product meal.

Experiments were conducted to explore why turkey meal is difficult to stabilize. A bench rendering model was created and a series of experiments were performed to determine the impact of bone inclusion and poultry species used. Antioxidant treatments were used either prior to the cooking process or applied afterward or both. After cooking, the resulting meal was tested for % fat, ash and moisture and then for oxidation parameters in the oxygen bomb and for Peroxide Values (PV). The meal was then stored at room temperature and tested for PV during storage.

Results indicate that the amount of bone in the raw material has a direct impact on the generation of PV’s and the addition of chelators and/or antioxidants could not overcome this addition. This observation is important as the use of mechanically separated chicken is common and the material contains varying amounts of bone inclusion. Turkey meal showed a more rapid rate of oxidation than chicken meal when treated with antioxidants the same way. Raw material treatment with antioxidant prior to rendering in this model was essential to the meal’s preservation as the material could not be effectively stabilized with antioxidant after cooking.

Key Words: rendering, pet food, turkey meal, chicken meal, oxidation

P242 Interaction between water quality and poultry processing efficiency Ronald Holser2 Russell Research Center, Athens, GA, USA

Water quality can influence process efficiency, product quality, food safety, environmental health, and human health. Bird washing and carcass chilling operations are two stages of poultry processing where process water directly contacts the fresh poultry carcass and can become contaminated. Bacteria that remain on the fresh poultry product can lead to reduced shelf life and spoilage with risk to human health from consuming the contaminated product. Poultry processing facilities use large volumes of potable water in these operations that subsequently require treatment. The role of water quality on microbial growth was investigated in this laboratory study.

Experiments were performed with a Bioscreen system that measured the optical density of 96 well plates inoculated with bacteria in media containing added levels of common hard water ions, e.g., Calcium and Magnesium. A blocked factorial experimental design was followed with replication. Growth curves were constructed from data collected over the duration of the experiment. Growth curves were also collected from inoculated media treated with trisodium phosphate.

Results showed that water containing 500 mg/kg hard water ions was as effective as 5% treatment with trisodium phosphate in reducing bacterial growth. The type of ion was not significant. In this case hard water showed an inhibitory influence on bacterial growth. This is favorable for reducing bacteria that are present after bird washing and chilling process operations. It also suggests reduced contamination in process wastewater.

Key Words: contamination, water quality, water treatment

P243 Evaluating the correlation between water activity and percentage moisture in rendered protein meals Sarah Mathe1,2 Charles Starkey1, Cassandra Jones1 Kansas State University, Manhattan, KS, USA; 2American Proteins, Inc, Cumming, GA, USA

The rendering process is highly successful at microbial destruction, but environmental conditions of the products after cooking must be carefully controlled to prevent recontamination. Due to the expense of microbial testing, renderers and feed ingredient manufacturers may use water activity as a possible indicator for potential microbial growth. However, percentage moisture is a variable already commonly measured in rendering facilities, so it would be desirable to utilize it as an indirect measurement of water activity and potential microbial growth. Therefore, the objective of this experiment was to determine if a relationship exists between percentage moisture and water activity for rendered protein meals. As part of a survey to address this objective, both percentage moisture and water activity were measured from 7 different rendered proteins from 4 rendering plants in the southern United States over a 3 month period. Overall, percentage moisture and water activity were highly associated with both a linear ($R^2 = 0.83$) and exponential relationship ($R^2 = 0.86$). Within prod-
uct, percentage moisture was most predictive of water activity for chicken meal ($R^2 = 0.91$) and feather meal ($R^2 = 0.90$). Poultry byproduct meal was the least predictive overall ($R^2 = 0.45$), with percentage moisture and water activity being least associated in the feed grade, low ash, or regular meals ($R^2 = 0.31, 0.34, 0.45$, respectively). Interestingly, water activity and percentage moisture were highly related for the high protein poultry byproduct meal ($R^2 = 0.89$). The relationship between percentage moisture and water activity appears to be dependent upon product matrix, plant, and collection location, but not time or day of collection. Therefore, percentage moisture may be a good indicator of water activity during continuous observation within a product and facility. However, additional research is necessary to confirm the relationship between percentage moisture and incidence of microbial activity.

Key Words: microbial, moisture, protein meal, rendering, water activity

P244 Dripping test to evaluate the quality of frozen chickens' carcasses sold in northwestern São Paulo State supermarkets, Brazil

Max José Araújo Faria Junior, Carolina de Matos Figueiredo, Guilherme Pedrini Bortolatto, Iderlipes Luiz Carvalho Bossolani, Marcos Franke Pinto, Silvia Helena Venturoli Perri, Manoel Garcia Neto Faculdade de Medicina Veterinária de Araçatuba – UNESP – Univ. Estadual Paulista, Araçatuba, Brazil

Brazil occupies an outstanding position as a producer and exporter of broiler chicken meat, which demonstrates the great efficiency reached by this industry in all aspects of the productive chain. The maintenance of this position requires a constant evolution, especially in the variables that determine the quality. An important quality control parameter of poultry meat is the amount of water absorbed by the carcass during processing. In Brazil, pre-cooling of the carcasses is done by immersion in chilled water. In this process, the carcass is re-hydrated, restoring the water lost during transport and in initial slaughter operations. At this stage, some care is needed to assure the amount of water absorbed to be under the limit allowed by Brazilian law. In 2010, the Brazilian Ministry of Agriculture published a methodology for the carcass water release measurement by thawing techniques. The maximum limit for the water loss by frozen chicken carcasses, thawed under controlled conditions (dripping test), is 6.0%. The objective of this study was to evaluate by dripping test six different brands of whole frozen chickens’ carcasses commercialized in supermarkets located in Araçatuba, a northwestern São Paulo State city, comparing with broiler carcasses slaughtered at an experimental abattoir, under ideal conditions, following all the legal exigencies (control group). The data was collected using 28 carcasses (24 obtained from different supermarkets and 4 from the control group), consisting of 7 treatments with 4 repetitions each. The results were submitted to variance analyses (ANOVA) and means were compared by Duncan test ($p < 0.005$), using SAS. In control group, the mean of water lost in thawing process was 1.73% ± 0.22%. Only one of the six chickens’ brands evaluated presented a water released mean value statistically similar to the control group: 0.12% ($p > 0.05$). One brand presented 7.7% ± 1.66% of water lost during the thawing process, a result superior than the value preconized by regulatory law. The other four brands presented means ranging from 0.22% to 1.75% ($p < 0.05$). In conclusion, these outcomes suggested the need of constant official inspection to avoid the excess of water in chickens meat and the consequent damages to the consumers.

Key Words: chicken meat, dripping test, drip loss, water absorption, official inspection

P245 Dietary inclusion of docosahexaenoic acid (DHA) rich micro-algae meal on oxidative stability and water-holding capacity of broiler thigh meat during storage

Rebecca Delles', Tuoying Ao, Mike Ford, Ryan Samuel, Youling Xiong, Anthony Pescatore, Austin Cantor, Karl Dawson, Alltech, Inc., Nicholasville, KY, USA; Alltech, Inc., Lexington, KY, USA; University of Kentucky, Lexington, KY, USA

Alltech SP1 (CCAP 4087/2; Alltech, Inc.) is a natural and sustainable micro-algae meal that contains at least 16% docosahexaenoic acid (DHA). Long chain polyunsaturated fatty acids (PUFA) such as DHA have demonstrated various health benefits in humans and enhanced PUFA content of meat products is desirable. However, PUFA are highly susceptible to oxidation. Previous studies have shown that fish oil supplementation increased oxidation and decreased shelf life in fresh meat. The objective of this study was to investigate the dietary inclusion of SP1 on boneless, skinless broiler thigh meat quality when packaged under polyvinylchloride (PVC) and during retail display at 2–4 °C, for up to 7 days. Of 920 broilers that received diets supplemented with 0, 0.5, 1.0, or 2.0% SP1 for 42 d, 48 birds (4 birds from 3 pens per treatment) were selected for meat quality attributes. During the first 3 days of storage, broilers fed 0.5% SP1 had the lowest (P<0.05) level of lipid oxidation, compared with all other dietary groups. Free sulfhydrls, a measurement of protein stability, decreased in all samples throughout storage, regardless of micro-algae meal inclusion. Samples from broilers fed diets supplemented with 2.0% SP1 had the lowest amount of free sulfhydrls, most notable (P<0.05) by day 6 of storage. Gel electrophoresis revealed significant, time-dependent losses of myosin heavy chain (MHC) and concomitant formation of high molecular weight polymers for all dietary treatments, indicative of myofilbrillar deterioration and protein oxidation. Prominent losses in the MHC occurred in samples from broilers fed either 0 or 2% SP1. Water-holding capacity was similar across all dietary treatments. Dietary supplementation with up to 1.0% SP1 had similar quality attributes to control samples and did not negatively influence oxidative stability of chicken thigh meat during storage. Therefore, dietary inclusion of SP1 can provide a source of PUFA for the enrichment of meat that does not decrease shelf life of fresh meat products.

Key Words: Micro-algae, Oxidation, DHA

P246 Defeathering of broiler carcasses subjected to delayed scalding 1, 2, 4, and 8 hours after slaughter

Caitlin Harris1, Dianna Bourassa2, Kimberly Wilson1, R. Jeff Buhr2

1The University of Georgia, Athens, GA, USA; 2USDA-ARS Russell Research Center, Athens, GA, USA

With implementation of farm slaughter, scalding and defeathering could be delayed for a minimum of 2 to 4 h. This research evaluated the potential for delaying scalding and defeathering up to 8 h after slaughter. Following 12 h feed withdrawal broilers were cooped and transported to the pilot plant, batches of 10 broilers were stunned at 15 V for 10 s, and bled for 2 min. Carcasses that were held prior to scalding were transferred to stationary shackles and remained suspended by their feet. The 1st batch stunned was held for 8 h, the 2nd batch for 4 h, the 3rd batch for 2 h, the 4th batch for 1 h, and the 5th batch remained on line and was scalded and defeathered after bleeding. All batches were hard scalded at 60°C/140°F a total immersion time of 90 s (30 s in each of three tanks). The picker had been adjusted to achieve acceptable defeathering with minimal overpick.

Key Words: chicken meat, delayed scalding, defeathering, poultry byproduct meal inclusion.
in the picker. The pH recorded for breast muscle indicated a continued drop from 6.37 at 0 h, to 6.22 at 1 h, 5.98 at 2 h, 5.81 at 4 h, and 5.75 at 8 h indicating that the onset of muscle rigor had occurred between 1 and 2 h (pH 6.0) and ultimate pH values of 5.4 were not attained. These experiments reveal that carcasses subjected to delayed defathering will require modification of present scalding and picking protocols to achieve acceptable defathering of the less pliable in-rigor carcasses.

**Key Words:** delayed defathering, broiler, scalding

**P247 Reduction of Salmonella on chicken skin by the sequential application of chemical treatments and Salmonella lytic bacteriophage preparation**

Anuraj Theradiyil Sukumaran1, Chander Shekhar Sharma 1

Mississippi State University, Mississippi State, MS, USA

The objective of this study was to examine the efficacy of sequential application of chemical antimicrobials and Salmonella lytic bacteriophage preparation in reducing Salmonella on chicken skin. Chicken skin (5×5 cm) samples were inoculated with a cocktail of S. Typhimurium, S. Heidelberg and S. Enteritidis (ca. 3 log CFU/cm²). The treatments included dipping the Salmonella inoculated chicken skin samples in either 30 ppm chlorine, 0.2% cetylpyridinium chloride (CPC), 200 ppm lauric arginate (LAE), 50 and 400 ppm peracetic acid (PAA) followed by a spray application with Salmonella lytic bacteriophage preparation. Each sample was immersed in 100 ml of one of the antimicrobial solution for 20 seconds and subsequently sprayed with 0.5 ml of bacteriophage solution (10^9 PFU/ml). Chicken skin samples treated with sterile distilled water or receiving no treatments were used as controls. Samples were stored at 4°C for 24 h and Salmonella counts were enumerated after 2 and 24 h of storage on XLT4 agar plates. Duplicate skin samples were used for each treatment and each day of storage and the whole experiment was replicated three times. Salmonella counts for the positive controls were 3.4 and 3.3 log CFU/cm² on day 0 and day 1, respectively. Spray application with bacteriophage alone reduced Salmonella by 0.9-1 log CFU/cm² (P < 0.05). Immersion treatment in 30 ppm chlorine, 0.2% CPC, 200 ppm LAE, 50 and 400 ppm PAA alone reduced the Salmonella populations (P < 0.05) by 0.5-0.6, 0.6-0.7, 0.5-0.6, 0.4-0.6 and 1.5-1.7 log CFU/cm², respectively. Immersion in chemical treatments followed by phage spray revealed greater reductions in Salmonella counts as compared to individual treatments. The reductions in Salmonella counts for 30 ppm chlorine, 0.2% CPC, 200 ppm LAE, 50 and 400 ppm PAA treatments followed by phage spray were 1.6-1.8, 1.2-1.3, 0.8-1.1, 1.7-2.2 and 2.2-2.5 log CFU/cm², respectively. In conclusion, the sequential application of phage with commonly used antimicrobials during poultry processing shows significant synergic activity in reducing Salmonella on chicken skin.

**Key Words:** Salmonella, chicken skin, antimicrobials, bacteriophage

**P248 Nutritional and physical characteristics of specialty eggs**

Madalena Lordelo1, Elisabete Fernandes1, Susana Alves2, Rui Bessa2

1Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal; 2Faculdade de Medicina Veterinária, Universidade de Lisboa, Lisboa, Portugal

Consumers worldwide are increasingly concerned about the quality of commercially available chicken eggs. Often, eggs from alternative production systems are believed to have better nutritional properties. In the current study, 144 commercially available eggs were obtained from 6 different origins: free range organic with indigenous breed, free range organic, free range, cage-free, and cage with or without omega-3 essential fatty acids supplementation (n = 24). The chemical and physical characteristics of the eggs and the egg components were analyzed such as egg components weight, Haugh units, yolk color, albumen protein content, and yolk fatty acid and cholesterol content. Results indicated that the percentage of albumen in relation to the whole egg was higher (P < 0.05) in both free range organic origins. Yolk color was lighter also in eggs originated from either free range organic systems but closer to orange in eggs enriched with omega-3. Eggs from caged hens had a lower (P < 0.05) Haugh unit value in contrast with eggs from either free range organic production systems. Caged hens produced eggs with a higher protein content while free range organic hens produced eggs with the lowest level of protein in the albumen (P < 0.05). Omega-3 supplemented caged hens produced eggs with the least total saturated fatty acids (SFA) and the most omega-3 polyunsaturated fatty acids (PUFA). Eggs from caged hens that were not supplemented with omega-3 had the most monounsaturated fatty acids (MUFA) and the least PUFA (P < 0.05). No differences were found in the cholesterol content of eggs from the different origins. Choosing an egg solely on the basis of the laying hen production system may not be enough to guarantee a product with superior quality. A number of factors unknown to the consumer, other than the type of production system, such as the quality of the range and layer genotype, age and diet, may also affect egg properties.

**Key Words:** Specialty eggs, Production systems, Egg quality, Laying hen, Organic eggs

**P249 Raising ducks on water lines vs water troughs: Part 1, Effects on gut ecology and water contamination.**

Amanda Porter1, Allyson Schenk, Chelsea Campbell, Alexis Meelker, Kelly Frazier, Erin Alenciks, Susan Fraley, Gregory S. Fraley*Hope College, Holland, MI, USA

Controversy has developed over recent years as to whether or not water nipple line water delivery systems or water troughs are more appropriate for Pekin ducks in grow-out commercial barns. We hypothesized that duck cecal samples and water samples from barns utilizing a water trough delivery system would contain a larger diversity of bacteria, and contain more potentially harmful bacteria. We also hypothesized that duck health, as reflected by caecal composition, would be significantly impaired in water trough conditions compared to water lines. Ducks were divided into 4 pens per barn (n = 1000 ducks/pen), with each barn containing water lines or water troughs. Water samples were taken every three days and duck caecal samples were collected on days 5, 21, and 33 of the typical grow-out time frame. We found that ducks in water line conditions did not have significantly different caecal compositions from ducks in water trough conditions, and water sample compositions did not significantly affect duck caecal compositions in either treatment. Age was the primary driving force of caecal bacterial succession. Water sample bacterial loads from each delivery system were significantly different from one another throughout the grow-out period. The amount of bacterial diversity in water trough conditions was much higher than in water line conditions. Water troughs also contained an increased number of possibly pathogenic bacteria that may be harmful to both humans and ducks, including traces of Riemerella anatipestifer. Combined with body condition, environmental, and production data the use of water troughs when raising meat ducks may not be appropriate.

**Key Words:** gut ecology, next generation sequencing, microbiome, water contamination

**P250 Raising ducks on water lines vs water troughs: Part 2, Effects of water source on barn environment.**

Gregory S Fraley1, Allyson Schenk1, Chelsea Campbell1, Alexis Meelker1, Erin Alenciks1, Kelly Frazier1, Susan Fraley2

1Hope College, Holland, MI, USA; 2South Crossing Veterinary Center, Caledonia, MI, USA

Controversy has developed over the last few years as to whether or not water nipple lines or water troughs are more appropriate for Pekin ducks in grow out commercial barns. We hypothesized that the water line barn environment would have significantly better water conditions, including: normal pH, as well as lower nitrile, ammonia, and iron levels compared to the barns with water troughs. We also expected to see lower water usage throughout the grow-out period. The amount of bacterial diversity in water trough conditions compared to water lines. Ducks were divided into 4 pens per barn (n = 1000 ducks/pen), with each barn containing water lines or water troughs. Water samples were taken every three days and duck caecal samples were collected on days 5, 21, and 33 of the typical grow-out time frame. We found that ducks in water line conditions did not have significantly different caecal compositions from ducks in water trough conditions, and water sample compositions did not significantly affect duck caecal compositions in either treatment. Age was the primary driving force of caecal bacterial succession. Water sample bacterial loads from each delivery system were significantly different from one another throughout the grow-out period. The amount of bacterial diversity in water trough conditions was much higher than in water line conditions. Water troughs also contained an increased number of possibly pathogenic bacteria that may be harmful to both humans and ducks, including traces of Riemerella anatipestifer. Combined with body condition, environmental, and production data the use of water troughs when raising meat ducks may not be appropriate.
ducks and with recently described verandas. Ducks were divided into 4 pens per barn (n = 1000 ducks/pen). The study was repeated to give a final n = 8 per water source. Water samples were collected from the water source in each pen several times on days 8, 22, and 32 beginning after the water troughs were cleaned out each day (T = 0.15, 30, 60 min & 2, 4, 8 hours). For all data analyses, a p < 0.05 was considered significant. We tested the water condition and quality using a repeated measures ANOVA for each week. Water usage was significantly higher for each week of the experiment in the barn with water troughs compared to water lines. Ammonia levels were also found to be significantly higher in water troughs at age 21, 28, and 33. The levels of nitrates and iron were also significantly higher in the water trough barn compared to water troughs. By day 31 the pH levels in the water lines were significantly lower than the water troughs. We conclude that the use of water troughs has negative impacts on the barn environment that may ultimately affect duck and human health.

Key Words: ammonia, duck well being

P251 Raising ducks with water lines vs. water troughs: Part 2, Water troughs adversely affect duck body condition and behavior. Erin Alenciks*UG, Allyson Schenk, Chelsea Campbell, Alexis Meelker, Kelly Frazier, Amanda Porter, Susan Fraley, Gregory S Fraley Hope College, Holland, MI, USA

Controversy has developed over the last few years as to whether or not water nipple lines or water troughs are more appropriate for Pekin ducks in grow out commercial barns. We hypothesized that water troughs would show improved duck body condition compared to water lines. To test this hypothesis, we housed ducks in two barns, one with water lines and one with water troughs. Water troughs were constructed to meet RSPCA guidelines for number and density of ducks and with recently described verandas. Ducks were divided into 4 pens per barn (n = 1000 ducks/pen). The study was then repeated (n = 8 pens per water source). We scored the ducks’ body condition 3 times during the study using an established scoring rubric and analyzed using SAS Proc GLM-Mix as binomial data. We also took plasma samples from ducks housed in each barn. For all data analyses, a p < 0.05 was considered significant. Beginning at 28 days of age, ducks housed with water troughs showed significantly (p < 0.001) higher (thus worse condition) scores for eyes, nostrils, feather quality and cleanliness, and for foot pads. Furthermore, the ducks in the water trough barns had significantly higher Angiotensin II (AGII), which suggests increased thirst. The corticosterone (cort) levels, which is an indirect measure of stress, were also higher with the ducks housed in the water trough barns. These results show that the overall quality of the ducks’ appearance and health was significantly better in the pens with water lines compared to ducks raised with water troughs, furthermore we reject our hypothesis.

Key Words: Pekin Duck, Stress, Thirst

P252 Raising ducks with water lines vs. water troughs: Part 4, Water troughs significantly increase mortality and decrease production Kelly Frazier*U1, Amanda Porter, Allyson Schenk, Chelsea Campbell, Alexis Meelker, Erin Alenciks, Susan Fraley, Gregory Fraley Hope College, Holland, MI, USA

Controversy has developed over the last few years as to whether or not water nipple lines or water troughs are more appropriate for Pekin ducks in grow out commercial barns. We hypothesized that water troughs would show fewer duck mortalities compared to water lines. To test this hypothesis, we housed ducks in two barns, one with water lines and one with water troughs. Water troughs were constructed to meet RSPCA guidelines for the number and density of ducks and with recently described verandas. Ducks were divided into 4 pens per barn (n = 1000 ducks/pen). The study was repeated giving a final n = 8 pens per water source. The feed conversion ratio (FCR) and feed efficiency index (FEI) were obtained from Maple Leaf Farms, Inc. The mortality rates were recorded daily and all ducks were necropsied by technicians employed by Maple Leaf Farms, Inc. to determine the apparent cause of death. We also obtained carcass condemnation numbers from the USDA inspectors who were unaware of the treatment conditions used in this study. Data was analyzed by a Student’s T-test and a p ≤ 0.05 was considered significant. The results demonstrated that duck total mortality was significantly higher in the barn with water troughs compared to the water line barn. The average duck mortality and total culled ducks were also significantly higher in the water trough barn in weeks 3, 4, and 5. Furthermore, the total number of condemned carcasses was significantly higher in the water trough barn compared to the water line barn. The FCR did not significantly differ between the two barns, however the feed efficiency index was significantly lower for ducks raised in the water trough barn compared to the water line barn. This information should be taken into account when considering water distribution in grow out commercial barns.

Key Words: Pekin Duck, Nipple Lines, Breast Fat

P253 Relationships of eggshell, air cell, and cloacal temperatures of embryonated broiler hatching eggs during incubation Opeyemi Olojede*G1, Katie Collins1, Sharon Womack1, Patrick Gerard2, David Peebles1 1Mississippi State University, Starkville, MS, USA; 2Clemson University, Clemson, SC, USA

The relationships of eggshell, air cell, and embryo cloacal temperatures in Ross x Ross 708 broiler hatching eggs were determined. Twenty eggs were weighed and set on each of 3 levels of a single incubator. The shell temperatures of the eggs were recorded twice daily (AM & PM) between 0 and 20 d of incubation (do) using an infrared thermometer. All eggs were candled at 12 do. Subsequently, eggs containing live embryos (12 per level) were implanted with a transponder in the air cell. At 19 do, transponders were implanted in the cloaca of live embryos. Shell and air cell temperatures were recorded twice daily (AM & PM) between 12 and 19 do, and air cell and cloaca temperatures were recorded every 6 h between 19 and 21 do. Transponder and infrared thermometer readings of eggshell temperatures were previously shown not to be different. Eggshell and air cell temperature readings between 12 and 19 do were positively correlated (r = 0.42; P ≤ 0.0001). Furthermore, their respective mean temperatures were 38.6°C and 38.8°C respectively, which differed significantly (P ≤ 0.0001). Eggshell and air cell temperatures were not significantly influenced by tray level, do, or time of day. In addition, there was a significant interaction (P ≤ 0.05) between time period and transponder location (air cell and cloaca). However, across the entire 19 to 21 do interval, mean air cell (38.3°C) and cloaca (38.2°C) temperatures were not significantly different (P = 0.50) and were positively correlated (r = 0.28; P ≤ 0.01). These data suggest that air cell temperature readings are higher than those of the eggshell during the last half of incubation, and that between 12 and 19 do air cell temperature can be used as an accurate measurement of broiler embryo core body temperature.

Key Words: Broiler embryo, air cell temperature, eggshell temperature, incubation, transponders

P254 On-farm performance and electrical savings of LED lighting. Jonathan Moyle1, William Brown2 1University of Maryland Extension, Salisbury, MD, USA; 2University of Delaware Extension, Georgetown, DE, USA

Electricity is one of the largest expenses in growing poultry. This expense is increasing as electric companies continue to face increasing costs associated with generating electricity and delivering it to customers. On broiler farms, lighting can represent over 30% of the total cost of electricity when using incandescent light bulbs. Newer technology such as LED bulbs/lamps are much more efficient at producing light while using a fraction of the electricity consumed by incandescent bulbs. In order to determine the cost savings for poultry growers, an on-farm study was undertaken in Delaware. For this study, two paired houses were equipped with
electric meters that measured only the electricity used for interior house lighting. One house contained 60 watt incandescent light bulbs while the other house was equipped with 8 watt, A19 style, LED bulb/lamps. Chicks were placed at the hatchery, to insure that parent stock was the same for each house, prior to chick placement. The results of 5 flocks found no significant difference in bird weight, feed conversion or livability. Electrical savings were $1,700 per house/year ($0.12/KwH). The cost of the LED lamps used in this study was $16, resulting in an 11 month payback on lamp cost. This study demonstrated that LED lamps can be used to lower the electrical usage of poultry farms without affecting production.

Key Words: Poultry, LED, Lighting, Production, Electricity

P255 An on-farm assessment of Heavy Use Area Protection at capturing nutrients. Jonathan Moyle1, Jennifer Rhodes2 1University of Maryland Extension, Salisbury, MD, USA; 2University of Maryland Extension, Centreville, MD, USA

Poultry growers continue to work on improving their farm’s environmental footprint and one of the tools used is Heavy Use Area Protection (HUA). HUA is the establishment of a stable surface from suitable materials along with any needed structures, to protect areas heavily impacted by livestock, vehicles or development. HUAs are a Natural Resource Conservation Service (NRCS) approved practice code 561. The purposes and benefits include: reduction in runoff of nutrients and other pollutants that impact water quality, prevention of soil erosion by providing a stable surface for livestock and equipment, and maintenance and/or improvement of livestock management and health. On poultry farms, HUAs are typically concrete pads that stabilize areas that can be disturbed by heavy equipment usage during the production and rearing of poultry. These areas (typically, 148.6 m²) are located at the end doors of the poultry house, which receive heavy use during load out, clean out and placement of the birds. Additionally, areas in front of the litter storage structures and mortality composting facilities are considered HUAs. 

In order to determine the quantity of nutrients from poultry litter that is prevented from entering the local environment and water ways, all the litter left on the HUAs after loading out the birds, and managing the litter, was collected and weighed. A total of four different farms were used and the farms were visited multiple times during the year. An average of litter left on the HUAs after loading out the birds, and managing the litter, was collected and weighed. A total of four different farms were used and the farms were visited multiple times during the year. An average of 0.328 kg/m² of litter was recovered after each load out. The average nutrient content of litter sampled was: 4.02%N, 3.10%P and 3.63%K (dry basis). Therefore, in this study HUAs prevented 0.011kg/m² of Nitrogen, 0.01kg/m² of Phosphorus and 0.01kg/m² of Potassium from entering the environment per load-out/clean out.

Key Words: Poultry, Nutrients, Heavy use areas, Production area

P256 Reversion of stressed and unstressed hydrogen sulfide (H2S) producing strains of Salmonella in different media. Kellie Hogan1, Nicole Holcombe1, Cheryl Wellier1, Alora Gumm1, Matthew Postel1, Nelson Cox2, Doug Cosby2, John Cason2, Mark Berrang2, Kurt Richardson1, Peter Street1 1Anitox Corporation, Lawrenceville, GA, USA; 2USDA-ARS, Athens, GA, USA

Salmonella can be difficult to assess and isolate in poultry feed due to uneven distribution and poor growth. Previous studies have shown that several strains of Salmonella can be affected by changes in environment, resulting in the growth of H2S-negative colonies. This is concerning, as H2S production is the main way to isolate Salmonella colonies on selective media, as well as to identify the organism. The purpose of this research was to determine if incubation in selected media could revert H2S-negative colonies (yellow) to H2S-positive (black). Strains assessed were S. enteritidis, S. infantis, S. montevideo, and S. schwartzengrund. Strains were grown in non-stressed (NS) and stressed (S; dry inoculum in meat and bone meal) environments. All were added to pH 7 citrate buffer and incubated at 35°C overnight. Samples were plated on XLT4 media, grown overnight at 35°C, and then assessed for yellow colonies. Yellow colonies were then grown in several media broths overnight, including UPB, TSB, BHI, Nutrient, TT (at 35°C and 42°C) and RV. Samples were plated on XLT-4 media and the percentages of yellow and black colonies were recorded after 24 and 48 h incubation at 35°C. All S. enteritidis (S and NS) and S. schwartzengrund (NS) colonies were black and showed no H2S production loss. However, S. schwartzengrund (S) was more varied dependent on media. S. montevideo showed the most H2S reversion, with 100% reversion in all media for the (NS), and an average of 92% reversion for the (S) organism. S. infantis showed the least amount of reversion, with an average of 4% reversion for (NS) and 0% reversion overall for the (S). The results from this study suggest that while H2S production may be a useful way to confirm Salmonella in feed, pH and a temperature stressed environment can have an impact on the production of H2S, and thus, make it difficult to properly isolate or biochemically confirm the identity organism. This has major implications for analytical and food production laboratories, as it is possible that false negative results could be reported.

Key Words: Salmonella, reversion, Hydrogen sulfide, Animal feed

P258 Methodology to Compare Radiant Heater Efficiency using Spatial Modeling John Linhoss1, Jeremiah Davis2, Joseph Purswell2 1Mississippi State University, Starkville, MS, USA; 2USDA-ARS Poultry Research Unit, Starkville, MS, USA

The U.S. broiler industry spends approximately 500 million dollars annually on heating fuel. As much as 55% of the total fuel used during a single flock occurs in the first week of brooding when the highest temperatures are maintained. Thus, a 3% increase in broader efficiency could potentially save 8.25 million dollars in the first week of brooding alone. Radiant heaters are the preferred method of providing heat to chicks during brooding because they are a localized heat source that provides a range of thermal comfort options for chicks. While fuel usage during brooding constitutes one of the largest variable costs for live production, little research has been conducted to compare the efficiency of commercially available radiant heaters.

The purpose of this project was to quantify the total heat energy (BTU/hr) delivered to the floor by three low-pressure 42,202 kJ (40,000 BTU) heaters. Heat energy at the floor was measured using thin-film radiant flux sensors. Radiant flux sensors where chosen because they provide a direct measurement of heat energy at the sensor locations, and are unaffected by air movement. Radiant flux for each heater was measured at heights of 1.22, 1.52, and 1.83 m above the bedding. A total of twenty sensors were mounted on four arrays extending radially from the heater center-line. The sensors were mounted 7.6 cm above a 5-cm thick bed of pine shavings. Each heater was allowed to equilibrate before collecting data over a 5-min period. The heater was then rotated 45 degrees and the process repeated for a total of 8 sections (160 unique sampling locations, sampling density = 2 sensors/ft²). Ordinary kriging was used to spatially map radiant flux for each heater. Integration was performed on the kriging data to find the total heat energy at sensor height, which was 16,162 BTU/hr, 13,477 BTU/hr, and 14,612 BTU/hr for heaters 1, 2 and 3, respectively. An efficiency ratio was determined for each heater by dividing the total energy reaching the floor by the total energy output. The efficiency ratios were 0.45, 0.42, and 0.42 for heaters 1, 2, and 3, respectively. All data provided is for a heater height of 1.52 m.

Key Words: housing, energy efficiency, radiant heating, brooding, spatial mapping

P259 Prevalence of Vultures at Delmarva Broiler Farm Composters Lasheda Brooks1, Jon Moyle1, Bill Brown1, Brigid McCrea1 1Delaware State University, Dover, DE, USA; 2University of Maryland, College Park, Salisbury, MD, USA; 3University of Delaware, Georgetown, DE, USA

Vultures, and other animals, can breach compost piles and travel between farms potentially carrying diseases with them. This behavior places biose-
curity protocols and plans at risk. We hypothesized that the most prevalent raptor seen on a composter would be a Turkey Vulture, rather than Black Vultures, due to their olfaction capacity. In order to conduct this research, we used four game cameras to track vulture sightings.

Based on the 133 days of data, Turkey Vultures were seen for 62% (n=86) of the days; Black Vultures were seen on 15% (n=21) of the days; in 28% (n=36) of the days the species of vulture could not be distinguished; and for 21% (n=28) of the days no vultures were present. The largest groups of vultures were seen in the mornings between the hours of 6-9 am followed by the afternoon of 5-7 pm. The average number of Turkey Vultures seen in both the morning and afternoon hours was four, however, the maximum number seen was 21 and 29 birds, respectively. For Black vultures, an average of two and one birds were seen in the morning and afternoon hours, however, the maximum number seen was 21 and 28, respectively.

The maximum number of vultures seen with the game camera, regardless of species, at a farm composter was 50. Other animals captured by the game cameras include cats, eagles, dogs, and foxes. The trial is currently ongoing so that seasonal influences on the farms can be assessed.

Key Words: Vulture, composter, broiler

P265 Effect of SaniCide™-5, 5% Aqueous Stabilized Chlorine Dioxide pre-harvest feed & water treatment (5 ppm chlorine dioxide addition) on broiler chicken live performance & intestinal bacteria counts before & after the feed withdrawal period. J.L. McNaughton1, M. Roberts1, M. Barnas1, T. Amlaw2, J.L. McNaughton*, 1AHPharma, Inc., Salisbury, MD, USA; 2CRITICAL SURFACE SOLUTIONS, Albany, NY & BIOECO, Denver Co., Albany, NY, USA

SaniCide™-5 (aqueous stabilized chlorine dioxide source or SCD), in two trials, were administered via either feed 48h pre-feed withdrawal (WD) or 9h feed WD in finisher corn-soy-meat type basal diet to mixed-sex broiler chickens. SaniCide®-5 (aqueous stabilized chlorine dioxide source or SCD), in two trials, were administered via either feed 48h pre-feed withdrawal (WD) or 9h feed WD in finisher corn-soy-meat type basal diet to mixed-sex broilers at a rate of 5 ppm available chlorine & compared to a Control (feed & water) without SCD. Supplemental Escherichia coli (EC) & Salmonella spp. were administered to all test birds on 44d (prior to bird treatments) at the rate of 10^6 cfu & 50-100 colonies per bird, respectively.

Each treatment was administered to Ross 708 mixed-sex broilers (n=50/treatment), fed a finisher diet (44-46d) and reared on built-up litter. Test period began on either Trial Day 46 (Trial #1) or Trial Day 44 (Trial #2). Treatments included Control (no additive), SCD in a 9-hr feed WD period & SCD in both 48-hr feed plus 9-hr WD. Live performance (48h pre-WD, time of WD and 9h WD) and crop & small intestinal Escherichia coli (EC) & Salmonella spp. were determined 48h pre-WD, time of WD and 9h WD.

SCD did not affect live performance (body weight & feed conversion). Water consumption was reduced by 6% during the 44-46d feeding period & an additional 8% during the 9-hr feed WD. Available CI was reduced on average 16% during a 48h water feeding program & 11% during the 9-hr water administration. Crop & small intestinal content EC & Salmonella incidence (SI) levels averaged 7-logg & 100% SI for all Controls. SCD-treated birds intestinal per mL data: 5-logg & 30% for 48h FEED; 4-logg & 26% for 9-hr WATER WD (P<0.05 from control); and 3-logg & 10% for combination of FEED & WATER administration in EC & SI (P<0.05 from control), respectively. SCD appears to significantly reduce crop and intestinal Escherichia coli (EC) & Salmonella spp. in pre-harvest age broiler chickens.

Key Words: SaniCide™-5, Aqueous Stabilized Chlorine Dioxide, Escherichia coli, Salmonella spp., chicken
P269 Nutrient analysis of Mississippi broiler litter
Tom Tabler1, Ashli Brown1, Gale Hagood1, Morgan Farnell1, Chris McDaniel1, Jon Kilgore2
1Mississippi State University, Mississippi State, MS, USA; 2Mississippi Farm Bureau Federation, Jackson, MS, USA

Mississippi has ~1,900 poultry farms producing 762M broilers each year. Management of litter generated on these farms is an important environmental issue. Poultry litter, a mixture of manure, feathers and bedding material, is a valuable source of plant nutrients. The fertilizer value makes litter of interest to many farmers. However, land application of poultry litter is being closely scrutinized regarding the short- and long-term environmental impacts, especially as it relates to phosphorus (P) runoff and its potential role in accelerating eutrophication of surface waters. The objective of this study is to determine the current accurate nutrient content in Mississippi broiler litter. A study by Chambless and Todd (2002) indicated Mississippi broiler litter was 19% moisture and contained 57 pounds of nitrogen (N), 67 pounds of P as P2O5, and 59 pounds of potassium (K) as K2O. In the current study, litter samples were collected from one house on each of 210 broiler farms across Mississippi representing all 6 of the state’s broiler integrators from March-September 2014. Samples were collected across a wide range of litter ages (0 - 50 flocks of production). Sixteen random samples were taken in a zigzag pattern throughout each sampled broiler house, placed in a large plastic tub, and thoroughly mixed together. After mixing, a 1-qt subsample of the litter was collected and placed in a labeled and sealable plastic bag. Sample bags were coded so that sample analysis could be done without revealing which grower and which integrator had provided the sample. All litter samples were submitted to the Mississippi State Chemical Laboratory on the MSU campus for determination of N-P-K, moisture, pH, and water extractable phosphorus (WEP). The WEP is important because it represents a portion of the P pool that is available to runoff. Results indicate that average fresh broiler litter produced in Mississippi has a pH of 7.1, is 27% moisture, and contains 47 pounds of N, 61 pounds of K2O, 69 pounds of P2O5, and 9.2 pounds of WEP per ton. However, P2O5 in the litter is less for those growers whose integrators require a total clean out to the floor every 2 to 3 years vs. growers whose integrators do not require regular total clean outs to the floor. Growers who do not do total clean outs remove only a portion of the litter when it gets too deep and leave the rest in the house as bedding material to grow additional flocks. Results also indicate that litter amendment use decreased pH but increased lbs/ton of K2O, N, P2O5, and WEP. This information will prove valuable to governmental agencies that assist growers and other poultry litter end users in creating nutrient management plans and waste management guidelines.

Key Words: Broiler litter, Environment, Eutrophication, Phosphorus, Water extractable phosphorus

P270 Effect of in ovo vaccination of F-strain Mycoplasma gallisepticum on the survivability of commercial layer embryos and chicks
Katie Collins1, Scott Branton1, Jeff Evans2, SharonWowmack1, E. David Peebles1 1Mississippi State University, Starkville, MS, USA; 2USDA, Starkville, MS, USA

Although in ovo vaccination has proven successful for viral vaccines in broiler chickens, the applicability of this vaccination method for administering bacterial vaccines to layer chickens has not been adequately addressed. Therefore, a live Mycoplasma gallisepticum (MG) vaccine (Poulvac Myco F) was hand-injected into Hylane W-36 layer eggs from an MG clean breeder flock at 18 days of incubation (do) as a 50 μL solution of one of four different dosages to determine embryo survivability in 2 trials (316 eggs in trial 1; 2340 eggs in trial 2). The vaccine was resuspended and diluted in Poulvac Marek's diluent. Control embryos were either not injected or injected with only diluent. MG-vaccinated embryos were administered a high 1X dose from the vaccine vial, a 10^4 dilution (medium dose), 10^4 (low dose), or a 10^6 dilution (low-low dose). The vaccine was plated for viability and cfu/dose determination. Hatchability (HE) was expressed as a percentage of the number of live embryonated eggs injected at 18 doi. In trial 2, 85 chicks from each of the 6 treatments were raised in isolation units and mortality was recorded through the first 2 wk posthatch. The plated vaccine indicated that embryos in the high dose treatment received an average of 5.5 x 10^6 cfu/dose in trial 1 and 2.4 x 10^6 cfu/dose in trial 2. The HE in trials 1 and 2 in the non-injected control, diluent-injected control, low-low, low, medium, and high dosage treatments were respectively, 97.9 and 95.6%, 93.8 and 95.4%, 95.8 and 95.0%, 87.5 and 94.5%, 75.0 and 93.4%, and 60.4 and 66.5%. Although a higher HE occurred in the medium and low doses in trial 2, by 13 d of age posthatch, no control birds had died, and percentage mortalities in the treatment groups were: 1.2% diluent, 3.5% low-low, 52.4% low, 72.9% medium, and 88.2% high. Higher dosages of MG administered in ovo at 18 doi caused a dose-dependent increase in mortality in both embryos and posthatch chicks. Based on these results, the low-low dose (2.4-5.5 cfu/dose) has the highest potential for future in ovo use.

Key Words: in ovo, vaccine, Mycoplasma gallisepticum, layer, embryo

P273 The effect of Brazilian propolis on serum thyroid hormones in broilers reared under chronic heat stress
Omar Amen1, U. T. Mahmoud1, M. A. Abdel-Rahman1, M. H. A. Darwish1, T. J. Applegate2, H. W. Cheng3 1Assiut University, Assiut, Egypt; 2Purdue University, West Lafayette, IN, USA; 3USDA-ARS Livestock Behavior Research Unit, West Lafayette, IN, USA

This experiment evaluated the effect of dietary supplement with green Brazilian propolis on serum thyroxin (T4) and tri-iodothyronine (T3) levels in broiler chickens exposed to chronic heat stress for 4 wks (from 15 to 42 d of age). 502, 15-d-old, male broiler chickens (Ross 708) were randomly allocated to 6 treatments (4 pens/treatment; 21 birds/pen). The dietary treatments were basal diet (control) and 5 concentrations of propolis (100, 250, 500, 1000, and 3000 mg/kg diet, respectively). The average temperature and relative humidity during the day time was (31.7±0.3°C and 56±4) while at night was (28.8±0.4°C and 58±3) respectively. At 42 d of age, serum was collected from 12 birds in each treatment (3 birds per pen x 4 pens per group), and the thyroid hormones levels were measured by using T4 and T3 chicken ELISA commercial kits. The data were analyzed by means of SPSS 22.0 Software using the general linear models (GLM) followed by simple regression model procedure. Supplementation of broiler chickens diets with propolis did not significantly (P>0.05) affect T4 and T3 concentrations in comparison to controls. However, there were treatment effects on T3/T4 ratio. The hens fed with 250 mgkg-1 had the highest T3/T4 ratio, which was significantly increased (P=0.023) in comparison to controls. In conclusion, the results of T3/T4 ratio indicated that dietary supplement with 250 mgkg-1 green Brazilian propolis may help broiler chickens to accommodate with the heat stress condition, so further investigation is recommended.

Key Words: Broiler, propolis, heat stress, thyroid hormones

P274 Correlation of frozen cloacal swabs to cecal contamination for Campylobacter and Salmonella in young broilers
Beverly L. McClendon1, Nelson A. Cox2, Douglas E. Cosby2, Jeanna L. Wilson1 1University of Georgia, Athens, GA, USA; 2USDA-ARS, PMSPRU, Athens, GA, USA

This study is designed to investigate the correlation of Salmonella Typhimurium (ST) or a marker Campylobacter coli (CC) with freezing affecting the reliability of cloacal swabs to detect Salmonella and Campylobacter in poultry. Day-old broilers were orally inoculated with either 10^7 or 10^8 CFU non-marker Salmonella Typhimurium (ST) or a marker Campylobacter coli (CC). Following inoculation, the chicks were placed into isolation units (IU). On days 7, 10, 14 and 21 post challenge, ten (10) birds were removed and cloacally swabbed. For ST each swab was put into 5.0 ml of Buffered Peptone (BP); for CC each swab was put into 5.0 ml Teca Broth (TB). All swabs were placed into -20°C storage. After swabbing, birds were euthanized and the ceca removed aseptically. All samples were placed into
P275 Effect of pullet limestone particle size on performance and bone health of pullets and laying hens raised in deep litter systems

Pamela Eusebio-Balcazar1, Sheila Purdum1, Kathryn Hanford1, Mary Beck2

1University of Nebraska-Lincoln, Lincoln, NE, USA; 2Mississippi State University, Starkville, MS, USA

As hens are more likely to suffer bone fractures in alternative housing systems, there is a need to revise nutritional strategies to improve bone health. The objective of this trial was to evaluate the effects of limestone particle size (LPS) in pullet diets on production performance and bone health in deep litter systems. For this, 9-wk old Bovan White pullets were randomly housed in 8 floor pens (15 pullets/pen; 929 cm²/pullet). Floor pens provided perches, nest area, feeder tubes, and fountain drinkers. Pullets were fed a grower diet (9 - 15 wk) including either a fine (F) (0.431 mm) or a blend of fine and large particles (B) (0.878 mm) limestone (ILC Resources, Weeping Water, NE). For the pre lay diet (16-17 wk), 75% of limestone was either ‘F’ or ‘B’, and 25% of limestone was coarse (3.10 mm). Hens received the same layer diet from 19 to 24 wk. BW was recorded about every 4 wk. Feed intake was determined every 2 wk. Egg production was recorded daily. At 13, 16 and 24 wk of age, all birds were slaughtered to record keel bone condition. At 13, 17, 20 and 24 wk of age, a sample of 5 birds per pen were scanned to determine in-vivo bone mineral density (BMD), content and area of right tibias using dual-emission x-ray absorptiometry. Ten eggs from each floor pen were sampled to determine egg W, eggshell percentage (EP) and eggshell breaking strength (EBS) weekly from 22 to 24 wk. Data was analyzed using a randomized complete block design. BW was used as a covariate for bone characteristics.

Key Words: limestone particle size, Bone health, Eggshell
were identified using rep-PCR including: Aspergillus spp., Verticillium spp., and Eurotium spp. The results from the present study will provide a normal fungi genera under commercial conditions, relate these fungi to foodborne pathogens, and will be a stepping stone for investigating the impact of fungi on the gastrointestinal tract and overall health of poultry.

**Key Words:** Laying hen, fungal, Salmonella

**P282** In ovo DNA vaccination with cytokine adjuvants against Newcastle disease virus Robert Dunwoody1, Stivalis Cardenas-Garcia, Patti Miller, Claudio Afonso Southeast Poultry Research Laboratory, USDA-ARS, Athens, GA, USA

Newcastle Disease Virus (NDV) is one of the most economically significant burdens on poultry production globally despite stringent vaccination by most poultry producers. The current standard for NDV vaccination, the attenuated NDV LaSota virus, is lethal to chicken embryos and negatively affected by the presence of maternal antibodies. This leaves chickens vulnerable to infection by virulent field strains of NDV during their first three to four weeks after hatch. DNA vaccination has been shown to induce an immune response in the presence of maternal antibodies and does not cause disease. In ovo immunization of chickens with DNA vaccines against NDV has the potential to protect chickens from disease shortly after hatch. However, DNA vaccines typically do not elicit an immune response robust enough to confer protective immunity. Genetic adjuvants, usually a cytokine expressing plasmid, have been shown to be a simple system for improvement of DNA vaccines. Concurrent immunization with a DNA vaccine and cytokine expressing plasmid can modulate the immune response to produce higher levels of immunity. In this study, chickens were vaccinated in ovo with a DNA vaccine expressing the Fusion protein from the virulent ZJ1 strain of NDV along with different cytokine expressing plasmids for each treatment group to determine the effectiveness of in ovo vaccination with cytokines against NDV. The birds were subsequently boosted two weeks after hatch with the same treatment administered in ovo and then challenged with a lethal dose of ZJ1 four weeks after hatch. Survivability was found to be dependent on which cytokine was used as a vaccine adjuvant and varied from 53% protection to a commercially acceptable 90% protection between treatment groups.

**Key Words:** Newcastle disease, in ovo, DNA vaccine, cytokine

**P283** Behavioral observations of White Leghorn laying hens in aviary versus cage systems. Ashley Bigge1, Sheila Purdum, Pamela Eusebio-Balcazar University of Nebraska-Lincoln, Lincoln, NE, USA

A series of observations was conducted to determine if there was a significant difference in the number of pecking and comfort behaviors among laying hens in different housing systems. White Leghorn hens were observed in conventional cages and aviary style systems and daily egg production was recorded. The aviaries were divided into eight areas to include floor, feeding and nest areas, and perches. Conventional cages counted as their own areas. Observations were five minutes long for each area and behaviors were tallied. Pecking behaviors were classified into 3 categories: contact aggression (CA), no contact aggression (NCA), and gentle pecks (GP). CA included any behavior which resulted in physical contact between birds, including pecking of the skin and feather pulling. NCA included behaviors such as threatening postures and pecks that did not make physical contact, and GP was determined to be any peck that made contact, but did not cause the target of the behavior to move away or become submissive. The data were analyzed using a two tailed distribution with unequal sample variance. The number of pecks/minute was calculated and an average was determined for each whole aviary unit and cage. The hens in the cages had significantly higher percent egg production than those in the aviaries (p=0.0087). NCA was significantly higher in the aviary compared to the cages (p=0.0331), as was CA (p=0.0069). GP was not significantly different between either of the systems (p=0.3376). The amount of space available to the hens was also calculated. Floor space was determined in m2 while the lengths of the feeders and perches were measured in meters. The number of pecks/minute for each specific area of space was calculated as average pecks/minute/m2 and average pecks/minute/m. The averages for each specific area of the aviary were compared to those of the cages. Aviary areas were not compared to other aviary areas, NCA average pecks/min/area in the cages were significantly greater than all aviary areas (p<0.05), while CA and GP pecks/min/area were not significantly different (p>0.05) for all areas. Comfort behavior data was collected during the last 2 observations and included stretching, dust bathing, preening, wing flapping, and tail wagging. These data were calculated as average total behaviors/min/bird. Analysis showed that there is no significant difference in comfort behaviors between the aviaries and the cages (p=0.8434). Knowing how housing can affect behavior is important for producers in order to improve hen welfare while maintaining high production levels.

**Key Words:** laying hen, aviary, cage, pecking, aggressive behavior

**P284** Dynamics of House Sparrows (Passer domesticus) in Newcastle disease virus transmission within the avifaunal-poultry interface: An epidemiological modeling approach Andrea J. Ayala1, Claudia L. Afonso1, Timothy L. Olivier1, Krishna R. Hamal2, Diego G. Diel1, Patti J. Miller2 University of Georgia, College of Veterinary Medicine, Athens, GA, USA; 1USDA-ARS Southeast Poultry Research Laboratory, Athens, GA, USA; 2USDA-ARS Southeast Poultry Laboratory, Athens, GA, USA

As emerging and persistent pathogens increase in prevalence, the agricultural-wildlife interface has recently been identified as a field requiring further research. Acceleration of wildlife urbanization, exotic species introductions, and habitat encroachment are concomitantly disrupting species, spatial and temporal barriers once separating microbes from atypical hosts. These disintegrating host-pathogen barriers afford rapidly-evolving microbes crucial pathways to opportunistically invade and persist into novel hosts. These "spillover events", from which pathogens expand their range of susceptible species, may irrupt into epidemics with regional or population-level consequences; for example, West Nile virus in the U.S. One pathogen exhibiting fluctuating epizootics at the agricultural-wildlife intersection is Newcastle disease virus (NDV); an RNA virus representing at least 18 genotypes and numerous isolates of variable pathogenicity. A wide body of literature attests to a diverse host range inclusive of free-ranging birds and poultry species, although primarily distinguished as a poultry disease agent. Laboratory studies in conjunction with surveillance data identified hundreds of wild bird species with the potential to seroconvert and/or shed NDV to conspecifics (same species) or even among mixed-species flocks. Agricultural operations represent a unique habitat for NDV and peridomestic birds, including the ubiquitous, exotic, gregarious House Sparrow (HOSPs), which quickly adapted to anthropogenic activities providing accessible roosting and foraging sites. Serology from poultry farms and experimental data on viral shedding determined that HOSPs are not only susceptible to NDV, but may transmit the virus among conspecifics, leading to conjecture that HOSPs may serve as NDV ‘reservoirs’ to poultry; albeit true wildlife reservoirs maintain/transmit pathogens, only succumbing to disease if immuno-compromised. To address the potential bi-directionality of HOSP NDV transmission to poultry, we present a modified MSEIR (Passively Immune – Susceptible – Exposed – Infectious -Recovered) model incorporating behavior, environmental contamination, and waning immunity as covariates of disease risk. Numerical parameters such as HOSP and poultry density, contact rates, and vaccine spillover to HOSPs resulting in poultry transmission disruption will undergo simulations varying the constants for these parameters. Ultimately, the primary objective is to assess the utility of NDV vaccination and biosecurity measures identifying optimal threshold interactions of these interventions in the event of proximal NDV outbreaks.

**Key Words:** Newcastle disease virus, House Sparrows, Infectious Disease Modelling, Poultry, Intervention
P285 Gelling agent reduces chilling in commercial poultry during spray application of biologics Jacob Lumi*, Jose Luis Vicente-Salvador, Matthew Faulkner, Ross Wolfenden Pacific Vet Group USA, Fayetteville, AR, USA

Spray application of biologics in commercial poultry hatcheries is an efficient method of treating large numbers of commercial poultry due to its low labor cost, uniform application, ease of monitoring, and lack of interfering environmental factors. One drawback of this method is that poultry may become chilled when a relatively large volume of liquid is sprayed on them. Even a temporary drop in body temperature can result in increased mortality and reduced production later in a bird’s life. A gelling agent was used in a novel probiotic designed for spraying on to commercial poultry in the hatchery. It was seen that chicks sprayed with the liquid containing the gelling agent were able to recover their body temperature more quickly than chicks sprayed with either dyed water or another commonly use commercial gelling agent. After 10 min chicks sprayed with the probiotic gel were within 1° F of their starting temperature, whereas chicks treated with dyed water or the commercial gelling agent were 3° F and 9° cooler, respectively. The results suggest that the gelling agent used in the neonatal probiotic can not only reduce chilling in commercial poultry during spray application of biologics but may also aid in rapid ingestion of the probiotic, increasing its efficacy.

Key Words: spray application, gel, hatchery

P286 Can Bio-economic efficiency be affected by heat stress and early thermal conditioning? Manoel Garcia Neto*, Mayara Maia Rodrigues, Danilo Guailberto Sandre, Lidiane Fancelli Livero, Max José Araujo Faria Júnior, Marcos Franke Pinto UNESP - Univ Estadual Paulista, FMVA, Araçatuba, Brazil

The heat stress is a major factor limiting the production and lost profits of broilers, especially in the finishing phase, in tropical areas. Therefore, an experiment was conducted to evaluate, through non-linear formulation, the possible interactions between early thermal conditioning and electrolyte balance of the diet on the performance of broiler chickens, as well as studying the economic feasibility of measures to minimize the undesirable effects of chronic heat stress on the broiler through bio-economic energy conversion [BEC= (Total energy intake*Feed weighted cost per kg)/ (Weight gain*kg live chicken cost)]. A total of 640 male Cobb 500 chicks were initially raised in a battery cages in a completely randomized design. On d 8, the broilers were transferred to 32 floor pens with wood shavings as litter while maintaining the same treatments with eight replicates each, in a 2x2 factorial arrangement [with and without early thermal conditioning (ETC)] and diet with and without electrolyte balance (EB). The diet with EB was calculated as mEq/kg for Na+/K-Cl and the value the ratio (K+/Cl)/Na, with 300 mEq/kg and a ratio of 3.1, respectively. The birds were fed: (1) a traditional diet (176 mEq/kg and a ratio the 3.36:1) without ETC; (2) traditional diet with ETC; (3) diet with EB and without ETC and (4) diet with EB and ETC. Feed and water were supplied ad libitum. Half of birds were exposed to 36°C for 24h at the age of 5, whereas the remaining half was not exposed to thermal conditioning. At the age of 35 to 39 d, all chicks were thermally challenged by a chronic heat stress of 32°C for 6h. Feed intake (FI) and body weight gain (BWG) as a result of treatment (P>0.05). Insignificant differences were found in feed conversion ratio (FCR) between birds which had received NEXO (T3), GALLI (T4), +ve control (T1) or TECHNO (T5) (1.579, 1.585, 1.622 and 1.632 g: g, respectively). Conversely, birds which had received +ve control (T2) had the worst FCR as compared to all other treatments. No differences in dressing percentage, breast muscle, leg quarter, abdominal fat or livers were found. However, jujenal and ileal villus height were influenced by treatment (P<0.001). Longer jejunal villi were obtained from birds which had received SYM (716.3 μm) as compared to all other treatments. The shortest jejunal villi were obtained from birds which had received +ve control (514.8 μm). It can be concluded that GALLI or TECHNO can serve as an alternative to the AGPs in poultry feed without sacrificing the performance. It’s more effective to use these products separate and not combined.

Key Words: Antimicrobial growth promoters (AGPs), Eubiotics, Broiler’s Performance, Safer alternatives., Clostridium perfringens,

P288 Impact of high magnesium, calcium and sulphate content in drinking water on laying hens performance Dushanthi Ariyamuni*, Derek Anderson Department of Plant and Animal Sciences, Faculty of Agriculture, Dalhousie University, Truro, NS, Canada

The impact of water quality on modern layer performance has not been well studied. This study evaluated the effects of high magnesium, calcium and sulphate content in drinking water on the laying hen production performance and egg quality, using 300 Lohmann LSL-Lite white hens fed the same diet for 39 weeks in a completely randomized experiment. Five water treatments including 625 ppm magnesium sulphate (MgSO4), 1250 ppm MgSO4, 625 ppm MgSO4 plus calcium sulphate (CaSO4), 1250 ppm MgSO4 plus CaSO4 or well water (Mg-9 ppm, Ca-56 ppm and SO4-31 ppm) as the control were assigned to 33 weeks old hens and data were collected every 28 days intervals. Data were analyzed using repeated measures analysis of Proc mixed procedure in SAS and differences were considered significant at P<0.05. Feed consumption (P=0.33), hen-day egg production (P=0.12) or feed conversion ratio (P=0.08) were not affected with high levels of minerals in water. Water consumption (WC) was significantly lower in 625 ppm, 1250 ppm MgSO4, and 625 ppm MgSO4 plus CaSO4 treatment groups (P=0.001). WC of the control birds were 186±1.65 mL/bird/day while other 3 groups consumed 178±1.67 mL. The body weight of 1250 ppm MgSO4 treated hens were significantly lower than the 1250 ppm MgSO4 plus CaSO4 group (1700 g vs 1793±20.49 g).
P289 EFFECTS OF PROBIOTIC ADMINISTRATION, VIA IN OVO INOCULATION OR SPRAY PULVERIZATION, ON THE ULTRASTRUCTURE OF CECUM OF BROILERS CHALLENGED WITH SALMONELLA ENTERITIDIS Bruna Boaro Martins1,2, Ariel Antônio Mendes1, Márcia Regina Fernandes Boaro Martins1, Edina de Fátima Aguair1, Bauer Oliveira e Alvarenga2, Ivan Lee1, Rinaldo José Ortiz3 'São Paulo State University - UNESP, Botucatu, Brazil; 'BioCamp, Campinas, Brazil; 'BioCamp, Botucatu, Brazil

As an alternative to traditional growth promoters, probiotics, products based on live microorganisms or microbial products have been widely sought in the poultry industry. The term competitive exclusion, is used to describe the process by which beneficial bacteria exclude pathogens from the intestine. Although probiotics composed of complex microbial communities may lack proper characterization as to genera or species, some studies suggest these formulations can be effective in improving animal performance and reducing colonization with Salmonella or Campylobacter. Two experiments were conducted with the aim of evaluating the cecum ultrastructure of broilers at 21 d-old and probiotic efficiency against Salmonella Enteritidis. Seven-hundred-and-twenty and forty-five 1-day-old male Cobb® chicks were used for experiment I and II, respectively. Treatments were the same for both experiments. The experimental design was a completely randomized arrangement of three treatments in both experiments; there were 8 repetitions of 30 birds each for the experiment I and II, respectively. The treatments were: T1 (control) – chicks from eggs vaccinated on the 18th day of incubation against Marek disease; T2 – chicks from eggs inoculated with probiotic on the 18th day of incubation using Marek’s disease vaccine as diluent; T3 – chicks from eggs vaccinated on 18th day of incubation against Marek disease and pulzerized after selection via spray with probiotic solution. Birds were challenged with Salmonella Enteritidis via intraesophageal inoculation on 3rd day of age. At 21 days old, thirty chicks were transported to the experimental slaughterhouse of FMVZ-UNESP/Botucatu after 6 hours of fasting. Chicks were individually weighted, insensibility by electronarcosis and sacrificed by a cut in jugular vein and carotid artery. Later in each experiment, cecal segments from 5 chicks per treatment were collected, fixed in glutaraldehyde and processed according to the protocol of Center of Electronic Microscopy of IBB - UNESP. Cecal samples were analyzed through scanning electron microscopy and images were obtained. Data were submitted to analysis of variance and means compared by Tukey Test at 5% of significance using GLM procedure of SAS. There was no difference on the cecal integrity of broilers challenged or non-challenged with Salmonella Enteritidis at 21 d-old. However, the circular fold of the crypts of the cecum mucosa were more regular for broilers receiving probiotic (T2 and T3) than broilers from control group (T1), which means the preservation of enteric integrity. The probiotic addition in both ways improved the cecal mucosa integrity.

Key Words: alternative additives, competitive exclusion, in ovo nutrition

P290 Performance of Commercial Broilers as Influenced by Varying Level of Metabolizable Energy and Guar Meal Munawar Hussain1
University of Veterinary and Animal Sciences Lahore, Okara, Pakistan

Experiment was conducted to evaluate the effect of varying level of metabolizable energy and guar meal on performance of commercial broilers. Seven hundred and fifty day old male broiler chicks were used in 2x3 factorial arrangement under completely randomized design. Birds were weighed and randomly divided into six groups of five replicates (Twenty five, birds/replicate) each. Six iso-nitrogenous broiler diets were formulated using three levels of guar meal (GM), i.e., 0, 3 and 6% (GM0, GM3 and GM6, respectively) and two levels of metabolizable energy i.e., 2750 and 2650 (regular and low energy, respectively). Birds were fed experimental diets for forty two days. Energy x GM was non-significant (P>0.05) for all parameters throughout the experiment. Weight gain by the birds during 1-21 and 1-42 day were different (P<0.05) and showed quadratic responses towards GM level. Highest weight gain was recorded in birds fed diets containing 3% GM which was 3 and 4% higher than GM0 and GM6, respectively. Energy level didn’t influence weight gain and feed intake. However, feed intake and feed conversion ratio increased linearly with increasing level of GM. While, FCR was affected (P<0.05) by energy level during 1-21 and 1-42 days. Lower FCR was observed in birds fed regular energy diets and higher in low energy diets. Guar meal level affected (P<0.05) the energy and protein efficiency ratios during all phases of experiment. They increased linearly with increasing level of GM. Energy level did not affect (P>0.05) energy efficiency ratio while, protein efficiency ratio was different (P<0.05) due to energy levels during 1-21 days of age. On the basis of results, it is concluded that GM and energy levels have no interaction and inclusion of GM at 3% of the diet improves the weight gain while its higher levels can adversely affect the bird performance. However, energy level can influence the nutrient utilization efficiency only during 1-21 days of age.

Key Words: Guar Meal, Metabolizable Energy, Broiler

P291 CECAI ULTRASTRUCTURE OF BROILERS SUBMITTED TO DIFFERENT WAYS OF PROBIOTIC APPLICATION Bruna Boaro Martins1, Ariel Antônio Mendes1, Márcia Regina Fernandes Boaro Martins1, Edina de Fátima Aguair1, Bauer Oliveira e Alvarenga2, Ivan Lee1, Rinaldo José Ortiz3 'São Paulo State University - UNESP, Botucatu, Brazil; 'BioCamp, Campinas, Brazil; 'BioCamp, Botucatu, Brazil

During the evolution of modern chicken production, there have been several changes in the nutritional requirements associated with a healthy feed product. In fact, in recent years, several food additives have been applied as replacements for antibiotic growth promoters. The most recent of these additives are probiotics, probiotics and synbiotics. The aims of this study were to evaluate the enteric integrity and performance of broilers and the probiotic efficiency at the final phase of broiler breeding. Seven-hundred-and-twenty one-day-old male Cobb® chicks were distributed in the following treatments. T1 (control) – chicks from eggs vaccinated on the 18th day of incubation against Marek disease; T2 – chicks from eggs inoculated with probiotic on the 18th day of incubation using Marek’s disease vaccine as diluent; T3 – chicks from eggs vaccinated on 18th day of incubation against Marek disease and pulzerized after selection via spray with probiotic solution. The experimental design was a completely randomized arrangement of three treatments; there were 8 repetitions of 30 birds each. Performance, weight gain, feed intake, feed:gain ratio, viability and energy levels have no interaction and inclusion of GM at 3% of the diet improves the weight gain while its higher levels can adversely affect the bird performance. However, energy level can influence the nutrient utilization efficiency only during 1-21 days of age.

Key Words: Guan Meal, Metabolizable Energy, Broiler
ning electron microscopy in five birds per treatment. Data were submitted to analysis of variance and means compared by Tukey Test at 5% of significance using GLM procedure of SAS. There was no difference among treatments (p>0.05) for the parameters related to the broiler performance. As regards to enteric integrity, broilers from T2 had better crypts integrity compared to the other treatments at 42 days old; T1-broilers had crypts with irregular borders and higher distance among them. Broilers from T3 treatment showed a fusion of the mucosal crypt limits and marked misshapen crypts than broilers from T1. The probiotic addition in different ways did not affect the performance parameters, but when the administration is via in ovo inoculation can improve the cecal mucosa integrity.

Key Words: alternative additives, competitive exclusion, in ovo nutrition

P292 Effect of synthetic amino acid on the ultrastructure of broilers duodenal mucosa Márcia Regina Fernandes Boaro Martins*, Édina de Fátima Aguilar, Ariel Antonio Mendes, Bruna Boaro Martins, Rinaldo José Ortiz São Paulo State University, Botucatu, Brazil

Through its trophic action, glutamine improves the villus integrity of small intestine by providing a substrate for the enterocytes and it is also considered a nitrogen-donor for the purine and pyrimidine biosynthesis among others functions in the organism. Since glutamic acid is the precursor of glutamine it is believed that this acid can have a common via in the enterocyte, besides its importance to the maintenance. With the objective of evaluating the effect of synthetic amino acids on the measurements of enterocyte microvilli and the integrity of the duodenal mucosa of broilers at 7 and 42 days of age, 340 1-day-old male Cobb® chicks were housed in the experimental shed for 42 days. The experiment followed a completely randomized arrangement of treatments; there were 4 treatments and 5 replications of 17 birds each. Treatments: T1 – basal diet; T2 – basal diet with 1% of glutamine supplementation; T3 – basal diet with 1% of glutamic acid supplementation; T4 – basal diet with 2% of glutamine and glutamic acid supplemented in association. Duodenum segments were collected from 8 birds per treatment and then fixed in a mixture of glutaraldehyde and paraformaldehyde for transmission electron microscopy evaluation. Duodenum segments from five birds per treatment were also fixed in glutaraldehyde for scanning electron microscopy evaluation. Samples were processed according to the protocol of Center of Electronic Microscopy and then, analyzed by transmission and scanning electron microscopy. After capturing the images, the measurements of microvilli and the transversal axis between two enterocytes were obtained. Data were submitted to analysis of variance and means compared by Tukey Test at 5% of significance. The height and width of the microvilli and the transversal axis of the enterocytes of the duodenal mucosa was not influenced by treatments at 7 and 42 days of age. As regards to the duodenal mucosa integrity broilers receiving diets supplemented with 1% of glutamine and 2% of glutamine and glutamic acid in association had better villus integrity compared to broilers from the others treatment at the initial phase (7 days old). However, birds from all treatments did not show differences in the villus integrity after 42 days old. Synthetic amino acid supplementation to broilers diets acts as trophic agent on the intestinal development only in the initial phase of breeding.

Key Words: birds, enterocytes, integrity, villus

P294 Use of 25-hydroxycholecalciferol (25-(OH) D3) in diets of broilers chickens on growth performance, immunity and bone calcification Gabriela Gómez*,1, Jacqueline Vázquez*,1, Gabriela Gómez Verduzco1, Carlos López Coello1, Arturo Cortés Cuevas2, Antonio Díaz Cruz3, Ernesto Ávila González1, 1National Autonomous University of Mexico, Mexico City, Mexico; 2National Autonomous University of Mexico, CEIEPAv, Tláhuac, D.F. Mexico, Mexico City, Mexico

The aim of this study was to evaluate the dietary addition effects of vitamin D3 metabolite 25-hydroxycholecalciferol [25-(OH) D3] to different doses on growth performance and immune response of broilers in 21 days old. Broilers from 1 day-old Ross were randomly assigned to 4 treatments with 6 replicates of 8 birds each. The treatments were 1) Diet 200,000 IU / Ton, vitamin D (NRC 1994). 2) Diet 200,000 IU / Ton, vitamin D (NRC 1994) + 69 mg 25-(OH) D3 / Ton. 3) Diet with 500,000 IU / Ton, vitamin D (Ross). 3) Diet with 500,000 IU / Ton, vitamin D (Ross). The diets were based on sorghum + yellow corn and were administered ad libitum. Weekly data weight, weight gain, feed intake, feed conversion were calculated. Internal and external egg quality was evaluated during different phases of the experiment. To verified the effect of treatments on the humoral immune response, the birds were immunized at 10 days old with a Newcastle disease vaccine with a simultaneous method. Samples of blood were taken to determine antibody titers at 21 days old by hemagglutination inhibition. Also blood samples were analyzed to determine hematologic parameters. Celluar immune response was assessed on 21 day old through flow cytometry test. Left tibias were separated, to determined the percent of ash (AOAC) and bone strength with Shell Packaging equipment and finally serum25 (OH) D3 concentration was assessed by radioimmunoassay (RIA) at 21 days old. The production parameters data obtained in 21 days old were not affected by 25 times more the inclusion of the requirement of vitamin D3 or the addition of 1,25 (OH) 2D3. However, the results obtained for the immunological variables; showed (P < 0.05) than for the variable HI positive effect was obtained by including higher levels of vitamin D3 or 1,25 (OH) 2D3. Also this supplementation increased blood lymphocyte levels significantly. For erythrocytes, eosinophils and monocytes variables a significantly decreased in the number of these blood cells. Conversely the CD4 + lymphocytes levels were increased by 1,25 (OH) 2D3 group. Otherwise CD8 + lymphocytes were decreased . The IgA concentration increased (P < 0.05) with the addition of vitamin D3.
of vitamin D3 or 1,25 (OH)2D3 in the diet. Also the tibia resistance and the ash concentration were increased (P < 0.05) as 1,25 (OH)2D3 serum concentration.

**Conclusion:** The addition of 1,25 (OH)2D3 in broiler chicken diets can be a useful tool to ameliorate growth performance, immunity and bone calcification on broilers.

**Key Words:** bone calcification, growth performance, 25 hydroxycholecalciferol, immunity, broilers.

**P295 Evaluation of nutritional traits of soy protein concentrate (SPC) for broiler chicks**
Noorjan Zazai1,2, Sunday Adekun, Todd J Applegate
Purdue university, Department of Animal Science, West Lafayette, IN, USA

The objective of this study was to determine the apparent metabolizable energy (AME) of soy protein concentrate (SPC) and standardized ileal amino acid digestibility (SIAAD) of SPC and dehulled soybean meal (SBM) (each ingredient was the only source of amino acid in the semi-purified diets) in 7 and 21 d old broiler chicks. Two experiments (Exp 1 and 2) were conducted with 6 replicate cages of 20 (d 7) and 6 (d 21) birds/cage. In Exp. 1, experimental diets containing 0, 7, 14, and 21% of SPC replaced the energy contributing ingredients in the diet. Each diet contained 0.5% of chromic oxide as an indigestible marker. Excreta were collected from d 5 - 7 and d 19 - 21, frozen, and dried. In Exp. 2, two semi-purified diets were formulated to contain 20% CP and 21% of SPC. The SPC replaced the energy contributing ingredients in the diet. In Exp. 1, increasing dietary SPC had no effect on AME or nitrogen-corrected AME (AMEn) at 7 d of age. However, increasing SPC linearly improved AME (P=0.002) and AMEn (P=0.019) at 21 d. The AME and AMEn for SPC containing diets based on linear regression was 2,784 and 2,622 at 7 and 3,676 and 3,473 at 21 d, respectively. In Exp. 2, apparent N digestibility was different between ages (P<0.05) for SIAAD, where SBM digestibility increased only slightly from d 7 to 21, while digestibility of SPC increased quite remarkably. In conclusion, SPC had a much higher AME and AMEn than that published values for SBM, and SBM has a slightly higher SIAAD (%of amino acid) compared to SPC. Additionally, the efficiency of DM, N, and amino acid digestibility was substantially less at 7 versus 21 d of age. Nevertheless, SPC has considerably higher energy and amino acid density than SBM.

**Key Words:** broiler chick, metabolizable energy, soybean meal, soybean protein concentrate, standardized ileal amino acid digestibility.

**P296 Evaluation of nutritional traits of soy protein concentrate (SPC) for turkey poults**
Noorjan Zazai1, Todd J Applegate
Purdue university, Department of Animal Science, West Lafayette, IN, USA

The objective of this study was to determine the apparent metabolizable energy (AME), nitrogen corrected AME (AMEn), and standardized ileal amino acid digestibility (SIAAD) of soy protein concentrate (SPC) and dehulled soybean meal (SBM). Soy protein concentrate and SBM was the only source of CP in their respective semi-purified diets used for estimating SIAAD in 7 and 21 d-old turkey poults. Two experiments (Exp 1 and 2) were conducted with 6 replicates/diet of 20 and 6 birds/cage at d 7 and 21, respectively. The experimental diets for Exp.1 contained 0, 7, 14, and 21% of SPC. The SPC replaced the energy contributing ingredients in the diet. Each diet contained 0.5% of chromic oxide as an indigestible marker. Excreta were collected from d 5 - 7 and 19 - 21, frozen, and dried. For Exp. 2, two semi-purified diets were formulated to contain 20% CP coming from either SPC or SBM. Experimental diets were fed for 5 d (d 2 - 7 and 16 - 21) and ileal digesta were collected on d 7 and 21. In Exp. 1, increasing SPC linearly improved AME and AMEn on d 7 and 21 (P ≤ 0.028). The AME and AMEn for SPC containing diets based on linear regression was 3,385 and 3,152 at 7 and 3,666 and 3,409 on d 21, respectively. In Exp. 2, apparent DM digestibility for SPC-and SBM-based diets were not significantly different between ages (P >0.10) and diets (P=0.097). Apparent N digestibility was different between ages (P<0.05) but not different between diets (P<0.10) with no age by diet interaction. The SIAAD were not significantly different between ages and diets. Based on these results, replacing energy contributing ingredients with graded levels of SPC resulted in significant improvement in AME and AMEn on d 7 and 21 versus published values for SBM. Also, the amino acid content of SPC was well utilized by the young poult at d 7 and 21 d.

**Key Words:** metabolizable energy, soybean meal, soybean protein concentrate, standardized ileal amino acid digestibility, turkey poult.
2. Sulph 32:8:32 = ppm of Zn, Cu & Mn from Sulphates sources, respectively
3. Mintrex® 32:8:32 = ppm of Zn, Cu & Mn from Mintrex® sources, respectively
4. Mintrex® 32:30:32 = ppm of Zn, Cu & Mn from Mintrex® sources, respectively.

In general, there were no differences across treatments on live performance measurements except for FCR which improved (P<0.01) when feeding Mintrex® 32:30:32 vs. all other dietary treatments during the finisher period (28 to 35d). In general, the supplementation of (HMTBA)2-metal chelates resulted in improved flock uniformity. Carcass traits were mostly not affected by the different trace mineral treatments; whilst feeding Mintrex® 32:30:32 resulted in the greatest carcass yield (P<0.03) and carcass weight (P<0.09). Footpad health was also evaluated and the score system used, attributed a greater value to a more severe footpad lesion. Birds fed Mintrex® 32:30:32 had the lowest presence of footpad lesions at 21d of age; and the greatest percentage of feet under score 1 + 2 and the lowest incidence of scores 3+4+5 (P<0.002) at 35d. A lower average carcass scratch length and higher ileum strength were both observed from the supplementation of (HMTBA)2-metal chelates (P<0.05). The skin strength measured as force at break was found to be similar between treatments however, feeding Mintrex® resulted in lower carcass scratch incidence, lower incidence of breast lesions and greater jejunum strength (P<0.05). These results suggest that (HMTBA)2-metal chelates can be fed at lower dosages than sulphates with benefits such as optimized carcass yield, reduced footpad lesion scores, and improved skin health and increased intestine strength and improved broiler flock uniformity. The latter was observed when increasing Cu from Mintrex® from 8ppm to 30ppm. 

Key Words: Mintrex, Copper, Broilers, Footpad, skin integrity

P299 Rapid feed passage: why should we reinterpret the urease activity range in soybean meal? Nelson Ruiz Nelson Ruiz Nutrition, LLC, Savannah, GA, USA

The objective of this poster is to illustrate with data collected from the field since 1998 that the old urease activity (UA) range of 0.05-0.20 pH units to define the adequacy of soybean meal (SBM) processing needs to be changed to the new range of 0.000-0.050 pH units due to the rapid feed passage (RFP) syndrome. Rapid feed passage is defined for the purpose of this presentation as the condition observed in commercial flocks of broiler chickens in which droppings lose their normal shape, do not display the characteristic uric acid cover, contain undigested feed visible to the naked eye, have a yellowish-orange color, and frequently are watery, containing intestinal sloughing tissue. As a consequence of a rapid feed passage outbreak the litter becomes wet and slippery. Birds lack uniformity, pigmentation is poor, and although mortality is not increased, and birds do not look sick feed conversion ratio and body weights are considerably affected with the subsequent economic losses. At least 6 RFP events were observed between 1998 and 2004 in 4 different countries in South America. In all cases SBM quality was associated with the outbreak. Testing of different possible etiologies indicated that the trypsin inhibitors (TI) content of the soybean meals involved were correlated with the RFP events. A detailed account of those RFP events has been recently published (Feedsnews, Jan. 30, 2012 issue). The initial assessment of the correlation observed between TI and RFP suggested that depended on the inclusion level of SBM in the diet of broiler chickens 3.5-4.0 mg of TI per gram of SBM were correlated with RFP [Poult. Sci. 84(Suppl 1): 70, 2005]. However, since 2005 until today tens of RFP outbreaks have been observed in the field involving SBM (and full-fat soybeans) and now it is known that the optimum level of TI in SBM and full-fat soybeans is less than 2 mg/g.

The table above shows that the UA values of the different SBM lots involved in RFP outbreaks were clearly within the current UA test range of adequacy with the exception of one of the events in Colombia whose UA range was above 0.20 pH units (0.25-0.33). In other words, the 0.05-0.20 pH units range didn’t match the TI values for adequacy. It became evident that the range no longer defines adequacy of SBM processing. Since the UA test is an indirect method, the redefinition of the range has to be established measuring TI values. The proposed new range of adequacy for the UA test is 0.000 to 0.050 pH units which corresponds with a range of TI values of 1.44 to 2.33 mg/g of SBM. It is important to note that the current UA test range is what is outdated not the UA test in itself.

Key Words: Trypsin inhibitors, Urease activity, Soybean meal quality, Rapid feed passage, Broilers

P300 Sensorial evaluation of chicken meat fed with different inulin concentrations María Juárez Silva, Rocio Salas Montiel, Shalaiko Carlin Valderraban 1 INSTITUTO NACIONAL DE CIENCIAS MÉDICAS Y NUTRICION SALVADOR ZUBIRAN, Mexico City, Mexico

More and better food from animal origin to human consumption is an important issue. Leading the way in research is the development of nutritional alternatives that ensure the safety, organoleptic quality and no decrement on poultry meat productivity. Inulin (prebiotic) inclusion on the feed could be considered partially or totally on the necessity for antibiotic growth promoters, is a healthy option since it allows obtaining richer chicken meat in proteins, it lowers in fat, but with a flavor and a typical color. A total of 100 (Rose) male broilers (Gallus gallus domesticus), 1 day old, were reared on floor with pine shaving bed, were randomly grouped as the following percent inulin inclusion on the diet: T1: 0.1%, T2: 0.2%, T3: 0.4%, T4: 0.0 %, T5: commercial diet. Groups were fed under the same diet ingredients (corn-sorghum-soy) during 46 days and then sacrificed. Meat samples were taken from the treatments: leg, thigh and breast. Under the same procedure; deboned and cooked meats were evaluated using hedonic scales: 4 score levels. To each non-trained judge a questionnaire was given to assess the organoleptic attributes: appearance, color, odor and taste. The data means were analysed (Kruskal-Wallis test, P<0.05). In the appearance for breast T1 and T4 were the most accepted, T3 and T4 were for leg. No difference for thigh. In regards to color: Breast and leg T1 and T4 were different to T5 and T3. Smell without significance. On flavor: leg T1 and T4 had differences as well as for thigh T3 and T4, was not significance for breast. The replacement of antibiotic growth promoters in poultry diets by inulin inclusion is a good alternative and an innovation on broilers, by the way, if we consider diminishing the antibiotics waste by feces or urine. Plus the beneficial effects that the inulin has had on poultry reared in a healthy way, is added the acceptance of chicken meat, so we can offer to the consumer healthier food, rich and nutritious.

Key Words: Broiler, prebiotic, hedonic, sensory, inulin

P302 Digestible energy and nutrient availability of diets containing wheat distillers dried grains with solubles (DDGS) when fed to laying hens I.M Whiting1, VR Pirgozliev1, SP Rose1, A.M Mackenzie1, A.M Amerah2 1Harper Adams University, Shropshire, United Kingdom; 2Danisco Animal Nutrition, Wiltshire, United Kingdom

Wheat DDGS is the predominant by-product of the bioethanol industry in the UK. The conversion of starch to ethanol results in the remaining nutrients increasing by approximately threefold. As a result, DDGS is high in important nutrients such as protein and fat, however, a primary limitation of feeding DDGS is nutrients within it can vary between production sites. Little information is available on the variability of DDGS produced by the same production site. Therefore, the aim of the present experiment was to investigate the effect of four samples of wheat DDGS produced by a single biorefinery (Ensus Ltd, UK) on dietary digestible energy (DE) and nutrient digestibility when fed to laying hens. A total of one hundred and forty four Hy-Line brown laying hens were randomly allocated to 48 layer cages (3 birds per cage). Eight experimental wheat-soya based diets were formulated to contain either 15% or 30% of each DDGS sample, respectively. Titanium dioxide was used as an indigestible marker. The birds
received the experimental diets for eight days, from 22 weeks of age. Each diet was replicated six times in a randomised block design. At the end of the study ileal digesta were collected and pooled into one pot per cage. Data were statistically analysed by ANOVA using a 2 x 4 factorial arrangement of treatments. The main effects were the different batches used and the inclusion rate. Batch variability was observed for DE (P = 0.010), dry matter (P = 0.025), fat (P = 0.001) and nitrogen (P = 0.040) digestibility. Increasing DDGS inclusion rate from 15% to 30% improved dry matter and fat digestibility (P = 0.001) by 12 and 15%, respectively. Data from this experiment shows batches of wheat DDGS produced by the same bio-ethanol plant can vary. Data also shows that DDGS inclusion rate effects nutrient digestibility over an eight day feeding period.

Key Words: Energy, Wheat, DDGS, Layers

P303 Programmed Nutrition (PN) feeding strategy on the performance and bone quality of brown pullets Markuisha Paul1,2, Anthony Pescatore1, Touying Ao2, Lizza Macintall1, Austin Cantor1, Mike Ford2, Karl Dawson1, Altech-University of Kentucky Nutrition Research Alliance, Lexington, KY, USA

Early life nutrition has an important role in the life-long health and performance of animals. The Programmed Nutrition (PN, Alltech, Inc.) feeding strategy is a novel, nutritional program designed to improve nutrient absorption and metabolism through nutrient imprinting in early life and allow for adaptation to dietary nutrient density changes in later life. The PN strategy employs a 72 h nutrient imprinting or conditioning period starting at 1 d of age before placement on a PN diet containing antioxidiant, enzyme and organic trace mineral technologies, yet formulated to have reduced ME and nutrient (avail. P, Ca, trace mineral, and Vitamin E) content. The purpose of this study was to investigate the effects of the PN feeding strategy with and without the 72 h dietary conditioning period on the growth performance and bone breaking strength of pullets. Utilizing a completely randomized design, a total of 315, one-day old Hy-Line® Brown commercial pullets were assigned to a corn-soybean meal control diet, a PN diet without conditioning, or the PN feeding strategy (PN diet with conditioning). Seven replicate cages (15 pullets/cage) were assigned to each treatment. After 10 wks of treatment, pullets fed the PN diet without conditioning tended to have lower (P = 0.06) BW than pullets on the PN diet with conditioning or pullets fed the control diet. By 16 wks, BW of chicks fed the PN diet without conditioning was significantly lower (P = 0.03) compared with the other treatment groups. There was no difference between the control diet and the PN diet with conditioning even though there was reduced energy and nutrient content in the PN diet. No effects of treatment on FI, Feed:Gain, or bone breaking strength were observed. Based on the results from this study, the PN feeding strategy (PN diet with conditioning) enables brown pullets to adapt to a diet reduced in energy and nutrients without compromising growth performance or bone quality.

Key Words: Nutrient imprinting, Programmed Nutrition, pellet, performance, bone quality

P304 Effects of alternative feedstuffs and dietary enzyme on the performance of alternative breeds of chickens Tatijana Fisher1,2, Carla Duarte1, Carla Domingues1, Rafael Marques1, Elaine Santos1, Sarah Sgavioli1, Diana Castilblanco1, Juan Alva1, Henrique Nogueira1, Otto Junqueira1 1Faculty of Agriculture and Veterinary Sciences, Jaboticabal, Brazil; 2 Federal University of Goias, Goiânia, Brazil

This study was conducted to evaluate the replacement of corn and soybean meal (CSM) with alternative feedstuffs and dietary enzyme on the performance of straight-run commercial broilers (Cobb700) and two alternative breeds of chickens: males from a Black Sex-Link cross (BSL) and straight-run Rhode Island Reds (RIR). Each breed was fed five diets using a 3 x 5 factorial arrangement of treatments. The following isocaloric (2000 kcal AME (kg) and isonitrogenous (20% CP) diets were used: 1) CSM based diet; 2) ~30% of CSM in diet 1 replaced with field peas; 3) Diet 2 + Allzyme SSF (Alltech Inc.); 4) ~50% of CSM in diet 1 replaced with a mixture of field peas, buckwheat, and flax seed; 5) Diet 4 + Allzyme SSF. For each treatment, three replicate groups of 12 chicks were housed in floor pens at a density of 0.19 m²/bird. Diets and water were provided on an ad libitum basis. ADG, ADFI and feed:gain ratio (F:G) were monitored from 1 d of age until processing (42 d for broilers and 96 d for BSL and RIR). At processing, average BW was 1994 g for broilers, 1860 g for BSL males, and 1577 g for RIR birds. Broilers had higher (P = 0.01) overall ADG (37.5 vs. 17.6 vs. 14.9 g/bird/d) and lower (P = 0.01) F:G (2.3 vs. 4.2 vs. 4.4) compared with the BSL males and RIR birds respectively. BSL males had higher (P = 0.05) ADG (17.6 vs. 14.9 g/bird/d) and ADFI (75.8 vs. 65.4 g/bird/d) compared with RIR birds, while F:G was similar for both breeds. Replacing 30% of the CSM with field peas did not alter performance of chicks. Replacing 50% of the CSM with field peas, buckwheat and flax seed reduced (P < 0.05) ADG (21.0 vs. 24.6 g/bird/d) and increased (P < 0.05) ADFI (87.1 vs. 71.6 g/bird/d) resulting in poorer (P < 0.05) F:G (4.6 vs. 3.3). These negative effects were alleviated by adding Allzyme SSF. No breed x diet interactions were observed. In summary, broilers had better growth performance than BSL males and RIRs. For all three breeds, field peas replaced 30% of the CSM diet without reducing performance. However, a 50% replacement of CSM with field peas, buckwheat, and flax seed resulted in reduced performance that was mitigated by adding Allzyme SSF.

Key Words: Broilers, Heritage breeds, Alternative feedstuffs

P305 Breast meat quality of broilers fed diets with different levels of digestible lysine from 1 to 21 days of age Thays Quadros1, Karina Duarte1, Carla Domingues1, Rafael Marques1, Elaine Santos1, Sarah Sgavioli1, Diana Castilblanco1, Juan Alva1, Henrique Nogueira1, Otto Junqueira1 1Faculty of Agriculture and Veterinary Sciences, Jaboticabal, Brazil; 2 Federal University of Goias, Goiânia, Brazil

It is known that genetics and nutrition leads to better breast yield and meat quality in broilers. Meat yield can be increased by enhancing lysine and methionine. This experiment was conducted to evaluate the effects of different levels of digestible lysine on breast meat quality of broilers from 1 to 21 days of age. A total of 1,200 day-old male chickens (Cobb 500) were distributed in a completely randomized design with five treatments (1.125, 1.185, 1.247, 1.309, and 1.375% digestible lysine) with eight replicates of 30 chickens each. For breast meat quality evaluation 120 chickens were sacrificed by cervical dislocation at 21 d of age and evaluated for the following parameters: brightness, redness, yellowness with Minolta colorimeter, cooking loss, shear force and pH. Statistical analyzes were conducted by using SAS and when significant effects of lysine levels were detected it was concluded that breast meat yield can be increased by enhancing lysine and methionine content. It is known that genetics and nutrition leads to better breast yield and meat quality in broilers. Meat yield can be increased by enhancing lysine and methionine. It was concluded that breast meat quality level influences color of breast meat, but not in other variables.

Key Words: Digestible amino acids, meat quality, broilers, lysine, breast meat

P306 Two different oils in feeds for broiler; effects on fat digestion sugar pauld1 swine and avian research program, Nepal Agricultural Research Council Khumaltar lalitpur Nepal., Kathmandu, Nepal

The objective of present study was to investigate the digestibility of fat in the different segments of the small intestine in broiler chickens fed with two different feed containing either 4% soybean oil or 2% rapeseed oil + 2% linseed oil. Titanium oxide marker was mixed at 5 gram per kg in to both feed. T test was used for the analysis of significant of data. The feed containing soybean oil resulted in higher fat digestibility percentage (in jejunum 38.8 vs. 36.3% and the first part of ileum 85.8 vs. 74.6%) compared to the rapeseed plus linseed oil diet. Final body weight and liver weight
Samples were analyzed using Liquid Chromatography-Mass Spectrometry sourced worldwide from January to September 2014. No significant differences in the gizzard weight in two diet groups. The increased fat digestibility in jejunum and the first part of ileum might be one factor contributing to increased final body weight. Results show that small modification of diet given better results.

**Key Words:** digestibility, ileum, jejunum, fat, marker

**P307 Multi-Mycotoxin Screening in Feedstuffs**

Verena Stark1, Paula Kovalsky2, Karin Nährer3, Michael Sulyok1 1BIOMIN Holding GmbH, Austria; 2Austria, Herzogenburg, Austria; 3University of Natural Resources and Life Sciences, Vienna, Austria; Center for Analytical Chemistry, Department of Agrobiochemistry (IFA-Tulln), Vienna, Austria

Mycotoxins are a worldwide concern as they affect the quality of all kinds of commodities. As part of its mycotoxin risk management program, BioMin has been conducting a yearly Mycotoxin Survey since 2004 which provides insight into the risks caused by the main mycotoxins found in agricultural commodities such as corn, wheat, barley, and silage, as well as finished feed and others. The results presented include data from samples sourced worldwide from January to September 2014.

Samples were analyzed using Liquid Chromatography-Mass Spectrometry/Mass Spectrometry (LC-MS/MS, Spectrum 380™) screening for more than 380 mycotoxins and secondary metabolites. Limit of quantification (LOQ) level for each mycotoxin was adopted to determine positive samples. The aim of this study was to obtain information on the occurrence and contamination level of multiple mycotoxins in feed and feed raw materials samples from various regions. A total of 537 samples (raw materials like corn and wheat, as well as finished feed) were collected worldwide from the current harvest season and screened for the presence of multiple mycotoxins and other secondary metabolites using the Spectrum 380™. Figure 1 shows the number of samples found to be co-contaminated with two to 24 different mycotoxins. On average, 30 different metabolites were detected per sample. Emnodin, beauvericin and emmitins were the most common groups of mycotoxins found in over 80% of all samples. Sixty percent of the analyzed samples tested positive for DON and 75% of samples for total B-trichothecenes. The masked mycotoxin DON-3-glucoside was detected in 47% of all samples.

119 samples were also collected in South America’s main corn and soy exporting countries namely Brazil, Argentina, Paraguay, Chile and Bolivia. Fumonisins are the main concern in all South American corn at average concentrations of 2446 ppb fumonisin B1 and 994 ppb fumonisin B2. Total fumonisins were present in 72% of all corn samples at levels above 750 ppb, a concentration that poses a possible risk for poultry. Zearalenone was detected in 57% of the corn samples at average concentration of 200 ppb, a level that may pose a risk to breeders which are most sensitive to the effects of this mycoestrogenic substance.

Soy samples showed lower levels of contamination compared to corn samples. However, a total of 19 metabolites were found in more than 60% of the soy samples. These metabolites include some emerging mycotoxins such as beauvericin (present in all soy samples) and emmitins. Zearalenone was present in a high number of samples (79%).

These mycotoxin survey results clearly indicate that mycotoxins are a topic of concern in animal feed. 

**Key Words:** Mycotoxins, Corn, Soy, Latin America, Survey

**P308 Differences in gene expression of the sodium-phosphorus co-transporter 2b in the ileum and liver of turkeys on three dietary phosphorus regimens and the possibility of early life nutrient conditioning**

Shelly Nolin1, Zoe Lowman, Christopher Ashwell 1North Carolina State University Prestige Department of Poultry Science, Raleigh, NC, USA

Phosphorus (P) is an important nutrient in poultry diets, but as poultry feed is primarily composed of plants, much of the P contained in feed is in the plant storage form phytic acid, otherwise known as phytate. In order for phytate to be absorbed, enzymes known as phytases are required to break it down into bioavailable P. Non-ruminants have no means of synthesizing endogenous phytases, and as such phytates are not bio-available without the addition of dietary phytase enzymes. To insure P requirements are met, phytases as well as other forms of P are included in feeds. This approach, while beneficial to the birds, results in high levels of P in poultry litter which increases P run-off in aquatic environments, leading to levels in the ecosystem that can be detrimental and costly to fix. Research has been published supporting the possibility of early life dietary conditioning of broiler chicks to better utilize and absorb P. If this conditioning could be implemented on a production scale it would be extremely beneficial in terms of money savings on feed additives and a reduction in environmental impact. It was the objective of this experiment to see if results similar to those seen in chickens could be observed in turkeys. For this experiment, a total of 384 turkeys were donated by a commercial hatchery (Butternut, Goldsboro, NC) and placed into one of three dietary treatment groups for the 42 day experiment; 42 day control (CCC), 4 days low-25 days control-13 days low (LCL), or 29 days control-13 days low (CCL). This trial experiment allowed for the examination of the effects of low vs. control P as well as any effects of early life conditioning when changing from a control to low P diet at day 29. Birds were otherwise raised and cared for identically to avoid confounding variables. To examine differences due to diet at the transcriptional level, gene expression of the major P transporter in the gut, the sodium phosphorus co-transporter 2b (NPT2b), was measured using real time RT PCR in both ileum and liver samples from 12 birds per treatment at days 4, 29, and 42. Gene expression values, reported as threshold cycle (ct), were normalized to those of housekeeping gene GAPD and subjected to analysis of variance (ANOVA) using Statistical Analysis System program JMP® (2012; SAS, Cary, NC) at p<0.05. Significant differences in gene expression were observed between treatment groups for both tissues at days 4 and 42, suggesting differences in P absorption, and possibly utilization. More research is needed to determine the best nutritional conditions for optimal P utilization, but early life conditioning is one possible tool.

**Key Words:** Phosphorus, Gene expression, Nutritional conditioning, Poult nutrition

**P309 Measurement of fecal corticosterone metabolites in broiler reared in high stocking density and supplemented with vitamin C and tryptophan**

Monica Megumi Aoyagi1, José Roberto Sartori2, João Carlos Pinheiro Ferreira1, Rupert Palme2, Paola Gentile Serpa1, Juliana Cristiana Ramos Rezende1, Maria Márcia Pereira Sartori1, Vitor Barbosa Fascina1, Guilherme Aguiar Mateus Pasquali1, Eric Portilho Araujo1, Carla Martins Queiroz1 1Faculdade de Medicina Veterinária e Zootecnia - UNESP, Botucatu, Brazil; 2University of Veterinary Medicine, Vienna, Vienna, Austria

Aim reducing costs and improving productivity per area, high stock density is commonly used in broiler chicken operations. However, high stock density associated with high environmental temperatures lead to intense stress and adversely affects animal welfare. Use of nutritional additives such as vitamin C (VC) and tryptophan (Trp) as a form of reducing stress caused by stocking density were tested in this study. A total of 2,184 one-day male Cobb-500 chickens were assigned in a completely randomized design in a 2x5+1 factorial: (VC levels: 0 and 250 mg/kg diet × Trp levels: 100, 125, 150, 175 and 200 mg/kg diet). Results shows that p<0.05. Significant differences in gene expression were observed between treatment groups for both tissues at days 4 and 42, suggesting differences in P absorption, and possibly utilization. More research is needed to determine the best nutritional conditions for optimal P utilization, but early life conditioning is one possible tool.

**Key Words:** Phosphorus, Gene expression, Nutritional conditioning, Poult nutrition
et al., 2011) associated with high stock density, 17 birds/m² + low density control (LD): diet without VC+100% of Trp requirements and 12 birds/ m²) with 6 replicates. Source of vitamin C utilized was ascorbic acid conjugated with biopolymer (Biogenic). At 40 days of age, 36 fecal samples per treatment were collected, totaling 396 samples for measurement of fecal corticosterone metabolites (FCM) using a group-specific cortisone enzyme immunoassay (EIA). As a result, there was no interaction between VC and Trp levels on FCM (P>0.05). There was also no effect of VC and Trp levels on FCM (P>0.05). The effect of stress caused by high stocking density was detected in dosage of FCM, as observed by the difference for FCM (P<0.05) between some treatments: 100%Trp+VC (29 ng FMC/g of feces), 150%Trp (24 ng FMC/g of feces), 175%Trp+VC (27 ng FMC/g of feces) and 200%Trp (31 ng FMC/g of feces), in high density, in comparison with the LD (14 ng FCM/g of feces). Therefore, it was concluded that high stocking density negatively affects broiler chickens welfare and supplementation with VC and Trp have no effect on the stress indicator assessed.

Acknowledgments: FAPESP (Grant 2013/07281-5 and grant 2013/04524-4, São Paulo Research Foundation - FAPESP) for the financial support and Edith Klobetz Rassam for technical assistance with the EIA analysis.

Key Words: stress, ascorbic acid, amino acid, fecal sample, broiler chickens

P311 Dietary microalgae improved bone strength of pullets Tuoying Ao*, Lizza Macalintal, Marquisha Paul, Anthony Pescatore, Austin Cantor, Mike Ford, Karl Dawson Alltech-University of Kentucky Nutrition Research Alliance, Lexington, KY, USA

The incidence of leg weakness and broken bones is a serious problem in poultry industry worldwide, causing huge economic losses each year. Lipids have been shown to play an important role in skeletal metabolism and bone health. Recent research indicated that n-3 polyunsaturated fatty acids (PUFA) inhibited bone resorption and promoted bone formation, and thus increased marrow cellularity and bone strength. SP-1 (Alltech, Inc.) is derived from micro-algae and contains at least 16% of the n-3 PUFA DHA. A trial was conducted to investigate the effects of dietary supplementation of different levels of SP-1 on the development and bone quality using eight replicate groups of 16 Hy-Line W-36 pullets. Dietary treatments consisted of feeding corn-soybean meal starter and grower control diets alone or supplemented with 1.0 or 2.0% SP-1TM. Experimental diets were fed from 1 d through 17 wk of age. Feed and water were provided on an ad libitum basis. Bone samples were taken at 10 and 17 wk of age for assaying bone breaking strength, bone ash and bone mineral content. Dietary supplementation of SP-1 had no effect on BW. Feed intake of pullets fed 2% SP-1 was lower (P = 0.06) than that of those fed the control diet. Percent bone ash and bone micromineral concentrations (Mn, Zn, Fe & Cu) were not affected by dietary treatments. Tibia breaking strength sampled at 10 wk was increased (P = 0.057) by dietary supplementation of SP-1. At 17 wk, humerus breaking strength was increased by dietary supplementation of 2% SP-1 (P = 0.078). The results from this study indicate that dietary SP-1 may improve bone strength of replacement pullets.

Key Words: Chicks, Microalgae, Bone strength, Performance

P312 Exogenous xylanase improves dietary metabolisable energy and nutrient digestibility when fed to chickens waseem Mirza*, Vasil Pirgozliev*, Paul Rose1, Hadden Graham2, Mike Bedford2 1The National Institute of Poultry Husbandry, Harper Adams University, Shropshire, TF10 8NB, Shropshire, United Kingdom; 2AB Vista Feed Ingredients, Woodstock Court, Blenheim Road, Marlborough Business Park, Marlborough, Wiltshire, SN8 4AN, UK, Marlborough, United Kingdom

The experiment was conducted to investigate the effect of a novel xylanase on growth performance, dietary N-corrected apparent metabolisable energy (AMEn), nitrogen (NR) and dry matter (DMR) retention coefficients when fed to broiler chicks. Four wheat-based diets in total were offered to male Ross 308 broiler chickens from 7 to 21 days of age. Two well characterised wheat cultivar samples were used in diet formulations. Two basal diets containing 65% of each wheat cultivar sample were manufactured to be nutritionally adequate for chicks at that age (13.16 MJ/kg ME, 204 g/kg CP). The basal diets were then split on two batches and one of them was supplemented with 16 000 BXU/kg of Trichoderma reesei-derived endo-xylanase (Econase XT 25; ABVista Feed Ingredients, Marlborough, UK). Water and feed were provided ad libitum throughout the experiment. All diets were offered as mash. The treatments were allocated in a randomized complete block design with each treatment having 5 replicates. Small floor pens with 2 birds per pen. Data was analysed by ANOVA as a 2 x 2 factorial arrangement of treatments. The main effects were the two wheat cultivar samples and the enzyme supplementation (with and without). In all instances, differences were reported as significant at P < 0.05. Feeding xylanase resulted in improved (P < 0.05) AMEn, DMR and NR, compared to unsupplemented diets. Birds fed xylanase tended (P = 0.061) to consume more feed. No wheat by enzyme interactions were observed (P > 0.05). The experimental results confirm the hypothesis that exogenous xylanase may be incorporated in wheat diets to improve their feeding value for broilers.

Key Words: Xylanase, Broilers, ME, Nutrient Digestibility

P313 Defining the chick’s requirement for microminerals when provided by organic forms Tuoying Ao*, Marquisa Paul, Lizza Macalintal, Anthony Pescatore, Austin Cantor, Mike Ford, Karl Dawson Alltech-University of Kentucky Nutrition Research Alliance, Lexington, KY, USA

Levels of microminerals used in typical commercial diets are often in excess of the chick’s requirements. Recent research has shown that microminerals provided as organic sources are more bioavailable than their corresponding inorganic salts. An experiment was conducted to determine the chick’s requirement for microminerals provided as proteinates (Biplex®, Altech Inc.). Eight replicate cages of 16 replacement pullets (Hy-Line W-36), 1d of age, were randomly assigned to each of four dietary treatments for 17 week. Treatments consisted of feeding corn-soybean meal-based starter and grower diets supplemented with Cu, Mn, Fe and Zn at commercial levels (CL) in the form of inorganic salts or 20, 25 and 30% of CL in the form of proteinates. Growth performance, bone strength, micromineral concentration in bone ash and liver were assayed. Chicks supplemented with 30% CL as proteinates had higher (P<0.01) BW at 10 wk than those given other treatment diets. Humerus breaking strength of birds supplemented with the CL as inorganic salts at 10 wk was higher (P<0.05) than that of birds fed 20 or 25% CL as proteinates. Tibia and liver Mn concentrations were higher (P<0.01) for birds fed CL as inorganic salts, while tibia Zn for birds fed 20% CL as proteinate was lower (P<0.01), compared with respective values for other treatments. Liver Cu for birds given 20% CL as proteinates was lower (P<0.01) than that for birds of all other treatments, except for those fed 30% CL as proteinates. The results indicate that supplementing pullets with microminerals as proteinates at 30% of the levels of inorganic salts typically found in commercial diets can support performance and bone development.

Key Words: Chicks, Microminerals, Organic, Requirement, Proteinates

P314 Corn or sorghum diets with or without supplementation of canthaxanthin on reproductive parameters of roosters Juliana Forgariini*, Alexandre Rosa, Taína Toledo, Camila Santos, Carlos Vivas, Angélica Londero, Micheli Kuhn, Gracieli Schirmann, Vivian Lucca Federal University of Santa Maria, Santa Maria, Brazil

The experiment was carried out at Poultry Laboratory of Federal University of Santa Maria to evaluate the effects of supplementation of canthaxanthin (CTX) on com (CO) or sorghum (SO) diets on reproductive parameters of roosters. 48 males Plymouth Rock White were used from 48 to 59 weeks
of age. The males were distributed in a 2X2 factorial design, with two diets (CO or SO) and two levels of canthaxanthin (0 or 6 mg of CTX/kg of diet) totaling four treatments. It was used twelve replicates by treatment, where each male was considered a replicate. CO or SO diets were formulated according to the nutritional requirements of males. The semen was collected weekly by the method of abdominal massage, after were measured ejaculate volume (mL), motility (%) and sperm vigor. The sperm vigor was rated by score from 0-5 (0 to immobility spermatic and 5 to intense movement spermatic). Significant differences were not observed between treatments in the studied parameters. It can be concluded that sorghum may replace the corn without affecting seminal characteristics of roosters. The supplementation of canthaxanthin not contributed to improvement of reproductive roosters.

Key Words: sorghum, corn, canthaxanthin, semen

P315 Evaluation of Tartrate Resistant Acid Phosphatase & Bone Alkaline Phosphatase as blood markers for breeder hen egg production and quality. Andrew Magnuson, Niran Boonsinchai, Justina Caldas, Karen Vignale, Judy England, Craig Coon, University of Arkansas, Fayetteville, AR, USA

Broiler breeders are expected to produce a large quantity of high-quality eggs can lead to metabolic problems due to the high nutrient cost of creating them so frequently. Two enzymes involved with bone turnover, tartrate resistant acid phosphatase (TRAP) and bone alkaline phosphatase (BAP) are shown to be correlated with the activity of osteoclasts and osteoblasts respectively. A study was conducted in order to investigate the correlation between eggshell quality, bone quality of the breeders, and the concentration of TRAP and BAP in the blood for use as potential markers for breeder selection. Three hundred individually caged breeders were hens fed a standard breeder diet and their eggs were collected twice a week beginning at 30 weeks of age for four months. Eggs were measured with dual energy x-ray absorptiometry (DXA) to determine the mineral concentration of the shell. Based upon the eggshell mineral concentration the hens were divided into two groups: poor eggshell quality and good eggshell quality. The hens with the best and poorest eggshell quality were then scanned with the DXA to measure their bone quality. Blood was collected from twenty hens with the best eggshell quality and the poorest eggshell quality within thirty minutes of laying an egg in order to minimize the effect of egg laying on TRAP and BAP concentrations. The TRAP activity was significantly lower in the hens with good eggshell quality (1854 ±102 U) compared to poor eggshell quality (4794±384 U) (P > 0.022) while BAP was not significantly correlated with eggshell quality (P > 0.6934). Hens with good bone quality had significantly lower TRAP activity (1130±145 U) than poor bone hens (6320±634 U) (P > 0.013). BAP concentration was higher in good bone quality hens, but the difference was not significant (P=0.13). These findings suggest that birds with poor eggshell quality aren’t limited in the calcium necessary to synthesis the egg shell due to the abundance of TRAP mobilizing minerals from their bones, but due to being inefficient in using those minerals in the egg shell gland. Hens which are better adapted at creating egg shell have less of a demand to mobilize their bones and can focus on building bone. TRAP and BAP are shown to be correlated with the activity of osteoclasts and osteoblasts respectively. Significant differences were not observed between treatments in the studied parameters. It can be concluded that sorghum may replace the corn without affecting seminal characteristics of roosters. The supplementation of canthaxanthin not contributed to improvement of reproductive roosters.

Key Words: sorghum, corn, canthaxanthin, semen

P316 Dried Chlorella vulgaris algae as a feed ingredient for broiler chickens. Wallace Berry1, Joseph Hess2, Robert Wallace1, Auburn University Department of Poultry Science, Auburn University, AL, USA; 2Georgia Tech Research Institute, Atlanta, GA, USA

A trial was done using young broilers to test whether including dried algae (54% protein) in the feed at modest levels can produce growth and efficiency benchmarks similar to feeds using conventional feed ingredients only. Dried Chlorella vulgaris algae was formulated into a mash broiler starter feed at 2.5, 5.0 and 10% of the diet and fed to broilers to determine broiler growth and efficiency. Broilers were reared from 1-21 days of age in Petersime batteries with eight replicates per treatment and five mixed-sex broiler chicks per battery pen. Feed and water were offered ad libitum and lighting was continuous. No significant differences were recorded for body weight. Feed consumption was highest in the 2.5% algae group and similar in the other three treatments (1129 gm/bird vs 1079 gm/bird). Feed conversion efficiency was elevated in broilers fed algae, with birds fed 2.5 and 5% showing significantly higher levels (1.33 vs 1.38). Algae inclusion significantly darkened the color of the feed, so we included a subjective measure of broiler leg coloration at 21 days using a Hoescht Skin color chart that measures broiler skin coloration from 1 (lightest) to 7 (darkest). Skin color increased with increasing algae level in the diet (2.00 vs 3.50). In conclusion, Chlorella vulgaris, used as a protein source in broiler diets, will support normal growth, albeit with somewhat lower efficiency of feed utilization. In addition, Chlorella increased skin pigmentation above that found in birds fed a diet without Chlorella.

Key Words: algae, Chlorella vulgaris, broiler, live performance

P317 Evaluation of the inclusion of a thermostable xylanase in broiler corn-soy diets. Kyle Brown1, Jake Pieniazek1, Kyle Smith1, Rocky Latham1, Cody Flores1, Frances Yan2, Jonny Lyon1, Jason Lee1, Texas AM University, College Station, TX, USA; 2Novus International, St. Charles, MO, USA; 1Verenium Corporation, San Diego, CA, USA

An experiment was conducted to evaluate increasing concentrations of a thermostable xylanase (CIBENZA® XYLAVERSE®, Novus International, Inc.) on growth performance, energy digestibility, digestive organ weights, digesta dry matter (dm), and processing parameters of male broilers fed energy reduced diets. The experimental design included six dietary treatments: a corn-soy positive control (PC) diet, a negative control diet (-100 kcal/kg AME reduction) (NC), and the NC diet + xylanase at multiple levels (250, 500, 1,000, and 2,000 U/kg). Each treatment included seven replicate pens with 35 male broilers per pen. The dietary program included a starter (d 1-18), grower (d 18-35), and finisher (d 35-42). All diets were pelleted at 85°C. Broilers were weighed and feed consumption determined at the end of each dietary phase. On d 18, one broiler per replicate pen was randomly selected and necropsied, with digestive organs removed for weights and determination of digesta dm. On d 42, jejunum and ileum contents were collected from three broilers and pooled on a pen basis for the intestinal viscosity and ileal digestible energy (IDE) determination. Inclusion of xylanase at 2000 U/kg decreased (p<0.05) pancreas weights as compared to the PC and NC fed broilers. Inclusion of xylanase at 1000 U/kg reduced (p<0.05) ceca dm as compared to the PC and NC. Reduction of dietary AME increased (p<0.05) d 1-42 FCR in the NC fed broilers as compared to the PC fed broilers. Inclusion of xylanase at 250 U/kg reduced (p<0.05) cumulative FCR from d 1-42 as compared to the NC. A significant difference in IDE was observed between the PC and NC fed broilers. Inclusion of xylanase at 250, 500, and 2000 U/kg increased IDE to levels similar to the PC diet. On d 43, five birds per replicate pen were processed to determine effects of diet on processing weights and yields. No differences were observed in processing weights between the control diets and the inclusion of xylanase to the energy reduced diet; however, an increase (p<0.05) in breast meat yield was observed with the inclusion of 250 U/kg as compared to the NC diet. These data confirm the benefits of xylanase at low inclusion levels in a corn-soy diet on broiler performance, energy digestibility, and processing yield.

Key Words: broiler, xylanase, performance, energy digestibility, processing
P318 Effect of sodium heptanoate, protected sodium heptanoate and protected sodium butyrate on broiler performance, intestinal microflora and villi development Juan Jose Mallo1, Monica Puyalto2
1Norel S.A., Madrid, Spain; 2Norel S.A., Barcelona, Spain
A total of 160 one-day-old Cobb chicks were allocated at random to 4 experimental treatments (T1: control; T2: control + 98% sodium heptanoate (1 kg/t (0-21 d) and 0.5 Kg/t (22-42 d)); T3: control + 65% sodium heptanoate protected with hydrogenated palm stearine (1 kg/t (0-21 d) and 0.5 Kg/t (22-42 d)); T4: control + 70% sodium butyrate protected with PFAD sodium salt (1 kg/t (0-21 d) and 0.5 Kg/t (22-42 d))); with 4 replicates/treatment. Mash feeds and water were offered ad libitum to the animals. Body weight (BW), average daily gain (ADG), average daily feed intake (ADF) and feed conversion ratio (FCR) were recorded for the 0-21d, 21-42d and 0-42d fattening periods. At the end of each period (21 and 42 days) one chicken per replicate was euthanized and samples from the ileum and caecum were taken to analyze gut microflora by plating; besides, samples of duodenum, jejunum and ileum epitheliums were obtained in order to determine their development status by microscopy measurement. Data were analysed as a completely randomised design by GLM of SAS using average weight at day 1 as covariate. There were no statistical differences in the zootechnical parameters; however, broilers receiving T4 had higher final body weight (FBW) than T1, T2 and T3 (2,811.9 vs 2,747.9, 2,580.3 and 2,811.9; p=0.12) and better ADG (66.0 vs 64.5, 60.4 and 63.7; p=0.12). Also ADFI was numerically higher (117.6 vs 116.0, 111.1 and 112.1; p=0.12). Animals receiving heptanoate protected (T3) had better numerical performance (FCR) (p=0.12) than T1, T2 and T4 (1.76 vs. 1.81, 1.84 and 1.79). The use of these treatments didn’t produce any effect on microflora (Lactobacillus, Coliforms and E. Coli). There were differences in the intestinal development: Butyrate protected (T4) and protected sodium heptanoate (T3) increased ratio Villus/Crypt in jejunum at 42 d vs. T1 and T2 7.11* and 5.74* vs. 4.43* and 4.59* (p<0.05). It can be concluded that butyrate protected with PFAD sodium salt is able to improve GIT villi development.

Key Words: Butyrate, Heptanoate, Villi, Microorganism, Performance

P319 Tissue distribution of HSPA9/mortalin in avian species and its regulation by gender, genotype and heat stress Phuong Nguyen1, Elisabeth Greene2, Geraldine Huff2, Alissa Pickarski1, Annie Donoghue1, Nicholas Anthony1, Walter Bottje1, Sami Dridi1
1University of Arkansas, Fayetteville, AR, USA; 2USDA, Fayetteville, AR, USA
Heat shock 70kDa protein 9 (HSPA9/mortalin) is a multipotent chaperone regulating cellular processes ranging from stress response to energy homeostasis. HSPA9 has been extensively studied in mammals however one regulating cellular processes ranging from stress response to energy homeostasis. HSPA9 has been extensively studied in mammals however there is a paucity of information in avian species. The present study aimed to characterize HSPA9 gene in chicken (Gallus gallus) and Japanese quail (Coturnix japonica) and to determine its regulation by gender, genotype and heat stress.

Using Polymerase Chain Reaction (PCR), we found that HSPA9 is ubiquitously expressed in both chicken and quail. The chicken HSPA9 sequence had 66.6, 69.7, 70, 71.6 and 78% homology with mouse, human, rat, porcine, and bovine HSPA9 sequences, respectively. Phylogenetic analysis showed that chicken HSPA9 is more closely related to human and rodent orthologs. Quantitative analysis using real-time PCR showed that in female Jungle Fowl the highest amount of HSPA9 was found in the ovary followed by lung, kidney, intestine, heart, and leg muscle. Interestingly, when we profile the two genders together, female chicken exhibited high expression of HSPA9 in the brain and the ovary compared to male. However, male chickens displayed higher HSPA9 expression in the adipose tissue, the lung and the kidney compared to female.

HSPA9 expression was also determined in a quail lines divergently selected for susceptibility or resistance to restraint stress. The long term selection of these lines produced stress resistant quail (R) that have 66% lower circulating corticosterone levels compared to the stress sensitive (S) quail. The S line displayed higher HSPA9 mRNA levels in heart, gizzard and testis compared to R line. R line, however, exhibited higher HSPA9 expression in liver, lung and kidney compared to S line. Importantly, acute heat stress differently regulates hepatic HSPA9 gene expression with down regulation in R line and up regulation in S line. In conclusion, this is the first report, to our knowledge, that describes the tissue distribution and the regulation of HSPA9 in avian species. Interestingly, the HSPA9 expression seems to be line dependent in S and R quail indicating that HSPA9 may be a key differential molecular signature in stress response in these lines.

Key Words: chicken, gene expression, HSPA9, heat stress, quail

P320 Field comparison of addition of protected sodium butyrate or monobutyrin in broiler diets Juan Jose Mallo1, Enrico Gentilliani2, Monica Puyalto1
1Norel S.A., Madrid, Spain; 2OrSell S.L., Modena, Italy; 3Norel S.A., Barcelona, Spain
The benefits of the use of butyrate protected on animal health have been described in the literature, but not all protections are equally effective. In previous studies (Ortiz, 2013) broilers receiving sodium butyrate protected with sodium salt of PFAD (GUSTOR N’RGY) had higher body weight than sodium butyrate coated with vegetable fat and control without additive and the economic analysis showed an improvement in the income over feed cost vs control (+10.3%) and sodium butyrate coated (+3.6%). The aim of this study was to evaluate the effect of two sources of butyric acid (sodium butyrate protected with sodium salt of PFAD (N’RGY) and ester of butyric acid with glycerol; monobutyrin (MB)) on the production of broiler chickens in a field trial. The trial compared the performance of 19,603 broiler chickens (Ross 708), fed with the standard diet with 1.5 Kg of ester of butyric acid per ton of feed and 20,000 animals with a standard diet and 1 kg of sodium butyrate protected with PFAD per ton of feed. The males in group with N’RGY had higher body weight (+8.8%) at 28 day than animals with MB (1.708 Kg vs 1.570 Kg). The feed conversion ratio of the MB was 60 g worst than N’RGY (1.9 vs 1.84). There were differences in mortality as well, the MB group had a mortality of 0.59% at 7 day and 1.18 % at 14 day, and the N’RGY group had less mortality (0.54% at 7 day and 0.86% at 14 day). It is concluded that the use of sodium butyrate protected with PFAD on broiler feeds allows higher growth, better FCR and less mortality than the use of MB in broiler flocks.

Key Words: Butyrate, Monobutyrin, Field, Zootechnical, Mortality

P321 Neuroendocrine regulation of autophagy by leptin in chicken Peter Ishola1, Elizabeth Greene1, Walter Bottje2, Clive Mark2, Elizabeth Gilbert1, Alissa Pickarski1
1University of Arkansas, Fayetteville, AR, USA; 2Virginia polytechnic Institute and State University, Blacksburg, VA, USA
Autophagy or cellular self-digestion, a lysosomal degradation pathway that is conserved from yeast to human, plays a key role in recycling cellular constituents, including damaged organelles. It also plays a pivotal role in the adaptation of cells to a plethora of distinct stressors including starvation. Autophagy has been extensively studied in mammals and yeast, but little is known in avian species. Thus, the major objective of the present study was to determine the effects of leptin on autophagy-related genes in chicken hypothalamus. Leptin is an adipocytokine that is mostly produced by white adipose cells in mammals and functions as a hormonal sensing mechanism for fat depo-
In the present study, recombinant chicken leptin (625 pmol, 10 µL) dilute in artificial cerebrospinal fluid was injected intracerebroventricularly (ICV) in one week-old Hubbard x Cobb 500 chicks (n=10) and feed intake was recorded at 30, 60 and 180 min after injection. At the end of the experiment, hypothalami were collected, snap frozen in liquid nitrogen and kept at -80°C until total RNA were extracted. Leptin significantly reduced feed intake after 30 min compared to the control group. Real-time quantitative PCR analysis showed that central leptin administration up-regulated the hypothalamic leptin receptor gene expression (p<0.05) without affecting the POMC and NPY gene expression. Interestingly, central leptin administration increased the expression of AMPKα1, the energy sensor, indicating that leptin may alter energy status in the hypothalamus. Furthermore, leptin appeared to exert some control of autophagy in hypothalamic tissue including upregulation of beclin 1, Atg4b, Ambra1 and UVRAC more, leptin appeared to exert some control of autophagy in hypothalamic tissue including upregulation of beclin 1, Atg4b, Ambra1 and UVRAC down-regulation of Atg3, Atg4a, Atg7, and Atg10. Our results indicate that leptin plays a key role in the central regulation of autophagy and supports a novel link between metabolic control and autophagy that warrant further investigations.

Key Words: Leptin, autophagy, hypothalamus, gene expression, ICV injection

P322 Effect of enzyme complex in pellet or mash feeds with different nutritional levels on the metabolizable energy and nitrogen retention of starter broiler chickens
Bruno Carvalho*GS, Melissa Hannas, Luiz Fernando Albino, Leandro Silva, Matheus Santana, Helvio Ferreira Júnior, Horacio Santiago Rostagno Federal University of Viçosa, Viçosa, Brazil

The objective of this research was to evaluate the effect of an enzyme complex in pellet or mash feeds, with two nutritional levels, on the metabolizable energy values and nitrogen retention of broiler chickens. A total of 384 Cobb male broilers from 13 to 21 days of age were randomly assigned in 8 treatments (factorial 2³) with 6 replicates of 6 birds each. The treatments consisted of two diets with nutritional levels (NL) differing in metabolizable energy, digestible amino acids and available phosphorus (recommended for the age or reduced according to the nutritional matrix of the enzyme complex), in two feeds form (FF), with or without the enzyme complex (EC). From 1 to 13 days, the birds received the same diet, according to the genetic strain guidelines. On day 13, birds were weighed and transferred to metal cages for 4 days of adaptation to the experimental treatments. Feed intake was determined by weighing the feed before and at the end of the experiment. Excreta were collected twice a day during the experimental period, weighed, homogenized and sampled for determination of dry matter, energy and nitrogen. Data were subjected to ANOVA and compared by F test (P<0.01).

As observed in table 1, pelleting increased nitrogen intake, as well as nitrogen retention and the retention coefficient thereof, without changing the energy of the diet. Diet with reduced NL has less metabolizable energy. The EC was effective in increasing the metabolizable energy of diets in 50 kcal/kg (1.5%), as also reduced nitrogen excretion to the environment.

<table>
<thead>
<tr>
<th>Feed Form (FF)</th>
<th>AMEn (kcal/kg)</th>
<th>NI (g/bird/day)</th>
<th>NE (g/bird/day)</th>
<th>NR (g/bird/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mashed</td>
<td>3337</td>
<td>2.02*</td>
<td>0.62</td>
<td>1.40*</td>
</tr>
<tr>
<td>Pelleted</td>
<td>3347</td>
<td>2.39*</td>
<td>0.64</td>
<td>1.75*</td>
</tr>
</tbody>
</table>

Table 1: Apparent Metabolizable Energy (AMEn), Nitrogen Intake (NI), Nitrogen Excreted (NE), Nitrogen Retention (NR) in broilers fed mash or pelleted feeds, in two different nutrient levels with or without an enzyme complex.

Key Words: Enzyme Complex, Feed Form, Nutritional Level, Metabolizable Energy, Nitrogen Retention

P323 Effects of commercially available Bacillus subtilis or B. licheniformis-based probiotics used alone or in combination with an antibiotic on 0-64 d broiler performance and processing
Priscila Zorzetto*GS, Wei Zhai1, David Harrington2, Aaron Kiess1, Kelley Wamsley1
1Mississippi State University, Mississippi State, MS, USA; 2Chr. Hansen A/S, Hoersholm, Denmark

Probiotic (PRO) incorporation into commercial poultry diets has increased; however, there is still a need to determine the appropriate application of PRO. The objective of the current study was to utilize a 2 x 4 factorial arrangement with variations in Narrow Spectrum Antibiotic (AB) Inclusion (Yes or No) and Bacillus spp. PRO Inclusion (No PRO, PRO1-Bacillus subtilis, PRO2-Bacillus licheniformis or PRO3-Bacillus subtilis and B. licheniformis) and determine their effects on 0-64 d broiler live performance as well as d 49 and 64 processing characteristics. Basal diets were formulated to contain corn and soybean meal as well as a meat and bone meal blend and varied only in AB and PRO inclusion. On d of hatch, 2112 male Ross x Ross 708 chicks were obtained from a commercial hatchery and randomly assigned to 96 pens containing used litter (22 chicks per pen, 0.91 x 1.2 m each, 12 blocks total). On d 0, 14, 28, 49, and 64, ileal and cecal contents and tissues were sampled from the same four blocks; samples were preserved for future analysis. Live performance data demonstrated some benefit of PRO2 inclusion into diets in terms of improved d 28 BW as compared to birds fed diets containing No PRO or PRO3 (P=0.056); however, benefit was lost at 48 and 63 d (P=0.05). Inclusion of AB decreased d 0-14 FCR by approximately 2 points (P=0.008) and tended to improve d 0-63 FCR by 4 points (P=0.06). For d 49 processing data, benefit was established for AB for the following yield variables (relative to d 48 BW): carcass, tender, drum, thigh, and wing (P=0.02, 0.001, 0.003, and 0.047, respectively). In addition, birds fed diets containing PRO3 had increased wing yield (relative to d 49 carcass weight) but were similar to birds fed diets containing PRO1 (P=0.008). Also, relative to d 64 carcass weight, birds fed diets containing PRO1 and PRO3 revealed the highest tender yield (P=0.024). In conclusion, these data demonstrated some benefit for AB and PRO; however, efficacy of their combined use is unclear. Ileal and cecal sampling may provide an explanation for improved early PRO2 performance and provide useful information to industry on PRO and AB effects on pathogenic bacterial populations at processing (49 and 64 d).

Key Words: probiotics, antibiotics, Bacillus, broiler performance, processing

<table>
<thead>
<tr>
<th>Enzyme Complex (EC)</th>
<th>Reduced</th>
<th>3308a</th>
<th>2.17</th>
<th>0.65</th>
<th>1.54</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF</td>
<td>0.458</td>
<td>&lt;0.001</td>
<td>0.173</td>
<td>&gt;0.001</td>
<td></td>
</tr>
<tr>
<td>NL</td>
<td>&gt;0.001</td>
<td>0.203</td>
<td>0.117</td>
<td>0.482</td>
<td></td>
</tr>
<tr>
<td>FF x NL</td>
<td>0.002</td>
<td>0.839</td>
<td>0.030</td>
<td>0.517</td>
<td></td>
</tr>
<tr>
<td>FF x EC</td>
<td>0.760</td>
<td>0.353</td>
<td>0.023</td>
<td>0.055</td>
<td></td>
</tr>
<tr>
<td>NL x EC</td>
<td>0.934</td>
<td>0.004</td>
<td>&gt;0.001</td>
<td>0.175</td>
<td></td>
</tr>
<tr>
<td>FF x NL x EC</td>
<td>0.021</td>
<td>0.946</td>
<td>0.341</td>
<td>0.788</td>
<td></td>
</tr>
</tbody>
</table>
| a, b - Means followed by different letters in the same column are different from each other by F test (P<0.01).

Key Words: Enzyme Complex, Feed Form, Nutritional Level, Metabolizable Energy, Nitrogen Retention
**P324** Antioxidants properties of bixin added to broiler diets and the effects on thighs meat
José Roberto Sartori1, Fabiana Golin Luiggi1, Ricardo Fasanaro1, Marcia Maria Pereira Sartori2, Priscila Cavalea de Araújo1, Monica Megumi Aoyagi1, Ivan Mailinch Gonçalves Pereira de Souza1, Vanessa Cristina Felicita1, Aline Mondini Calil Racoanci1
1Faculdade de Medicina Veterinária e Zootecnia - UNESP, Botucatu, Brazil; 2Faculdade de Ciências Agronômicas - UNESP, Botucatu, Brazil; "Universidade de Brasilia - UnB, Brasilia, Brazil

The bixin is a carotenoid present in annatto seeds, an effective biological suppressor of reactive molecules of singlet oxygen and an inhibitor of lipid peroxidation. Moreover, it is known that the dose can influence the pro-oxidant activity of carotenoids. Thus, an experiment was conducted with 1,000 male Ross 308 broilers with one day of age. The experimental design was completely randomized as a factorial 3 x 2 + 2 with eight treatments and five replicates (25 birds each). Treatments consisted of: T1 = basal diet (BD) + fresh soybean oil; T2 = BD + oxidized soybean oil; T3 = BD + 0.05% of bixin and fresh soybean oil; T4 = BD + 0.05% of bixin and oxidized soybean oil; T5 = BD + 0.10% of bixin and fresh soybean oil; T6 = BD + 0.10% of bixin and oxidized soybean oil; T7 = BD + fresh soybean oil + BHT (control 1) and T8 = BD + oxidized soybean oil + BHT (control 2). Birds were slaughtered at 42 d-old. Boneless samples of breast were collected and kept frozen at -20 °C. The compounds of rancidity were quantified by thiobarbituric acid reacting substances (µmol of MDA/kg of meat). Data were analyzed by ANOVA, complemented by Tukey test (α = 5%) using Minitab 16®. To compare the means of the controls with the factorial the Dunnet test (α = 5%) was used. For the cooked thigh meat the oxidation was controlled as the inclusion of bixin was increased (T1 = 11.05; T2 = 12.03; T3 = 10.17; T4 = 9.93; T5 = 7.33; T6 = 6.03). However, the BHT was more effective to control the oxidation (T7 = 4.41; T8 = 3.60). After 7 days of cold storage (4 °C), between the factorial means, the lowest level of oxidation was observed from T1 (59.24), T2 (62.08) and T6 (51.84). Despite do not have statistically significant difference when compared to T1 (59.24), T2 (62.08) and T4 (63.70), T3 (67.16) and T5 (66.82) had the highest levels of oxidation, which can be explained by the pro-oxidant action of the carotenoid, since the use of fresh oil was not sufficiently challenging, resulting in excessive available bixin. After 10 days of cold storage, the T6 (101.83) showed the highest level of oxidation, probably due to the depletion of the antioxidant capacity of bixin against the high concentration of free radicals. The best control of oxidation after 10 days of storage was observed on T7 (81.24), that did not differ from T4 (88.01). We can conclude that bixin can be used as an antioxidant, but optimal levels of inclusion need to be established, so that the carotenoid will not act as a pro-oxidant agent.

Acknowledgments: To FAPESP - São Paulo Research Foundation for the research funding granted (Process 2012/05415-1).

**Key Words:** antioxidant, bixin, carotenoid, prooxidant, broiler

**P325** Digestible valine for pullets W-36 from 13 to 17 weeks
Fernando Perazzo Costa1, Cristina Lima1, Eduaro Nogueira2, Danilo Cavalcante1, Edgar Ishikawa2, Gabriel Pessoa2, Matheus Lima1
1Federal University of Paraíba, Areia, Brazil; 2Ajinomoto do Brasil, São Paulo, Brazil; 1Federal University of the South of Bahia, Teixeira de Freitas, Brazil

Digestible valine is an important amino acid in egg production, especially in best balancing of feed, which provides a better protein synthesis, which in previous egg production stage, means a better bird formed in the tissues and greater efficiency production of larger eggs for longer time. Although it is known that importance, little is evaluating the recommendations in the stages of growth of these birds. It’s aimed to evaluate the ideal requirement digestible valine (dVal) to pullets’ W-36 from 13 to 15 and from 16 to 17 weeks of age. A total of 432 birds were distributed in six treatments with six replicates of 12 birds each. In stage 13-15 weeks, the levels of dVal used were 0.490, 0.559, 0.610, 0.670, 0.730 and 0.790%, and in the stage 16-17 weeks 0.540, 0.600, 0.660, 0.720, 0.780 and 0.840% of dVal. Levels of 0.610 and 0.660% of dVal are recommended by the management guide of the strain. The other nutrient levels were attended in accordance with the recommendations of the Brazilian Tables for Poultry and Swine (2011). In the phase 13-15 weeks it was found significant effect of dVal levels on WG (P<0.002), (WG = 0.503dVal² + 1291.7dVal – 216.9; R²=0.87), and FCR (P<0.04), (FCR= 22.93dVal – 30.62dVal + 14.452; R²=0.83), being determined optimal levels of 0.679 and 0.666% digestible valine to such variables, respectively. In the phase 16-17 weeks, there was no significant (P>0.05) effect of dVal levels for any variables, indicating that the lower level studied here was sufficient for the nutritional requirements of the birds in this phase. Thus, it is recommended a diet with 0.679% and 0.540% of digestible valine for pullets W-36 from 13 to 15 and from 16 to 17 weeks of age, respectively.

**Key Words:** Ideal protein, Poultry farm, Poultry replacement

**P326** The use of bixin as a natural antioxidant added to broiler diets and the effects on breast meat oxidation
Fabiana Golin Luiggi1, Ricardo Fasanaro1, Vitor Barbosa Fascina1, Marcia Maria Pereira Sartori2, Aline Mondini Calil Racoanci1, Everton Moreno Muro1, Natani Cruz Alexandre1, Ana Cristina Stradiotti1, José Roberto Sartori1 1Faculdade de Medicina Veterinária e Zootecnia - UNESP, Botucatu, Brazil; 2Faculdade de Ciências Agronômicas - UNESP, Botucatu, Brazil; "Universidade de Brasilia - UnB, Brasilia, Brazil

Considering the growing need of natural alternatives that can be used as antioxidants, studies have been done evaluating plant extracts and other compounds. The bixin is a carotenoid present in annatto seeds, cited as one of the most effective biological suppressors of reactive molecules of singlet oxygen and an effective inhibitor of lipid peroxidation. It is important to know that carotenoids can act as a pro-oxidant agent at high concentrations. Thus, an experiment was conducted with 1,000 male Ross 308 broilers with one day of age. The experimental design was completely randomized as a factorial 3 x 2 + 2 with eight treatments and five replicates (25 birds each). Treatments consisted of: T1 = basal diet (BD) + fresh soybean oil; T2 = BD + oxidized soybean oil; T3 = BD + 0.05% of bixin and fresh soybean oil; T4 = BD + 0.05% of bixin and oxidized soybean oil; T5 = BD + 0.10% of bixin and fresh soybean oil; T6 = BD + 0.10% of bixin and oxidized soybean oil; T7 = BD + fresh soybean oil + BHT (control 1) and T8 = BD + oxidized soybean oil + BHT (control 2). Birds were slaughtered at 42 d-old. Boneless samples of breast were collected and kept frozen at -20 °C. The compounds of rancidity were quantified by thiobarbituric acid reacting substances (µmol of MDA/kg of meat). Data were analyzed by ANOVA, complemented by Tukey test (α = 5%) using Minitab 16®. To compare the means of the controls with the factorial the Dunnet test (α = 5%) was used. For uncooked breast meat no difference was observed between T3 (0.62) and T7 (0.57), indicating the antioxidant potential of bixin. However, when the oil used was oxidized, bixin was not able to control with similar efficiency (T4 = 0.77; T8 = 0.61). Higher results shown by T5 (0.76) and T6 (0.77) can be due a pro-oxidant activity caused by the excess of bixin. After the heat treatment of meat, it has been found that to the diets with fresh oil, T5 (2.79) had controlled the oxidation as well as T7 (2.82), again showing that bixin can be an antioxidant, but we still have to define the best level to be used, paying attention in the level of oxidant challenge and in the possible action as pro-oxidant agent from the carotenoid. After 10 days of cold storage (4°C) T3 and T4 with 0.05% of bixin had shown the best results (44.91 and 41.08, respectively), followed by T7 (50.51) and T8 (56.22), with BHT. The results showed that the bixin can be considered an alternative to the synthetic antioxidant, but more studies may provide better addition levels, sources and storage period are still needed.

Acknowledgments: To FAPESP - São Paulo Research Foundation for the scholarship granted (Process 2011/23731-5).

**Key Words:** annatto seeds, antioxidant, breast meat, carotenoid, TBARS
The present study was conducted to determine the effect of dietary nutrient density on the morphometric structure of breast muscle fiber of broiler on various degrees of white striping. The Pectoralis major muscle in 10 to 40 d-old white striping (WS) broilers has been gaining increasing importance, as is the case with white striping myopathy. With increasing growth rates and the size of the muscles, the incidence of muscle disorders in broilers has been gaining increasing importance, as is the case with white striping myopathy is characterized by the appearance of various degrees of whitish streaks on the surface Pectoralis major muscle of broilers which follow the direction of the muscle fiber and increase with the age of the animal.

**Key Words:** Broilers, miopathy, muscle injury, muscle fiber, poultry

**P329 Use of L-Thr and L-Val in diet for male broilers**

Fernando Perazzo Costa1, Gabriel Pessoa2, Eduardo Nogueira2, Edgar Ishikawa2, Matheus Lima1, Federal University of Paraíba, Areia, Brazil; 2Ajinomoto do Brasil, São Paulo, Brazil; 1Federal University of the South of Bahia, Teixeira de Freitas, Brazil

This study was developed to evaluate the supplementation of L-Threonine, the variation in the Thr:Lys ratio and the use of L-Valine in diets for male broilers from 1 to 42 days old. A total of 1,200 male broilers COBB with a day old were distributed in four treatments with 15 replicates and 20 birds per experimental unit in a completely randomized design. The experimental diets were formulated according to the recommendations in the Brazilian Tables for Poultry and Swine 2011, except for Thr:Lys ratio. The diet of treatment 1 was formulated considering the recommendation but without the use of L-Thr and Thr:Lys ratio of 60%; Treatment 2 was formulated as treatment 1, but with L-Thr supplementation and Thr:Lys ratio increased to 65%; the Treatment 3 was formulated such as treatment 2, but with Thr:Lys ratio increased to 70%; the treatment 4 was formulated such as Treatment 3, but also supplementing L-Valine. Considering the total evaluated period (1-42 days) the FI, WG and FCR were influenced by treatments. The broilers of treatment 1 (without L-Thr supplementation) had the lowest FI (P=0.007), the lowest WG (P<0.0001) and the worse FCR (P=0.0085) compared to the other treatments. The increase in the Thr:Lys ratio from 65 to 70 resulted in significant improvement in FI and numerical in WG and FCR. The use of L-Val in diets with Thr: Lys ratio of 70 provided a significant improvement in WG (3277.39 vs 3315.43), although in FCR this improvement was only numerical (1.65 vs 1.63). The inclusion of L-Thr in treatment 2 adjusted the Thr:Lys ratio to 65% and corrected the deficiency of the treatment 1, resulting in significantly WG improvement. Increasing the Thr:Lys ratio to 70% numerically improved the WG compared to the treatment 2. The best result was with the use of L-Val in treatment 4, that shows a significant higher WG compared to other treatments. Thus, it can be concluded that current diets for broilers should not be formulated without the use of L-Thr; the Thr:Lys ratio of 70% resulted in better performance than the ratio in 65%; and the use of L-Val increased the performance of broilers fed diets with L-Thr with Thr:Lys ratio of 70%.

**Key Words:** Ideal protein, Poultry efficiency, Poultry farm

**P330 Effects of dietary addition of Actigen® on the performance and immune cell concentration of broiler chicks challenged with lipopolysaccharide**

Lizza Macalintal1, Tuoying Ao1, Anthony Pescatore2, Austin Cantor2, Michael Ford2, Karl Dawson1, Alltech, Inc., Nicholasville, KY, USA; 2University of Kentucky, Lexington, KY, USA

Mannan-oligosaccharides derived from *Saccharomyces cerevisiae* cell wall have been found to promote growth and enhance immune responses in food animals. *Actigen*, a yeast cell wall derived product, was added at 400g/T to evaluate its effect on growth performance and immune response in broiler chicks challenged with lipopolysaccharide (LPS). Lipopolysaccharide is a component of the outer cell wall membrane of gram-negative bacteria that has been widely used to immunologically stress chickens. Two hundred and eighty chicks, 1 d of age, were utilized with 10 replicate cages of 7 chicks per cage. A 2x2 factorial treatment arrangement...
was used with diets and LPS challenge as factors. At D7, 2 groups of chicks fed with or without Actigen® were injected intravenously via the jugular vein with 1 mg/ml LPS. At 1 and 14d post LPS injection, serum samples were collected for nuclear factor kappa-light-chain-enhancer of activated B cells (NFκB) and interleukin 1β (IL1β) quantification using ELISA. Both BW and FI were reduced (P<0.001) due to LPS challenge at d21. At 1d post challenge, there was a significant Actigen® x LPS interaction (P<0.05) for the serum NFκB concentration. Chicks challenged with LPS and not fed Actigen® had a significantly depressed level of serum NFκB. The challenged chicks that were fed the diet with Actigen® did not have this depression in serum NFκB. Actigen® fed birds had higher (P = 0.07) serum IL1β concentration than non-Actigen® fed birds. By 14d post LPS challenge, the immune cell production did not differ among treatment groups (P>0.05). Feeding dietary Actigen® altered the pattern of immune cell responses of broilers challenged with LPS. These results indicate that dietary Actigen® can enhance the cell-mediated immune response by modulating the production of inflammatory cytokines during the early phases of inflammation.

Key Words: mannan-oligosaccharide, lipopolysaccharide, immunity, cytokine, broiler

P331 Relationship of bone homeostasis markers and genetic line to eggshell quality Justina Caldas1, Phiphob Sedsee1, Karen V ignale2, Nirun Boonsincha1, Monticha Putsakum2, Ethan Holt3, Judith England4, Craig Coon5 1University of Arkansas, Fayetteville, AR, USA; 2C.P. Bangkok, Bangkok, Thailand; 3School of Agriculture and Cooperatives, Nonthaburi, AR, Thailand

Maintaining the proper balance of calcium and phosphorus in the body is important for bone integrity, eggshell formation and eggshell quality, as well as other metabolic processes in breeder hens. A trial was conducted to determine physiological factors involved in producing optimum egg shell quality in broiler breeders. 960 – 21 week old pullets from 4 pure lines (A, B, C, and D) were housed at the U of A research farm. Light stimulation and feeding program followed primary breeder recommendations. At 4 week intervals, all eggs laid for 3 days consecutive days were weighed and scanned with GE® Lunar Prodigy dual energy x-ray absorptiometry (DEXA) for shell weight and shell calcium. Specific gravity was determined by flotation in salt solutions of known specific gravity. 24 hens selected from each line were also scanned repeatedly, at 4 week intervals, using DEXA for whole body mineral content (WBMC). At 50 weeks of age, 50 hens from each line were randomly selected and blood samples taken for analysis of fibroblast growth factor 23 (FGF23), bone specific alkaline phosphatase (BSAP), tartrate resistant alkaline phosphatase (TRAP), plasma calcium and plasma inorganic phosphorus. Blood samples from 14 day old progeny of these hens was also analyzed. Genetic line significantly affects all shell quality parameters: WBMC, TRAP, plasma Ca and iP (P<.0001), but did not affect BSAP or FGF23. TRAP is negatively correlated to shell weight and shell calcium (P<.0001), specific gravity (P=0.0012) and WBMC (P=0.0422). BSAP is positively correlated to shell weight (P=0.0298) and shell calcium (P=0.0332). FGF23 was not correlated to eggshell quality, but was negatively correlated to plasma iP (P<.0001). Higher plasma levels of calcium did not necessarily translate to improved shell quality, however there was a significant negative correlation of iP with shell weight, shell calcium and egg weight. The percent of hens laying eggs with a specific gravity of less than 1.08 was 66, 14, 5, and 50 % for lines A, B, C, and D, respectively. The distribution of the number of hens laying eggs with good or bad shell quality differs between lines, as does the distribution of the number of hens or 14 day old progeny with different levels of TRAP. It may be possible to develop an index using BSAP and TRAP values that would indicate a hens potential to lay eggs with good shell quality. TRAP may be the best candidate for an indicator of shell quality as there were differences in the distribution of TRAP values between lines that correspond to differences in distribution of shell quality.

Key Words: EGGSHELL QUALITY, BREEDER, GENETIC LINE, TRAP, BSAP

P332 The effect of fats containing different levels of free fatty acids on broiler growth performance from 1 to 19 days Miguel Barrios1, Anna Kenyon1, Jason Payne1, Jonathan Morris1, Amy Batal2, Robert Beckstead1 1The University of Georgia, Athens, GA, USA; 2Huvepharma, Inc, Atlanta, GA, USA

A complete broiler ration contains between 1 and 3% fat. Inclusion of fat in the diet plays two major roles: increasing caloric density and improving palatability. The objective of this study was to understand the growth performance of broilers fed diets containing fats with differing free fatty acid (FFA) percentages. For this experiment, day old Cobb 500 by-product male chicks were placed in Custom Design batteries and raised for 4 days on a standard corn-soy diet. There were 6 chicks per pen, 10 pens per treatment, and 6 treatments for a total of 360 chicks. Treatment diets consisted of: a: corn-soybean meal low energy starter diet (no fat); 1, 1 + fat 1 (2.8% FFA), 1 + fat 3 (9.6% FFA), 1 + fat 6 (15% FFA), 1 + fat 8 (32.5% FFA), and 1 + fat 9 (crude corn oil, 2.5% FFA). On day 5, experimental diets were fed for the remainder of the experiments when broilers were 19 days of age. Broilers and feed were weighed on days 5, 11, and 19. At the end of the trial the pectoralis major, pectoralis minor, and fat pad were collected. A completely randomized design was used for statistical analysis and significance was established at p<0.05. Individual body weight gain from 5 to 19 days was the lowest in the diet without fat. Body weights increased as the percentage of FFA increased with a drop upon reaching 15% and 32.5% FFA. A similar pattern was found in feed intake from 5 to 19 days. The worst feed efficiency was found in chicks fed the diet without fat with the best in the corn oil treatment. Lastly, there were no significant differences in the pectoralis major and minor weights. Chicks fed the diet without fat had the lowest fat deposition while those fed 2.8% FFA had the heaviest fat pads. Fat pad weights decreased as FFA inclusion increased past 2.8%. These results demonstrate that 9.6% FFA is an optimal amount of FFA in broiler diets. Higher FFA inclusion rates may result in undesirable effects such as decreased body weight gain. Further research will determine the effects of these treatment diets with different exogenous enzymes on broiler growth performance.

Key Words: Free fatty acids, nutrition, broiler, growth performance, oil

P333 Lysine Mediation of Neuroendocrine Food Regulation in the Guinea Fowl Samuel Nahashon1, Ashley Payne, Michael Ivy Tennessee State University, Nashville, TN, USA

Obesity, which is in part influenced by food intake, is increasingly becoming a nationwide health problem. Hypothalamic food intake mechanisms are involved metabolically and neurologically via two peptide hormones Leptin and Ghrelin, and the amino acid, Glutamate, which can result enzymatically from lysine metabolism. Our hypothesis is lysine homeostasis mediates regulation of feed intake and performance characteristics via the brain-liver axis through glutamate sensing. The objective was to examine the effects of lysine homeostasis in avian food regulation and performance characteristics through neuroendocrine signaling. One-day-old male French Guinea fowl (GF) keets (216) were weighed and randomly assigned to 4 dietary treatments (0.86%, 0.92%, 1.10% control, and 1.22% lysine) in 3 replicates. At 4 and 8 weeks of age 28 and 32 birds, respectively were randomly selected, weighed and euthanatized. The duodenum, liver, pancreas, brain and adipose tissue were excised, snap frozen in liquid nitrogen and stored at -80°C until use. Messenger Ribonucleic acid (mRNA) was extracted and reverse transcribed into Complementary Deoxyribonucleic acid (cDNA) for quantitative Polymerase chain reaction (PCR) assays. Lysine at 0.80% hindered growth, caused poor development of some digestive organs and high mortality in GF which was associated with changes in the expression of both brain and liver glutamate and leptin receptors. The fold change for glutamate metabotropic receptor I was significantly lower (P<0.05) in liver and higher in brain at

Poult. Sci. 94 (E-Suppl. 1)
0.86 and 0.92% when compared to the control (1.10%) and 1.22% lysine. The Glutamate ionotropic receptor displayed high expression at the highest lysine concentration. Brain ghrelin receptor expression was higher in 0.86 and 0.92% than in other treatments. Therefore, based on this study, dietary lysine concentration may influence signaling pathways regulating food intake in the brain-liver axis via glutamate synthesis.

Key Words: neuroendocrine hormones, guinea fowl, obesity, poultry feed regulation, metabolism

P334 Phytoestrogenic Activities of Quercetin in Laying Hens during the Peak Laying Period Ying You*GS, Yao Li Northeast Agricultural University, Harbin, China

Quercetin, a typical flavonoid, has phytoestrogenic activity and produces estrogenic effects in animals. In this study, we investigated the effect of quercetin, as a phytoestrogen, on egg albumen and shell quality, clinical blood parameters and necropsy in genital organs in laying hens. One hundred and eighty 28-week-old Hessian laying hens, with an average 85% of laying rate at the start, were randomly allotted to three treatments and fed one of three different diets, (a negative control, and two levels of quercetin, 0.2 (low), 0.6 (high) g quercetin/kg diet) for 8 weeks. Egg quality parameters were measured at the end of every week. Clinical blood parameters and necropsy were measured at the end of the experiment. Results showed that high level quercetin increased absolute egg shell weight with low content supplementation of quercetin than the control group. High quercetin supplementation also improved egg albumen weight and height significantly. Both of low and high level quercetin supplementation increased number of largest follicle in ovarian significantly. Length of magnum was elevated in high quercetin supplement group compared to control group (P<0.05). Length of isthmus was found to increase significantly in both of the quercetin supplement groups. Low level of quercetin group had higher insulin concentration (P<0.05). Concentrations of IGF-1 in low and high quercetin groups were almost doubled compared to that of control group in laying hens (P<0.05). We conclude that quercetin can improve egg quality by influencing insulin and IGF-1 concentration in blood, and affecting differentiation and functioning of female propagative organs in laying hens during peak laying period. The appropriate level is 0.6 g quercetin/kg diet. This phytoestrogen activity may provide evidence of quercetin as a functional feed additive in laying hens.

Key Words: quercetin, egg albumen quality, egg shell weight, insulin, IGF-1

P336 The Study of Star Anise, Ginger and Salvia Miltiorrhiza on Antioxidant Status and Vitamin Stability Chongwu Yang*1, Zaibin Yang2, Shuzhen Jiang2 1College of Life science, Shandong Agricultural University, Tai-an, China; 2College of Animal science, Shandong Agricultural University, Tai-an, China

The trial was conducted to investigate the effect of star anise, ginger powder and salvia miltiorrhiza on stability of fat and vitamin. (Method) The vitamin A (4500 IU/kg), vitamin D3 (1250 IU/kg), vitamin E (12.5 IU/kg), vitamin B1 (0.90 mg/kg), vitamin B2 (3.0 mg/kg), vitamin B3 (3.0 mg/kg) were added to two carrier corn meal and soybean meal, respectively. Five treatments per carrier were: control diet without antioxidant and 4 test diets that were supplemented with star anise (10 g/kg), ginger powder (15 g/kg), salvia miltiorrhiza (15 g/kg) and BHT (150 mg/kg), respectively. The peroxide value (PV), acid value (AV), total fungal counts, moisture and vitamin content of diets were determined at day 0 and day 60 by sealed storage at 40°C. (Results) The results proved that all treatments had similar PV and AV at day 60 by sealed storage at 40°C. Supplementation of star anise, ginger powder, salvia miltiorrhiza and BHT improved the content and retention rate of vitamin A, D3, E and B1 as compared with control (P < 0.01). Supplementation of ginger powder and salvia miltiorrhiza reduced (P < 0.05) total count of mould in two carriers, and supplementation of star anise were the best (P < 0.05). Supplementation of BHT reduced (P < 0.05) total count of mould in soybean meal. (Conclusion) Star anise, salvia miltiorrhiza and ginger powder can be used as antioxidant protection additives of vitamin A, D, E, B1 and B2 and mould inhibitor.

Key Words: star anise, ginger powde, salvia miltiorrhiza, fat oxidation, vitamin stability
AUTHOR INDEX

P

Pacheco, Bruna, T208
Page, Greg, M76
Page, Kotlon, M87, M125
Paiva, Diego, M92, P219
Palme, Rupert, P310
Pantin-Jackwood, Mary, M6
Parduyms, Robin, T189
Park, J. W., M28
Park, Jung-Woo, M29
Park, Si Hong, M59
Parker, Holly, M18, P237
Parr, Terri, M106, T172
Parsons, Carl, M106, T172
Pasquali, Guilherme Aguiar Mateus, P310, T142
Patterson, Paul, M105
Paudel, Sagar, P306
Paul, Marquisha, P303, P311, P313
Payne, Ashley, P333
Payne, Jason, P234, P332
Peebles, David, M14, P253
Peebles, E. David, M10, P236, P270, T183
Peng, Ye, M38
Perri, Silvia Helena Venturoli, P244
Perryman, Kurt, M67, M132
Persis, Michael, M137
Pescatore, Anthony, M245, P303, P304, P311, P313, P330
Pessoa, Gabriel, P352, P327, P329
Pesti, G. M., M84, M85
Pesti, Gene, M11, M108
Phillips, Chelsea, P238
Piekarski, Alissa, M17, M39, P321
Pieniadz, Iván, P214
Pinto, Marcos Franke, P244, P286
Pirgozliev, V.R, P302, T197
Pirgozliev, Vasil, P312
Plumstead, Peter, M78
Pohlmian, Fred, M35
Pollock, Erik D., M90
Pollock, Erik D, T139
Pontin, Cesar, T146, T147, T148, T149, T199
Popa, Virginia, P217
Popham, Sheena, T190
Porter, Amanda, M15, P249, P251, P252
Postel, Matthew, P256
Poureslami, Ray, M87
Prado, Nadia, P214
Price, Jacob, M88
Pulido-Landinez, Martha, M23
Purdum, Sheila, P275, P283
Purswell, J.L., T198
Purswell, Joseph, M258, P264, T192
Putsakum, Monticha, M75, P331, T175
Puyalto, Monica, P318, P320

Q

Quadros, Thays, P235, P305, T143
Queiroz, Carla Martins, P310
Quiroz-Pesina, Manuel, P226
Quíñones-Chois, Gerardo, P221

R

Racanici, Aline Mondini Calil, P324, P326
Rajapakse, Banuka, M70
Rananavare, Pratap, T151
Rao, Shivaram, M124
Rastagno, Horacio Santiago, M81, P322
Rauber, Silvana, T199
Ravindran, Ravi, T169
Ravindran, Velmurugu, T145
Ray, R., M72
Read, Andrew, B-313
Regmi, Bibek, M58
Regmi, Prajwal, P224
Reyes, Jacqueline Vázquez, P294
Rezende, Juliana Cristina Ramos, P310
Rhodes, Jennifer, P255
Ribeiro, Andréa Machado Leal, M74
Riblet, Sylva M., M95
Richardson, Kurt, P256
Ricke, Steven, M59, P280
Rios, Heitor, T164, T200
Rios-Cambra, Francisco, M2
Rissi, Daniel, M97
Roberts, M., M50, P263
Rochell, Samuel, M106, T172
Rodrigues, Mayara Maia, P286
Rodrigues-Avila, Andres, P221
Rogers, Adrianna, M61
Rogers, Audrianna, M35
Rong, R., M72
Rosa, Alexendre, P314
Roos, Franz, T134
Rosen, Daniel, M104
Rose, Paul, M104
Rose, Paul, P312
Santos, Elaine, P235, P305
Sarsour, Albaraa, M8, M114, T143
Sartori, José Roberto, P310, P324, P326, T142
Sartori, Marcia Maria Pereira, P324, P326
Sartori, Maria Márcia Pereira, P310
Savoldi, Gustavo, P225
Schauberger, Simone, T163
Schenk, Allyson, P249, P250, P251, P252
Schieler, Carina, T177
Schirrmacher, Marie, M92, P219
Schirrmách, Gracieli, P314
Schleifer, John, M98
Schneiders, Gustavo Henrique, M95
Scott, Jenna, M114, M8
Scheer, Galarza, Rosario, M16, M55, M99
Sefion, Ted, M24
Segrest, Ammuayu, M53
Sellers, B., M116
Sellers, Holly S., M102
Sellers, Robert B., T141
Sellers, Robert B., M80
Selvaraj, Ramesh, M73
Senties-Cué, Gabriel, M9
Serafini, Natália Chaves, T170
Serpa, Paola Gentile, P310
Sesterhenn, Renata, P328
Sextar, Petek, T191
Severo, Guilherme, P225
Sgavioli, Sarah, P235, P305
Shannon, Tiffany, M104
Sharma, Ajay, M21
Sharma, Chander, M39
Sharma, Chander Shekhar, P247
Shaw, Daniel, M104
Sheltton, Samantha, M109
Shepherd, Eric, M6, M94, T154
Shirley, R.B., T168
Shivaprasad, H.L., M97
Silva, Amanda Lapa, T142
Silva, Leandro, P322
Sims, Michael, M121

S

Sá, Luciano, T150
Sahin, Kuzmin, P278, T135, T136
Sahin, Nurhan, P278, T135, T136
Sainz, Roberto D., P328
Salas, Monti, Rocío, P300
Salguero, Sandra Carolina, T171
Salmond, Gareth, P298
Samuel, Ryan, P245
Sanchez, Josue, P218
Sandra, Dania, Gualberto, P286
Sanfelice, Cristiane, P297
Santana, Mathews, P322
Santin, Elizbeth, M74
Santos, Camila, P314
Santos, Elaine, P235, P305
Sarsour, Albaraa, M8, M114, T143
Sartori, José Roberto, P310, P324, P326, T142
Sartori, Marcia Maria Pereira, P324, P326
Sartori, Maria Márcia Pereira, P310
Savoldi, Gustavo, P225
Schauberger, Simone, T163
Schenk, Allyson, P249, P250, P251, P252
Schieler, Carina, T177
Schirrmacher, Marie, M92, P219
Schirrmacher, Gracieli, P314
Schleifer, John, M98
Schneiders, Gustavo Henrique, M95
Scott, Jenna, M114, M8
Scheer-Galarza, Rosario, M16, M55, M99
Sefion, Ted, M24
Segrest, Ammuayu, M53
Sellers, B., M116
Sellers, Holly S., M102
Sellers, Robert B., T141
Sellers, Robert B., M80
Selvaraj, Ramesh, M73
Senties-Cué, Gabriel, M9
Serafini, Natália Chaves, T170
Serpa, Paola Gentile, P310
Sesterhenn, Renata, P328
Sextar, Petek, T191
Severo, Guilherme, P225
Sgavioli, Sarah, P235, P305
Shannon, Tiffany, M104
Sharma, Ajay, M21
Sharma, Chander, M39
Sharma, Chander Shekhar, P247
Shaw, Daniel, M104
Sheltton, Samantha, M109
Shepherd, Eric, M6, M94, T154
Shirley, R.B., T168
Shivaprasad, H.L., M97
Silva, Amanda Lapa, T142
Silva, Leandro, P322
Sims, Michael, M121
Singh, Manpreet, M53
Smeek, Jerod, T181
Smith, D. P., M41
Smith, Diane, M4
Smith, Doug, M27
Smith, Kyle, M88, P317
Sodsee, Phichob, M75, P331, T139
Sokale, Adebayo, M10
Son, Sona, M88
Son, Sona, M88
Song, Sangyoon, M60
Sorbara, Jose Otavio, T181
Sorbara, José Otávio, T171, T176
Soster, Patricia, T200
Spackman, Erica, M6, T157
Srinongkote, Saksit, T209
Sriperm, N., T168
Stanczak, Bartlomiej, T152
Stark, C. R., M107
Starkl, Verena, P307, T163
Stefanello, Catarina, P326
Steininger, Charlotte, M46
Stojanović, Mirjana, M104
Stradiotti, Ana Cristina, P326
Stratulat, Gheorghe, P217
Street, Peter, P256
Stringfellow, Kendre, M92
Suckeveris, Diana, T176
Sukumaran, Anuraj Theradiyil, P247
Sulyok, Michael, P307
Summers, J., M72
Swayne, David E, T158
Szelesczuk, Piotr, T152
T
Tabler, Tom, P269
Taha, Ensaf, M43
Tasoniero, Giulia, M4
Tastan, Hakki, T136
Teague, Kyle, M64, M65
Tellez, Guillermo, M16, M54, M55, M64, M65, M89, M99, T203, T205
Thaxton, Grace, M12
Thompson, Joel, M109
Thomson, John, M118, M119, T172
Tijare, Vishwesh V., M36, M37
Tillman, Paul B., T141
Toledo, Taiani, P314
Tony, Mohamed Ahmed, T179
Toro, Haroldo, M7, M12
Trevisan, Renata, T140
Tripllet, Melissa, M19, P239
Turkmut, Levent, T191
Tuzcu, Mehmet, P278, T135, T136
U
Urdaneta, Viviana, P214
Usry, James, M106, T172
V
van der Klis, Jan Dirk, T167
van Ginkel, Frederick, M7
van Rensburg, Christine Jansen, P298
van Santen, Vicky, M7, M12
Vazquez-Anon, Mercedes, T165, T203
Verbeek, Sipke, M32
Verduzco, Gabriela Gómez, P294
Vicente, Jose Luis, M42
Vicente, Jose, M89, T184, T186, T205
Vicente-Salvador, Jose Luis, P285
Vicuna, Eduardo, M16
Vicuña, Eduardo, M55, M99, T203
Vieira, Sergio Luis, T199
Vieira, Sergio Luiz, T146, T147, T148, T149, T164, T170
Vieira, Sergio, T200
Vieira, Sérgio L., P328
Vignale, Karen, M75, M90, P315, P331, T139, T175
Villalobos, T., T156
Villalobos, Tarsicio, T160, T161
Vivas, Carlos, P314
W
Wade, Courtney, P237
Waldroup, Park, M109, M110, M111, M112
Wallace, Robert, P316
Walters, Hunter, M88, M124
Wamsley, K.G.S., M116
Wamsley, Kelley, M82, M83, P285, T184, T186, T205
Wang, Jing, T75, M127, T175
Wang, Yi, M116
Wang, Yi, M83
Wang, Yue, T157
Ward, Nelson, M125
Watkins, Susan, M109, M113
Wedekind, Karen, T203
Weller, Cheryl, P256
Wen, Xianjiang, M116
Whiting, I.M, P302, T197
Wideman, R. F., M98
Williams, Chris, M14
Williams, Christopher, M10
Williams, Mallori, M126
Wilson, Floyd, M14, T153
Wilson, Jeanna L., P274
Wilson, Kimberly, M40, M44, M48, P246
Wilson, Mikaila, M101
Wing, Clayton, P234
Winkler, Scott, T190
Wolfenden, Amanda, M99, T159, T203
Wolfenden, Ross, M42, M64, M65, M89, P285, T184, T186, T205
Wornack, Sharon, P253, P270, T183
Wooten, McCaide, P233
Wyatt, Craig, M131
X
Xiong, Youling, P245
Y
Yan, Fenglan, T165
Yan, Frances, P317
Yan, Lifang, T153
Yang, Chongwu, P336
Yang, Famous L., M37
Yang, Famous, M36
Yang, Fengchun, M105
Yang, Zabin, P336
Yeince, Engin, T135
Yilmaz, Bahaddin, T135
Yoho, D. E., M63
York, Tara, M79
You, Ying, P334
Z
Zanellato, Ewerton, P225
Zavala, Guillermo, M96
Zazai, Noorjhan, P295, P296
Zeng, Qiu Feng, M103
Zentek, Jurgen, T177
Zhai, W., M116
Zhai, Wei, M82, M83, P323
Zhang, Qian, M103
Zoca, Sara, P228
Zorrilla-Fierro, Francisco, M2
Zorzetto, Priscila, P323
Zotte, Antonella Dalle, M4