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The study was conducted to evaluate the effect of locally prepared premix in broiler ration. One hundred and eighty broiler chicks were randomly allotted into two pens labelled A and B. Birds in the two pens were replicated thrice with 30 birds per replicate. The birds were fed broiler starter and finisher ration formulated according to the conventional procedure. However, birds in pen A had 0.5kg inclusion of commercial premix in the feed while birds in pen B had 0.5kg of locally prepared premix. The composition of the the local premix was blood meal (2.6kg), fish meal (1.0kg), wood ash (0.5kg) and red pepper (0.5kg). Water and feed were served ad libitum.

Result obtained showed that birds in pen A had the highest growth rate, weight gain, feed intake and feed conversion ratio. It is concluded that further research study is required for the locally prepared premix since conventional premix had a better performance than the locally prepared premix used in this experiment.

Key Words: local premix, conventional premix, blood meal, weight gain, feed conversion ratio

M2 Effects of dietary vitamin level on growth performance of fast growing broiler. L. Cai1, J. Wu1, K. Zhang*1, X. Ding1, S. Bai1, J. M. Hernandez2, and D. Yao3, 1Institute of Animal Nutrition, Key Laboratory for Animal Disease-Resistance Nutrition of China Ministry of Education, Sichuan Agricultural University, Yaan, Sichuan, P. R. China, 2DSM Nutritional Products Ltd., R&D Animal Nutrition and Health, Kaiseraugst, Switzerland, 3DSM(China) Limited, PuDong Area, ShangHai.

A study was conducted to study the effects of three vitamin levels (NRC, LOCAL, OVN®) on the growth performance of fast growing broiler. Total 1200 Chinese local broilers were random allotted to 3 treatments with 10 replicates (5 for male, 5 for female) of 40 birds. The broilers were free access to feed and water in floor pens with rice hull as litter. Body weight (BW), body weight gain (BWG), Feed intake (FI), feed conversion rate (FCR), mortality and cull rate at difference phase (1-21d, 22-42d, 0-42d) were measure. At the end of the trial, 2 birds were sacrificed to measure the dressing percentage (DP) and breast yield. Compared to NRC, Local and NRC improved significantly the BW21d, BWG and FG 1 to 21d with the tread to increase the BW42d (+1.9% vs. NRC; 1.1% vs. Local), BWG1 to 42d, FI 21 to 42d and 1 to 42d(P<0.05). OVN® also increased significantly the FI 1 to 21d (P < 0.05). There were no significant differences among treatments on dead rate, cull rate, dressing percentage and breast yield, but OVN® and Local decreased numerically the dead rate that was almost significantly(P = 0.097). When combined the dead rate and cull rate, OVN® and Local decreased significantly the dead and cull rate. Results showed that the fast growing broiler growth performance would be improved with the increase of dietary vitamin especially in early age with OVN® level.

Acknowledgment: this trial was financial supported by DSM.

Key Words: Cobb broilers, vitamin, performance, OVN®

M3 Effects of dietary vitamin level on growth performance of slow growing broiler. J. Wu1, L. Cai1, K. Zhang*1, X. Ding1, S. Bai1, J. M. Hernandez2, and D. Yao3, 1Institute of Animal Nutrition, Key Laboratory for Animal Disease-Resistance Nutrition of China Ministry of Education, Sichuan Agricultural University, Yaan, Sichuan, P. R. China, 2DSM Nutritional Products Ltd., R&D Animal Nutrition and Health, Kaiseraugst, Switzerland, 3DSM(China) Limited, PuDong Area, ShangHai.

A study was conducted to study the effects of three vitamin levels (NRC, LOCAL, OVN®) on the growth performance of Erlang mountain broiler, a slow growing broiler. Total 1200 Chinese local broilers were random allotted to 3 treatments with 10 replicates (5 for male, 5 for female) of 40 birds. The broilers were free access to feed and water in floor pens with rice hull as litter. Body weight (BW), body weight gain (BWG), Feed intake (FI), feed conversion rate (FCR), mortality and cull rate at difference phase (d1-28, d29 - 49, d50 -70, d1 -70) were measured. At the end of the trial, 2 birds were sacrificed to measure the dressing percentage (DP) and breast yield. BW 70 and BWG of d1-70 for OVN were significantly higher (P < 0.05) than that of NRC (+4.7%) or Local (+4.5%). There were no significant differences among...
treatments on BW of d1 or d28 or d49, BWG of d1-28, d29-49, and d50-70. OVN showed a tendency to improve the BW at d 28, d 49, and BWG of d1-28, d 29-29, d 50-70, as well as tended to improve the F/G of d1-28, d 29-49, d 50-70, and d 70 (K=5.5% vs. NRC; -1.9% vs. Local). FL of OV N showed also a similar increasing trend. In this trial there were no significant differences among treatments on dead rate and cull rate, dressing percentage or breast yield. Results showed that the slow growing broiler growth performance would be improved with the increase of dietary vitamin especially with OV N level. Acknowledgment: this trial was financial supported by DSM.

Key Words: local vitamin, performance, OV N

M4 Impact of feeding lower levels of chelated minerals vs. industry levels of inorganic trace minerals on broiler performance, yield, foot pad health, and litter minerals concentration. M. K. Manangi1, T. Hampton1, P. Fisher1, J. D. Richards1, M. Vazquez-Anon1, and K. D. Christensen2, 1Novus International, Inc., St. Charles, MO, 2OK Foods, Inc., Fort Smith, AR.

Two 54d grow-out trials were conducted in a commercial broiler facility to determine the impact on performance, yield, foot pad lesions, and litter trace minerals concentration by feeding broiler chicks diets containing lower levels of supplemental Zn as MINTREX® Zn (ZnHMTBa)2 (Trial 1) or MINTREX® Zn, MINTREX® Mn (MnHMTBa)2, and MINTREX® Cu (CuHMTBa)2 (Trial 2) in comparison to industry levels of inclusion of respective inorganic trace minerals (ITM). A total of 122,400 Ross-708 straight-run chicks were distributed into 8 houses with about 15,300 chicks/house for Trials 1 and 2. Both trials had 2 treatments (T1 and T2) each with 4 replicate houses per treatment. Trial 1 consisted of 30ppm Zn as MINTREX® (T1) and 100ppm Zn as ZnSO4 (T2). Trial 2 consisted of 32, 8 and 32ppm of Zn, Cu and Mn, respectively, as MINTREX® (T1), and 100, 125 and 90ppm of Zn, Cu and Mn, respectively, as sulfates (T2). Trial 1 was carried out on a year old piled up litter and Trial 2 was on fresh litter. Both Trials 1 and 2 results indicate no differences (P > 0.05) in performance, carcass yield, and tibia Zn over 54d period between treatments. On d 54 (Trial 1), the chicks fed diets supplemented with MINTREX® had 27.3% more grade 1 and 2 paws together compared to that of T2 (P < 0.01). On d 54 (Trial 2), the chicks fed MINTREX® had 23.3% more grade 1 and 2 paws together compared to that of T2 (P = 0.07). For Trial 2, litter Zn, Cu, and Mn from birds fed MINTREX® were reduced by 40, 74, and 35%, respectively, as sulfates (T2). MT expression (from 0, 15 and 30ppm trts) was regressed to Zn sulfate based on tibia Zn and small intestinal metallothionein expression. M5 Net absorption, carcass concentration and performance responses of broiler chickens to organic (SQM®) and inorganic Zn, Cu, and Mn. M. D. Sims*1 and J. E. Garrett2, 1Virginia Diversified Research Corp., Harrisonburg, VA, 2Quali Tech, Inc., Chaska, MN.

Inorganic and organic sourced Zn, Cu and Mn trace minerals (TM) were added to diets to compare the performance, net TM absorption (NTMA) and carcass TM concentration (CTMC) of broiler chickens fed corn-soy (CS) or semi-purified (PD) diets with and without a known TM antagonist, 7% cottonseed hulls (CSH). Inorganic TM (ITM) were sourced from ZnSO4, CuSO4 and MnO2. Organic TM were sourced from Qua li Tech, Inc (SQM). SQM TM are polysaccharide complexed organic TM. The following paired groups were observed: CS+ITM vs. CS+SQM; PD+ITM vs. PD+SQM; CS+ITM+CSH vs. CS+SQM+CSH; and PD+ITM+CSH vs. PD+SQM+CSH. PD diets were not suitable for valid performance data in birds older than 3 wks. Week 6 live weights were not different (P > 0.05) while FC of SQM (1.683 kg/kg) was better (P < 0.06) than ITM (1.726 kg/kg). NTMA testing used fasted 6 wk old broilers gavaged with 30 cc of treatment feed mixed with 0.5% Cr2O3, CTMC testing used broilers raised to 6 wks with wet mash PD feed to facilitate growth. Zn-CTMC of PD+SQM (757.14 ppm) was greater (P < 0.01) than PD+ITM (568.68 ppm) and Cu-CTMC of PD+SQM (62.73 ppm) was greater (P < 0.01) than PD+ITM (23.77 ppm). Mn-CTMC of PD+SQM (64.91 ppm) was greater (P < 0.01) than PD+ITM (31.03 ppm). PD+SQM+CSH Cu-CTMC (47.28 ppm) approached differing (P = 0.0704) from PD+ITM+CSH (36.39 ppm). PD+SQM+CSH Mn-CTMC (80.83 ppm) was higher (P < 0.05) than PD+ITM+CSH (51.20 ppm). The Zn-NTMA of CS+SQM+CSH (67.5%) was significantly greater (P < 0.05) than CS+ITM+CSH (43.4%). On evaluation of Cu-NTMA results, CS+SQM (54.9%) and CS+SQM+CSH (53.0%) were greater (P < 0.05) than CS+ITM (23.2%) and CS+ITM+CSH (28.7%), respectively. Performance data were similar (P ≥ 0.05) for SQM and ITM. Cu-NTMA in CS with and without CSh was best (P < 0.05) for SQM than ITM. Zn-NTMA in CS was best (P < 0.05) for SQM than ITM with CSh in diet. CTMC data indicate that SQM Zn, Cu and Mn were better retained (P < 0.05) by broilers through market weight than ITM and NTMA data show SQM Cu and Zn were more efficiently (P < 0.05) absorbed than ITM.

Key Words: broilers, trace minerals, organic, inorganic, net absorption


The bioavailability of MINTREX® Zn (MZn) was compared to that of Zn sulfate (ZnS). Cobb 500 male broiler chicks were assigned to 11 treatment (trt) groups: a Zn-unsupplemented corn-soy diet (basal), or the basal supplemented with 5, 10, 15, 20 or 30ppm Zn as ZnS or MZn. There were 6 replicates per trt (8 chicks per replicate), except the basal had 12 replicates. All trts were started on a low Zn pre-trt diet and switched to trt diets on day 8. Jejunum mucosa was collected from 2 birds per pen on day 11 (basal, 15ppm and 30ppm trts only). Metallothionein (MT) mRNA was measured by real time PCR. On day 14 both trts were collected from 2 birds per pen from all trts for Zn analysis. There were no significant effects of trt or Zn source on day 8-14 FCR. Birds fed MZn had lower feed:gain than birds fed the basal (P = 0.03). For Zn sulfate, the relationship between tibia Zn (µg) and supplemental (suppl.) Zn intake (mg) was linear (R2=0.95), while for MZn it was quadratic (R2=0.93). Levels below the inflection point for MZn (0ppm–15ppm suppl. Zn), and all levels of ZnS were used to determine Zn relative bioavailability (RBV) using multiple regression. The slopes between the two sources were significantly different (P = 0.001). With the tibia Zn response to ZnS set at 100%, the estimated RBV of MZn was 161%. Jejunum MT expression (from 0, 15 and 30ppm trts) was regressed against suppl. Zn intake for each source. The slopes of the two sources were significantly different (P = 0.009), and the estimated RBV of MZn vs ZnS was 248%. The difference in these estimates reflects what these assays measure: absorption (MT) vs. storage (tibia). Tibia data show...
that in battery cages, Zn requirement was met at <200ppm suppl. Zn with MINTREX, but was not met with ZnS. This is due to greater absorption of Zn from MINTREX (MT). Thus, suppl. Zn inclusion can be reduced substantially with MINTREX Zn.

Key Words: MINTREX®, bioavailability, zinc, broiler

M7 Intestinal microflora changes due to administration of the direct-fed microbial Avi-Lution® in broilers and turkeys. M. D. Sims1,2, P. D. Brown2, and D. A. Spangler2,1Virginia Diversified Research Corp., Harrisonburg, VA, 2Agri-King, Inc, Fulton, IL.

The types and concentrations of intestinal microflora can play an important role in the health and performance of broilers and turkeys. The objective was to measure broiler or turkey performance, litter microbial load (MLM) and/or intestinal microflora counts (IMC) when no additive (CON), antibiotic growth promotant (AGP), or Avi-Lution (AVN) was supplemented. In Trial 1, a 40-pen broiler study, showed AVN having IMC of clostridia (CP) and coliform bacteria (TC) as lower (P < 0.001) vs AGP, enterococci (EC) as greater (P < 0.001) and salmonella (SA) as lower (P < 0.005). AVN vs AGP 49d live weight (2.58 vs 2.56 kg; P ≥ 0.05), feed conversion (FC) (1.82 vs. 1.87 kg/kg; P = 0.03) and mortality (6.4 vs 5.3%; P ≥ 0.05) were determined. In Trial 2, a 12-pen broiler study, 27d IMC were CP of AVN=1.67 log10 colony forming units/g (cfu) vs CON=2.44 cfu (P < 0.01); TC of AVN=4.35 cfu vs CON=6.52 cfu (P = 0.137); SA of AVN=0 cfu vs CON=1.00 cfu (P = 0.17). The 41d IMC data from this study showed CP of AVN=1.97 cfu vs CON=3.86 cfu (P = 0.11); TC of AVN=4.77 cfu vs CON=5.20 cfu (P = 0.15); SA of AVN=0 cfu vs CON=2.01 cfu (P < 0.004); and EC of AVN=4.29 cfu vs CON=3.41 cfu (P = 0.03). Genetic community analysis (GCA) was performed via T-RFLP on adhered IMC to determine microbial diversity. GCA from 27d to 41d of CON increased 266 to 273 whereas AVN reduced 262 to 253. Reduced diversity of adhered IMC is typically associated with improvements in performance. AVN vs CON 41d weight gains (1.69 vs 1.62 kg; P = 0.21), FC (1.31 vs. 1.35 kg/kg; P = 0.22) and mortality (0.0 vs 8.7%; P = 0.02) were also determined. In Trial 3, a paired turkey house observation, LML data showed CP of AVN=3.03 cfu vs CON=3.54 cfu (P = 0.03); TC of AVN=5.96 cfu vs CON=7.83 cfu (P = 0.12); and SA was below detectable levels for both houses. Also in trial 3, the IMC data for CP of AVN=1.15 cfu vs CON=1.18 cfu (P = 0.48); TC of AVN=3.80 cfu vs CON=6.08 cfu (P = 0.17); SA of AVN=1.23 cfu vs CON=1.63 cfu (P = 0.42); and EC of AVN=7.36 cfu vs CON=6.85 cfu (P = 0.08). These data demonstrate that AVN influences gut microbial populations, which may result in a better bird performance.

Key Words: Salmonella, clostridia, Avi-Lution, broilers, turkeys

M8 Organic acids as alternative to antimicrobial growth promoter in broilers. L. G. Franco* and D. E. Faria, Universidade de Sao Paulo, Pirassununga, Brazil.

The purpose of this study was to evaluate the effect of different associations of organic acids supplementation as alternative to antimicrobial growth promoter in broilers from 1 to 41 days. A total of 1296 birds were distributed in a randomized block design totaling six treatments with six replicates of 36 chicks each. The treatments were: negative control, basal diet without antimicrobial and acids; positive control, basal diet with 0.005% of Halquinol without acids; basal diet with 0.2% of Mixture A (blend of protected organic acids; A PRO; Novus International); basal diet with 0.2% of Mixture A and 0.2% of Mixture B (blend of free organic acids and salt acid; A DA; Novus International); basal diet with 0.2% of Mixture A and 0.04% of Mixture C (blend of free organic acids; A WD; Novus International) added in drinking water; basal diet with 0.4% of Mixture A. Performance and intestinal morphometry were evaluated. The feed conversion (FC) of organic acids treatments was significantly better (P = 0.04) than positive control at 21 days. Evaluating the period from 1 to 35 days, the body weight gain (BWG) of the birds treated with organic acids were significantly higher (P = 0.03) than birds that received antibiotic. Considering the total period of rearing from 1 to 41 days, the association of protected organic acids added in feed and free organic acids added in drinking water was the most efficient in FC compared to the others treatments (P = 0.05 and P < 0.05). Concerning viability and production efficiency index (PEI), both were significantly higher (P = 0.008 and P = 0.007, respectively) for the organic acid treatments than positive control. Evaluating intestinal morphometry at 7 days, the association of protected blend and free organic acids blend supplied by feed provided higher villi: crypt ratio (V:C) in jejunum (P = 0.017) compared with positive control. It was concluded that organic acids supplementation could be a feasible alternative to antimicrobials growth promoter.

Key Words: acidifiers, antibiotics, birds, intestinal morphometry, performance


The study was carried out to determine the performance and profitability of broiler finisher served ginger fortified water. Two hundred forty broiler chickens at the finisher phase were randomly distributed into 4 pens labelled treatments 1, 2, 3 and 4. Each treatment contained 4 replicates with 15 birds giving a total of 60 birds per treatment. Ginger powder was dissolved in water at 1 g, 2 g and 3 g per liter and this were served to birds in treatments 1, 2, and 3 respectively without any conventional drugs. Treatment 4 was the control and the birds were served water and conventional drugs. The birds were fed broiler finisher and water served ad libitum. Result shows a significant difference (P < 0.05) in the final weight, feed conversion ratio and water intake with birds in treatment 2 having the highest average weight of 2.08 kg per bird. Treatment 4 consumed more feed on the average but had the least average final weight of 1.58 kg. Given a higher weight for birds served ginger at a lower cost compared to birds served conventional drugs at a higher cost and a lower body weight, the study concludes that birds served ginger had a better performance and more profitable.

Key Words: performance, profitability, ginger powder, fortified water, conventional drugs

M10 Probiotics and specific essential oil blends as growth promoters for broilers. N. A. Barbosa1,2, E. O. Oviedo-Rondon3,4, P. E. Eusebio-Balcazar1, J. Brake1, N. K. Sakomura2, C. E. Aker1,5, N. A. Ardon1,2, J. W. Wilson4, C. Paulus4, J. Jornigan1, and J. Whitley1,1North Carolina State University, Raleigh, 2Universidade Estadual Paulista, UNESP, Jaboticabal, SP, Brazil, 3Escuela Agrícola Panamericana Zamorano, Tegucigalpa, Honduras, 4DSM Nutritional Products Inc., Parsippany, NJ.
The search for the best eubiotics as growth promotants (GP) continues. Two consecutive broiler studies on the same litter were conducted to evaluate probiotics and specific essential oil (EO) blends as feed additives (FA) for broilers until 43 d of age. The 7 treatments evaluated included a positive control (PC) with GP antibiotic (BMD®) and ionophore (Coban®), negative control (NC) only with ionophore, 3 probiotics: BC30 (B. coagulans), B2B (B. licheniformis, B. subtilis), and Calsporin® (B. subtilis), and 2 EO: Crina® Poultry Plus (CPP) and Crina® PoultryAF (CPF). Day-old Ross 708 broilers were randomly assigned to 84 floor pens with previously used litter. Ten males and 10 females were placed in each pen. Corn-soybean diets with 5% inclusion of DDGS were used as basal diets and supplemented with FA according to treatments. In Exp. 1, 2 levels of CPP were evaluated (150 and 300 ppm), and in Exp. 2, 300 ppm CPP and CAF at 100 ppm were used. Broilers were weighed at 18 d (Exp. 1) or 14 d (Exp. 2) followed at 35 and 43 d, feed intake was recorded. BW gain and FCR corrected by mortality were calculated. Special care was taken to avoid cross-contamination of microbial species of probiotics. Data were analyzed as a completely randomized design with 12 replicates for each treatment. B2B, Calsporin, and CPP-300 promoted better FCR as compared to the NC and similar to PC at 18d. None of the FA improved FCR or BW gain compared to the NC at 35 and 43 d or from 1-43 d. However, FCR during the grower period was higher in CPP-150 than in the PC (1.687 vs 1.643); CPP-300 had better BW gain and FCR than Calsporin during the finisher period; and CPP-300 had better FCR than CPP-150 from 1-43 d. In Exp. 2, similar effects were observed. None of the FA improved FCR or BW gain compared to the NC from 1-43d. However, BC20 and B2B probiotics had lower BW gain than the NC and PC during the starter period. The EO CPP had worse FCR than the BC30 and B2B probiotics. It was concluded that CPP at 300 ppm and the probiotics BC30 and B2B may have GP effects in broilers during the starter period. Beneficial effects of FA may not be significant at market age.

Key Words: probiotics, essential oils, growth promotant antibiotics

M11 Probiotics and specific essential oil blends as growth promotants for broilers during a mixed Eimeria spp. infection. N. A. Barbosa1,2, E. O. Oviedo-Rondón*, M. Quiroz3, N. K. Sakomura2, C. E. Aker1,4, N. A. Ardon1,4, J. W. Wilson5, and C. Paulus2, 1Department of Poultry Science, North Carolina State University, Raleigh, 2Universidade Estadual Paulista, UNESP, Jaboticabal, SP, Brazil, 3NOVUS International Inc., Saint Louis, MO, 4Escuela Agrícola Zamorano, Tegucigalpa, Honduras, 5DSM Nutritional Products Inc., Parsippany, NJ.

Coccidial infection can be used as a model to evaluate efficacy of feed additives (FA) to modulate gut microflora. A mixed Eimeria spp. infection study was conducted to evaluate probiotics and specific essential oil (EO) blends as FA for broilers. The 8 treatments (Trt) evaluated included 4 controls and 4 FA: Uninfected-Unmedicated (UU), Unmedicated-Infected (UI), BMD®+Coban® as positive control (PC), and only ionophore (Coban®) as negative control (NC); 2 probiotics: BC30® (B. coagulans) and Calsporin® (B. subtilis C-3102); and 2 EO: Crina® Poultry Plus (CPP) at 300 ppm and Crina® Poultry AF (CPF) at 100 ppm. Day-old male Ross 708 broilers were randomly assigned to floor pens with litter used for 2 flocks fed the same Trt as assigned to each group. Forty eight chickens/Trt were raised up to 14 d, weighed and moved to Petersime battery cages to obtain 6 replicates/Trt of 6 broilers each, representing Trt BW distribution. Corn-soybean diets with 5% inclusion of DDGS were used as basal diets for each period and supplemented with FA. All chickens were fed with a starter diet until 14 d, and a grower diet from 14 to 22 d of age. Broilers were weighed at 15 d and inoculated with E. acervulina, E. maxima, and E. tenella. BW gain, lesion scores (LS), oocysts counts (OC), and survival rates were evaluated 7 d post-infection. An anticoccidial index was calculated with these parameters. CPP improved FCR at 14d compared to UI (1.38 vs 1.58), but was no different from the UU (1.38 vs 1.50). FCR from other FA were no different from UU, UI, NC or PC. All FA, except Calsporin, improved BW gain and FCR compared to the UI group, but none of them had similar BW gain to the UI. Only the probiotic BC30 and CPF improved feed intake compared to UI, but not similar to UU. PC, BC30, Calsporin and CPF had similar FCR to the one observed in UU and better than UI. Calsporin was the only FA to reduce LS only in ceca. None of the FA reduced (P > 0.05) OC, but PC, NC, and BC30 had 30-57% less OC than UI 7 d post-infection. It was concluded that BC30 and CPF had the best efficacy as FA in a mixed coccidiosis infection.

Key Words: probiotics, essential oils, growth promotants, coccidiosis

M12 Probiotic effects — challenge of in vitro verification. S. Henik1, G. Schatzmayr2, and V. Kloese4, 1BIOMIN Research Center, Tulln, Austria, 2University of Natural Resources and Applied Life Sciences, Tulln, Austria.

According to the FAO/WHO (2001), probiotics are defined as ‘Live microorganisms which when administered in adequate amounts confer a health benefit on the host.’ Within this study, cell culture based assays were established to verify health benefits of probiotic strains in vitro. The epithelial cell line IPEC-J2 was used as model. Adhesion properties were studied by DAPI and GIEMSA staining. Competitive pathogen exclusion (CEX) properties against Salmonella typhimurium were studied by FISH. Transepithelial electrical resistance (TER) was used as parameter to test the effects on permeability. Immune modulation was studied by measurement of IL-8 release by ELISA. Two strains showed comparable adhesion properties with the positive control S. typhimurium. CEX properties were independent from adhesion properties. Not all strains with good adhesion properties excluded S. typhimurium from adhesion, but some strains that did not adhere to the cells did. TER was significantly (P < 0.05) increased by an Enterococcus faecium strain, but this strain did not inhibit destruction of IPEC-J2 cells by S. typhimurium. Some strains reduced the IL-8 release of IPEC-J2 cells, whereas others induced the cytokine response. Three E. faecium strains significantly (P < 0.05) reduced the IL-8 response of IPEC-J2 cells to S. typhimurium. In vitro verification of probiotic health effects with cell culture assays turned out to be tricky, as you have to deal with two living organisms. In particular, TER measurements seemed not to be an ideal tool. Adhesion and CEX properties and modulation of IL-8 release were strain specific and not species specific, meaning that each single isolate must be tested. Summing up, the established methods are useful screening tools to verify probiotic effects, but health benefit has to be confirmed in feeding trials.

Key Words: probiotic, in vitro, cell culture, IPEC-J2, Salmonella typhimurium

M13 Statistical correlations of lactobacilli counts in fresh fecal samples with live performance of broiler chickens at different ages when fed diets without or with antibiotic and/or bacillus spores. N. Otomo1, T. Hamaoka1, B. Lee1, T. Lohrmann2, and D. M. Hooge3, 1Calpis U.S.A., Inc., Mt. Prospect, IL, 2Quality Technology International, Inc., Elgin, IL, 3Hooge Consulting Service, Inc., Eagle Mountain, UT.
Increasing counts of intestinal lactic acid producing bacteria is considered beneficial to gut health and performance of commercial broiler chickens. Fresh fecal assays from a broiler pen trial were used to calculate correlations between lactobacilli (LAC) counts and live performance. A total of 1,240 Cobb 500 male chicks were randomly assigned to 6 dietary treatments with 10 replicate pens of 19 chicks each. Diets included negative control basals (starter, grower, and finisher) and basals plus antibiotic and/or bacillus spores from 0-42 d. All diets were steam pelleted (crumbles/pellets). Bacteria enumerated in fresh fecal samples (log10 cfu/g sample) from most but not all of the pens at 15, 29, and 42 d of age included Enterobacteriaceae (ENT), lactobacilli (LAC), and total anerobes (TAN). The BW, feed conversion ratio (FCR), and mortality % (MORT) were measured at 14, 21, 35, and 42 d. Pearson correlations (Statistix 8) were calculated between LAC or LAC/TAN % and BW, FCR, or MORT. Using treatment means, significant ($P \leq 0.10$) correlations ($r$) were found between: 21-d BW and 15-d LAC, 0.765; 0-14 d FCR and 15-d LAC, -0.807; and 0-35 d MORT and 29-d ENT, 0.742. Using pen means, correlations were: 14-d FCR and 15-d LAC, -0.389; 21-d FCR and 15-d LAC, -0.276; 35-d MORT and 29-d LAC, -0.211; 42-d BW and 42-d LACT, 0.221; 42-d FCR and 42-d LAC/TAN %, 0.246; and 42-d MORT and 42-d LAC/TAN % and ENT, -0.290. In conclusion, evidence was presented that fresh fecal counts, indicative of intestinal microflora populations, of LAC or LAC/TAN % had a positive correlation with BW and negative correlations with FCR or MORT, and LAC/TAN % had a negative correlation with ENT, which were all beneficial effects. Therefore, efforts to increase fecal (intestinal) LAC and LAC/TAN % counts should improve broiler chicken live performance.

Key Words: antibiotic, broiler, bacillus, correlation, lactobacilli


An experiment was conducted to test the hypothesis that feeding 22 ppm of virginiamycin increases live performance and processing characteristics of turkey hens. Seven hundred and forty four day-old Nicholas 85 x 700 female poults were randomly assigned 24 pens with 31 poults per pen. There were two treatments with 12 replicates of 31 turkeys among the feed mill. The most important source of variation appeared to be the content of crude protein which was directly related to the final live weight of the birds and feed conversion.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Body Weight (kg)</th>
<th>Adjusted F.C.R. (%)</th>
<th>Mortality (%)</th>
<th>Feed to 6.36 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Control</td>
<td>6.532</td>
<td>1.907</td>
<td>3.226</td>
<td>11.990</td>
</tr>
<tr>
<td>2) Virginiamycin</td>
<td>6.666</td>
<td>1.857</td>
<td>4.106</td>
<td>11.590</td>
</tr>
<tr>
<td>S.E.</td>
<td>0.129</td>
<td>0.059</td>
<td>3.890</td>
<td>0.420</td>
</tr>
<tr>
<td>S.E.</td>
<td>0.145</td>
<td>0.064</td>
<td>3.395</td>
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</tr>
<tr>
<td>Difference</td>
<td>-0.134</td>
<td>-0.050</td>
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</tr>
<tr>
<td>Sig. prob.</td>
<td>0.047</td>
<td>0.032</td>
<td>0.602</td>
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</table>

Key Words: turkey, virginiamycin, stafac, yield, antibiotic


Good quality feed is obviously important to support animal health and growth. Therefore, good feed hygiene and feed manufacturing processes are clearly important to provide feed which is not a threat to animal health or food safety. An award winning Scottish egg producer reveals that “you get out what you put in”. To get exact picture of compound broiler feed manufactured in Oyo state of Nigeria, feed samples were collected from four feed mills. Five methods were used to evaluate the feed; consumer survey, visual observation, chemical analysis, microbial study and a feeding trial with one hundred broilers using broiler starter and finisher feed. Questionnaires were administered to forty poultry farmers in the area, and were analyzed using chi squares method. The result shows that 65% of the respondents buy their feed from only one source, though about 20% said that is possible after they have tried other feeds. Some of the farmers (50%) revealed that they have encountered some problems in the past due to poor quality or contaminated feed. The microbial study was done to determine the microbial load and identification of isolates in the feed samples. The result shows that all the feed samples contain pathogenic organisms that can be a threat to the health of the broiler. There were significant differences ($P < 0.05$) in nutrient concentration, and in growth and feed conversion of the broilers among the feed mill. The most important source of variation appeared to be the content of crude protein which was directly related to the final live weight of the birds and feed conversion.
M16  Egg quality characteristics of layers fed Cocoa bean shell based diet. M. D. Olumide1, R. A. Hamzat2, and E. O. Uwagboe*, 1University of Ibadan, Ibadan, Oyo, Nigeria, 2Purdue University, West Lafayette, IN, 3Cocoa Research Institute of Nigeria, Ibadan, Oyo, Nigeria.

The biggest constraint to poultry production in Nigeria has remained the cost of feed. The high cost of feed has been as a result of increased cost of ingredients especially the cereals and protein ingredients; this is why there is need to investigate into some agro-industrial bye products that have potential as feed ingredients. Cocoa bean shell constitutes waste in cocoa industries in Nigeria. This study is focused on evaluating the egg quality characteristics of layers fed cocoa bean shell based diets. One hundred and forty (140) six-week old hens were used for this trial with 20 birds per treatment in a 2 x 3 factorial arrangement. These diets were: A (0% CBS control). B (5% raw CBS); C (10% raw CBS); D (5% CBS with enzyme); E (10% CBS with enzyme); F (5% fermented CBS); G (10% fermented CBS). The birds were offered feed and water ad-libitum throughout the experimental period. The production performance and egg quality characteristics studied were egg production, feed conversion ratio, egg weight, egg shell thickness, haught unit, yolk colour, egg length, egg width, egg shape index, shell weight and shell surface area, yolk weight, yolk height, yolk width, albumen weight, albumen height, yolk colour, yolk index. Difference in egg quality parameters were not significant, therefore cocoa bean shell can effectively be used in layers diet without any adverse effect on the egg quality.

Key Words: constraints, agro-industrial, cocoa bean shell, egg quality, layers

M17  The effect of dietary Ca level on the efficacy of an *Escherichia coli* derived phytase in 0 to 21-day old broilers. S. Powell*, T. D. Bidner, and L. L. Southern, Louisiana State University Agricultural Center, Baton Rouge.

An experiment was conducted to investigate the effect of dietary Ca level on the efficacy of an *E. coli* derived phytase (Optiphos). Broilers were housed in environmentally controlled brooder batteries with continuous fluorescent lighting. On the day of hatch, 288 male Ross x Ross 708 broilers were weighed, wing banded, and randomly allotted to 8 treatments with 6 replications of 6 broilers per pen. All diets were corn-soybean meal based and formulated to contain 1.26% total lys, and all other nutrients met or exceeded the requirements for 0 to 21-d old broilers (NRC, 1994) except for Ca and nonphytate P (nPP) where appropriate. Feed in mash form and water were provided for ad libitum consumption. The left tibia was removed, cleaned of tissue, and frozen for determination of bone breaking strength (BBS), tibia ash percentage (ASH), and ash and bone weight. The treatments were: 1) control with 0.45% nPP and 1% Ca (PC); 2) to 4) negative control (NC) with 0.20% nPP and 0.67, 1.00, or 1.33% Ca; 5 to 8) treatments 1 to 4 with 500 FTU of phytase. Increasing Ca from 0.67 to 1.33% linearly decreased (P < 0.001) BBS, bone weight, ash weight, and ASH. The increase (P = 0.006 to P = 0.026) in bone weight, ash weight, and ASH with phytase supplementation was greater in broilers fed the higher level of Ca. The results of this research indicate that dietary Ca level, within the ranges used in this experiment, has no negative effect on the efficacy of phytase.

Key Words: broiler, phytase, calcium

M18  Assessment of a new phytase enzyme on live performance and bone parameters in broilers. A. L. Shaw*, J. B. Hess, J. P. Blake1, and N. E. Ward, 1Department of Poultry Science, Auburn University, Auburn, AL, 2DSM Nutritional Products Inc., Parsippany, NJ.

An experiment was conducted to evaluate the effects of a new phytase enzyme (IPA) fed to broilers through 21 d of age. Male Ross 708 chicks (384) were placed across 48 pens of grow-out batteries (8 birds/pen, 8 reps/trl). All birds were fed a corn-soybean meal diet (22% CP, 3087 kcal/kg) adequate in all nutrients but available phosphorus (aP). Dietary treatments were created using 3 aP levels (0.22, 0.30, or 0.38%) and 3 IPA levels (500, 1000, or 2000 FTU/kg) in combination with 0.22% aP. On d 21, BW and FC were recorded for each pen and FCR was corrected for mortality. Twenty-four birds/trl were sacrificed for removal of the left tibia and middle toe for breaking strength (tibia only) and ashing. Supplementation of 0.22% aP diet with 1000 or 2000 units of IPA induced BW not different from the 0.38% aP treatment (mean of 672 g), an improvement (P < 0.001) over the 0.22% aP diet (578 g). FCR of the two highest levels of IPA did not differ from the 0.38% aP level birds (1.503, 1.510 and 1.576, resp.), while breaking strength of birds fed 500 and 1000 units of phytase was similar to that of birds fed 0.30% aP (10.9, 12.2, and 10.8 kg, resp.). Each level of phytase sequentially increased (P < 0.05) tibia ash and 2000 FTU/kg was equivalent to the 0.38% aP diet. Percent toe ash, either non-dried or dried, was highest in birds provided 0.38% aP and declined (P < 0.001) with a decrease in aP. Regardless of inclusion level, percent toe ash for birds provided a 0.22% + IPA diet was intermediate to the two highest levels of aP. The addition of all IPA levels reduced (P < 0.001) phosphorus (P) excretion in comparison with the three aP levels (mean of 0.63% vs. mean of 0.98% P). Inclusion of the IPA phytase enzyme at up to 2000 FTU/kg provides similar growth performance and skeletal stability as 0.38% aP through 21 d of age.

Key Words: phytase, tibia ash, toe ash, bone strength, broiler

M19  Phytase efficacy in broiler chickens when crop digesta pH is altered with fumaric acid. E. Quansah*, R. Angel, F. Siewerdt, and W. Saylor, 1University of Maryland, College Park, 2University of Delaware, Newark.

A chicken trial was conducted to determine the impact of two commercial phytases (PHY) on phosphorus (P) retention when 1% fumaric acid (FA) was included in a low non-phytate P (NPP) diet fed to Ross 708 broilers. Based on preliminary in vitro pH optima of two PHY
Broiler response to increasing dietary phytic acid concentration during a live coccidia oocyst vaccination. R. N. Lehman*, 1, A. P. McElroy1, and A. J. Cowieson2. 1Virginia Tech, Blacksburg, 2AB Vista, Wiltshire, Marlborough, United Kingdom.

The effect of increasing concentrations of dietary phytic acid on coccidiosis-vaccinated and non-vaccinated broilers was evaluated. Day old Cobb 700 male broilers were obtained from a commercial hatchery, weighed, and half were spray-vaccinated with a live coccidia oocyst vaccine (Coccivac-B) before placement into one of 72 floor pens with clean pine shavings (35 chicks/pen). Vaccinated and non-vaccinated birds were given one of three diets with different phytic acid (PA) concentrations (low PA = 0.20% PA; medium PA = 0.28% PA; high PA = 0.36% PA) for a total of 6 vaccination X diet treatments (12 replications/treatment). The non-vaccinated birds did not receive any type of coccidiosis control for the 30 day trial. Body weight (BW) and feed intake (FI) were measured on days 18 and 30, and mortality was recorded daily. Non-vaccinated birds had improved (P < 0.05) feed conversion (FC) during the day 18 to 30 period. Birds fed the medium PA diet generally had the best FC compared to the low and high PA diets during each period (day 0 to 18 and 18 to 30) and cumulatively day 0 to 30. Vaccination caused a decrease in FI and body weight gain (BWG), while increasing PA concentrations increased FI and BWG causing a significant vaccination X dietary PA interaction (P < 0.05) for days 0 to 18, 18 to 30, and 0 to 30. There was a significant vaccination X dietary PA interaction for BW for day 18 to 30 and 0 to 30 periods. Vaccination caused a significant increase in mortality, mainly due to necrotic enteritis, during all periods. Birds fed the medium PA diet had significantly higher mortality than the other two diets, causing a significant (P < 0.0001) quadratic effect of PA on mortality of vaccinated birds while no effect of PA was seen on mortality of non-vaccinated birds. These results suggest a possible interaction between the level of dietary PA and coccidia vaccination, which was most evident in mortality.

Key Words: phytate, broiler, coccidia, phytic acid, vaccination

M21 The nutritional and feeding value of different single cell protein products. L. Larsen* and A. Batal, University of Georgia, Athens.

Studies were conducted to determine the nutritional parameters and feeding value of new single cell protein (SCP) products that are being produced for use as a new feed ingredient. Three chick experiments were conducted along with conventional and cecotomized precision-fed broiler assay techniques for the determination of the TMEa and amino acid digestibility values. The TMEa ranged from 2,378 to 3,712 kcal/kg, with a mean of 3,067 kcal/kg. Protein ranged from 33.6 to 45.5%, with a mean of 42.8%. Mean (and range) values for fat, fiber, and ash were 7.1 (4 to 13.5), 2.1 (1 to 4.1), and 5.5 (2.8 to 8.0%), respectively. Total concentration and percent availability, respectively, of several critical amino acids were: lysine, 2.45% (87); methionine, 0.81% (88); cystine, 0.69% (77); threonine, 1.83% (79); and arginine, 2.31% (91). In experiment 1 and 2, 1-d-old male broiler chicks were placed in Petersime battery brooders and maintained on a 24 h lighting schedule in a thermostatically controlled room. In Experiment 3, 1-d-old male broiler chicks were placed in floor pens equipped with hanging tube feeders, a Ziggity watering system and pine wood shavings. Chicks were maintained on a 24 h lighting schedule for the first 3 days and then a 23 h lighting schedule (1hr dark) in a thermostatically controlled room. Chicks had ad libitum access to feed and water from 0 to 42 d of age. Chicks were randomly assigned to the dietary treatments with 8 replicate pens containing 6 to 40 chicks each. The addition of 4.5 to 7.5% SCP in broiler diets significantly reduced body weight gain and increased feed efficiency as compared to birds fed diets with no SCP. However, the addition of 0.5% increased performance. There appears to be dramatic differences in SCP products due to species of yeast and processing. Due to new technologies employed in ethanol plants, by-products that have unique nutritional qualities are being produced and confirmatory analyses should be conducted prior to utilizing these and new co-product.

Key Words: single cell protein, broiler, TME, amino acid


An experiment was conducted to determine the effect of Virginiamycin or Calsporin in high and low energy corn-soybean meal (C-SBM) diets for Ross x Ross 708 broilers (0 to 18 d of age). Broilers were housed in environmentally controlled Petersime brooder batteries with continuous fluorescent lighting. Two hundred and sixteen female broilers were weighed, wing banded, and randomly allotted on the day of hatch to one of 6 dietary treatments, each with 6 replicates of 6 broilers per replicate pen. Broilers were fed either a low or high energy (2,900 or 3,200 kcal/kg) C-SBM diet or these 2 diets supplemented with either 16 ppm Virginiamycin or 12 ppm Calsporin in a 2 x 3 factorial arrangement. All diets were formulated to contain 1.43% total Lys and to maintain a ratio of TSAA:Lys of 0.75 and Thr:Lys of 0.70. All other nutrients met...
or exceeded the nutrient requirements for 0 to 3 wk old broilers. All diets contained 1% Ca and 0.45% nonphytate P. Broilers fed the high energy diets had greater \( (P < 0.001) \) ADG, G:F, and bone breaking strength (BBS) compared with broilers fed the low energy diets. Broilers fed Virginiamycin had higher \( (P = 0.010) \) ADG, G:F, and BBS compared with the broilers fed the unsupplemented diets or the diets supplemented with Calsporin. However, G:F was improved more \( (P = 0.07) \) in broilers fed the low energy diet with Virginiamycin. Calsporin had no effect \( (P > 0.10) \) on growth performance or BBS compared with broilers fed the unsupplemented diets. These data indicate that Virginiamycin improved growth performance and BBS in high or low energy C-SBM diets for 0 to 18 d-old broilers and this improvement was not achieved with the supplementation of Calsporin.

**Key Words:** broiler, Virginiamycin, Calsporin, bone

### M23 Enzyme supplementation of corn-based diets with or without distillers dried grains with solubles (DDGS) for broilers.

M. H. Schwartz*, 1, N. E. Ward, 2, P. R. Fercket, 3, and J. Brake, 1, 3North Carolina State University, Raleigh, 2DSM Nutritional Products, Inc., Parsippany, NJ.

The potential economic value of supplemental enzymes that improve energy availability increases as dietary energy costs increase, especially when they are used in low energy diets that may contain grain by-products such as distillers dried grains with solubles (DDGS). Ross 708 broilers chicks were randomly distributed among 72 pens (16 males and 16 females/pen), each assigned to one of 12 dietary treatments arranged as a factorial of 2 dietary energy levels (low and high), 2 dietary DDGS inclusion levels (0 and 10%), and 3 dietary enzyme treatments (control, Ronozyme® WX, Roxazyme® G2; DSM Nutritional Products, Inc.). Ronozyme® WX is a xylanase product, while Roxazyme® G2 contains a broad array of enzymes. The high and low dietary energy treatment levels differed by 200 kcal ME/kg. Broilers were fed 3 phases of mash feed that approximated requirements of digestible nutrients by age. BW and feed conversion ratio (FCR) were determined at 14, 35, 42, and 49 d of age. There were no treatment interaction effects beyond 14d. The high energy diets significantly increased 49 d BW of females \( (2.60 vs 2.69 \text{ kg}, \ P < 0.01) \) and males \( (3.21 vs 3.35 \text{ kg}, \ P < 0.01) \), and improved mixed sex 1-49 d FCR \( (2.06 vs 1.98, \ P < 0.01) \). Dietary enzyme supplementation improved 14 d BW of females \( (0.42 vs 0.44 \text{ kg}, \ P < 0.05) \) and males \( (0.45 vs 0.46 \text{ kg}, \ P < 0.05) \) and improved 1-14 d FCR \( (1.81 vs 1.66 vs 1.73, \ P < 0.05) \). Dietary DDGS inclusion had no significant effect on 14 d BW, but improved 1-14 d FCR \( (1.78 vs 1.68, \ P < 0.05) \). There were significant energy X enzyme interaction effects for 14 d male and female BW, but not for 1-14 d FCR. Dietary enzyme supplementation improved both male and female BW by approximately 6% in the low energy diets but by only 2 to 5% in the high energy diets. FCR improved at 14 d by 11.4% and 4.7% with enzyme supplementation in the low and high energy diets, respectively. Enzyme and DDGS supplementation in starter diets were most effective on broiler growth performance.

**Key Words:** growth performance, DDGS, xylanase, carbohydrase, broiler

### M24 Effects of varying levels of DDGS on pelleting characteristics and feed mill efficiency.

R. E. Loar II*, 1 J. S. Moritz, 2 and A. Corzo, 1, 1Mississippi State University, Mississippi State, 2West Virginia University, Morgantown.

Little research has been conducted on the use of high DDGS inclusion and feed manufacture consequences. Four diet formulations were manufactured using a Latin-square experimental design. Treatments consisted of: 1) a conventional diet with no DDGS inclusion as the control diet, 2) a nutritionally similar diet with 15% DDGS, 3) a nutritionally similar diet with 30% DDGS, and 4) a nutritionally similar diet with 30% DDGS and 2% sand. The latter treatment was created to assess the effectiveness of sand use to enhance milling variables. Feed rate into the conditioner was held constant, producing a goal through-put of approximately 1.2 MT/hr, slightly above the rated mill capacity of 0.9 MT/hr to simulate industry practice. Conditioning temperature was 82.2°C and pellets were formed using a 40-horsepower California pellet mill with a 4.76 x 38.10 mm (3/16 x 1 and 1/2-inches) die. Variables measured included production rate, relative energy usage of the conditioner, relative energy usage of the pellet mill, pellet durability index (PDI), modified pellet durability index (MPDI), and total fines produced. Significant results \( (P < 0.05) \) were obtained for all variables measured with the exception of production rate \( (P = 0.07) \). The diet containing 15% DDGS reduced \( (P < 0.05) \) conditioner electrical energy usage compared to both 30% DDGS feeds, while the control was intermediate. The control feed resulted in greater \( (P < 0.001) \) pellet mill relative energy usage compared to all other treatments. The control yielded \( (P < 0.001) \) pellets with more structural integrity, as measured by PDI and MPDI, than any other treatment, while the 30% DDGS feeds resulted in the poorest values; inclusion of 15% DDGS had intermediate PDI and MPDI measurements. The inclusion of 30% DDGS produced a higher \( (P < 0.001) \) value for total fines than the other treatments, with the control feed producing the least fines and the diet with 15% DDGS being intermediate. It is clear that the use of high levels of DDGS in the diet causes pellet quality to decrease while reducing energy usage at the pellet mill. The use of sand in the formulation did not result in milling variable enhancement.

**Key Words:** DDGS, pellet mill, conditioner, PDI, MPDI

### M25 Evaluation of expeller-produced and solvent-extracted soybean meal at two particle sizes on broiler performance.

W. J. Pacheco*, C. R. Stark, P. R. Ferket, and J. Brake, North Carolina State University, Raleigh.

Expeller soybean meal is what remains after the oil is mechanically removed from whole soybeans. Expeller soybean meal (ESBM) typically has a higher fat and energy content but lower protein than solvent-extracted soybean meal (SSBM). Local production of ESBM can benefit both the soybean grower and livestock producer by reducing the cost associated with the movement of soybeans and soybean meal (SBM). The objective of this study was to evaluate the nutritional value of ESBM, as compared to SSBM and the effect of SBM particle size on broiler performance. The experiment was a 2 x 2 factorial of SBM type (ESBM and SSBM) and particle size (coarse and fine). The fine SBM was produced by grading the material through a 1.6 mm hammermill screen (390 microns), the coarse treatments were fed as received from the supplier (1,040 microns). A total of 1,024 male 1-d old broiler chicks were randomly assigned to one of four treatments with 8 replicate pens per treatment and 32 birds per pen. The starter diets were fed in crumbled form and the grower and finisher diets in pelleted form. Commercially available SSBM and ESBM were used in the experiments. The SBM was analyzed for moisture, crude protein, and crude fat, which were then used to estimate the ME of the SBM. The estimated ME content of ESBM and SSBM was 2,800 and 2,588 kcal/kg, respectively. Feed consumption and BW were determined at 14, 35, 42, and 49 d of age and...
M26  Dietary lysine and energy response surface estimates for growing broilers.  A. C. de Leon*, W. B. Roush2, A. Corzo1, W. A. Dozier1, and M. T. Kidd1, 1Department of Poultry Science, Mississippi State University, Mississippi State, 2Agriculture Research Service, USDA, Mississippi State, MS.

The aim of this study was to determine the effect of ME to the estimated Lys, TSAA and Thr requirement from a previous experiment (de Leon et. al., 2006). Ross X Ross 308 broilers (676) were allotted to 52 pens (13 birds per pen) at d 1. At d 15, dietary independent variables were digestible Lys (0.98, 1.00, 1.05, 1.10 and 1.12 %) and AME (3,104, 3,125, 3,175, 3,225 and 3,246 kcal/kg) and were optimized using a central composite design. This design involved 8 design points equidistant around the center point. The center point was replicated five times creating 13 treatments. Each treatment was replicated four times. Analyzed amino acid levels of corn and soybean were utilized for linear programming formulation. Diets contained adequate or surplus nutrients except Lys and AME. BW and feed intake were measured at 15 and 35 d. Live weight and carcass measurements were taken from randomly selected birds in all pens (five birds per pen) at d 35. During slaughter front and back half weights and abdominal fat weights were recorded. No significant differences (P > 0.05) based on lack of fit (P > 0.005) were detected for BW gain, feed intake, feed:gain, carcass weight, carcass yield, front half weight, front half yield, back half weight, back half yield and mortality. Linear differences (P < 0.05) based on lack of fit (P > 0.005) were detected for abdominal fat weight and abdominal fat percentage. Response surface predicted maximal response levels (% of dietary Lys and metabolizable energy for: abdominal fat pad, 1.11% and 2,898 kcal/kg, respectively, and abdominal fat yield, 1.15% and 2,857 kcal/kg, respectively. Average recommendation of responses for digestible Lys and metabolizable energy were 1.13 % and 2,878 kcal/kg respectively. It appears that dietary energy levels do not affect skeletal muscle protein deposition and that skeletal muscle protein deposition is primarily affected by the concentration of the limiting amino acid in the diet.

Key Words: lysine, energy, broiler, amino acids

M27  Differential lysine utilization by growing broiler chicks fed a lysine limiting diet.  M. A. Raymond* and B. D. Humphrey, California Polytechnic State University, San Luis Obispo.

Lysine is first or second limiting for growth in poultry, yet the mechanisms controlling the utilization of lysine within tissues are not well understood. The objective of this study was to develop a lysine utilization model to allow for the identification of possible mechanisms regulating lysine use by tissues, especially the pectoralis. Male Cobb broiler hatchlings were weighed, identified with a wing band, placed in battery pens and fed a lysine adequate diet (LA; 1.3% lysine; 3,200 kcal ME/kg) ad libitum for three days. On d 3 posthatch, chicks were weighed, randomly assigned to pens and provided either a LA or lysine deficient diet (LD; 0.66% lysine; 3,200 kcal ME/kg). On d 14, individual chicks were sorted based upon gain between d 3 to 14. LD chicks with the highest gain were designated as high lysine utilizers (HLU; n=10) and birds with the lowest gain were designated as low lysine utilizers (LLU; n=10). LA chicks with average gain were assigned to one of three treatments: HLU pair-fed (n=10), LLU pair-fed (n=10), or control (C; n=5). These identified chicks were housed in individual pens and performance was measured for 3 d. Feeding the LD diet reduced body weight compared to C (P < 0.05); however, HLU chicks body weight was 2.3-fold greater than LLU chicks (P < 0.05). Despite differences in body weight, feed intake as %BW was similar (P > 0.05) between C, HLU and LLU chicks. C chicks consumed the most lysine as %BW (P < 0.05) while lysine intake as %BW between HLU and LLU chicks was similar (P > 0.05). Even with similar lysine intake as %BW, HLU chicks gain and breast yield was 134% and 61% greater than LLU chicks, respectively (P < 0.05). Lysine intake as %BW was similar (P > 0.05) between HLU, LLU and pair-fed controls, indicating that the observed differences between HLU and LLU chick performance was not due to differences in lysine intake. Collectively, differences in gain and breast yield between HLU and LLU chicks indicate differential lysine utilization despite similar lysine intake.

Key Words: food intake, lysine, pectoralis

M28  Incubation temperature effects on leg abnormalities of broilers fed TD and P rickets inducing diets.  M. Y. Shim* and G. M. Pesti, University of Georgia, Athens.

It would be of great benefit to manipulate the development of leg bone by making simple changes to incubation temperature such that chickens are better able to reduce the incidence of abnormalities. Raising the temperature of the eggs by just on degree, from 37.5°C to 38.5°C, during embryonic days (ED) 4 – 7 can increase the length of tibia and tarsus bones in Leghorns (Hammond et al., 2007). Oviedo-Rondon et al. (2008) concluded that tibias of broilers were longest at 38°C compared to 36, 37 and 39°C. They also concluded that temperatures greater than 37°C should be avoided to ensure optimal bone development at hatching. This study tested the hypothesis that increasing or decreasing the temperature of the eggs by just one degree, from 37.5°C to 38.5°C, during 3 days during early incubation (ED)4 – 7 affects hatchability, growth and leg abnormalities, of broilers fed Tibial Dyschondroplasia (TD) and Phosphorus (P) rickets inducing diets. Experiment 1 was conducted with control and TD inducing diets for 16 d with 240 Cobb 500 broiler chicks incubated at 37.5 and 38.5°C during embryonic days (ED) 4 – 7 can increase the length of tibia and tarsus bones in Leghorns (Hammond et al., 2007). Oviedo-Rondon et al. (2008) concluded that tibias of broilers were longest at 38°C compared to 36, 37 and 39°C. They also concluded that temperatures greater than 37°C should be avoided to ensure optimal bone development at hatching. This study tested the hypothesis that increasing or decreasing the temperature of chick incubation by as little as 1°C for 3 days during early incubation (ED)4 – 7 affects hatchability, growth and leg abnormalities, of broilers fed Tibial Dyschondroplasia (TD) and Phosphorus (P) rickets inducing diets. Experiment 1 was conducted with control and TD inducing diets for 16 d with 240 Cobb 500 broiler chicks incubated at 37.5 and 38.5°C during ED4 – ED7. Eggs hatched earlier, and more hatched, at 38.5°C. Only diet caused significant differences in leg problems. Experiment 2 was conducted with control, TD and P rickets inducing diets for 16 d with 450 Cobb 500 broiler chicks hatched from 705 eggs and incubated at 36.5, 37.5 and 38.5°C during ED4 – ED7. Egg setting times were plus 17 hours for 36.5°C eggs and minus 9 hours for 38.5°C compared to standard setting for 37.5°C (50th). Hatchability of fertile eggs (93.06%) was highest at 37.5°C and decreased at 36.5°C (89.81%) and 38.5°C (81.13%). Body weights were lower (43.17g) at 38.5°C than those (44.77g) at 37.5°C, because they were dried out. Incubation temperature did not reduce leg disorders.
As little as 1°C for 3 days during early incubation (ED4 – ED7) affected hatching time and weight.

**Key Words:** Incubation temperature, broilers, hatchability, TD, P rickets

M29 **Performance and carcass characteristics of broilers fed variously treated cocoa bean shell based diet.** M. D. Olumide*1 and R. A. Hamzat1, 1University of Ibadan, Ibadan, Oyo, Nigeria, 2Purdue University, West Lafayette, IN.

Cocoa bean shell is a waste obtained from cocoa processing industries. There is paucity of information on the extent to which cocoa bean shell (CBS) can replace maize which is the main energy source in poultry diets. This calls for need to investigate the utilization of this by product from cocoa industries as feed resources for commercial poultry production. This study investigated the effects of graded levels of variously treated CBS based diets on performance and carcass characteristics of broiler chicks. Three hundred and ninety (390) day old anak broiler chicks were used for this trial, with 30 birds per treatment. The chicks were replicated thrice with 10 birds per replicate in a 3 x 4 factorial design. A total 13 diets were formulated such that maize was replaced with graded levels of raw, enzyme treated and fermented CBS. The replacement was in the order of 0 %, 5%, 10%, 15% and 20% of each of the differently processed CBS. Some of the performance and carcass characteristics that were monitored include: feed intake, feed conversion ratio (FCR), live weight, eviscerated weight and dressed percentage. The feed conversion ratios of CBS-based diets were significantly influenced by dietary inclusion of CBS. Addition of enzyme enhances the quality of cocoa bean shell, while no significant different was observed in the dressed percentage of birds fed variously treated CBS based diets. CBS with addition of enzyme can effectively replaced maize in the diets of broilers.

**Key Words:** broiler, performance, carcass, graded levels, enzyme

Environment and Management I

M30 **Natural treatment to counteract the presence of Salmonella spp in digestive organs of chickens.** J. C. García-López*1, E. Zapata-Perez1, G. Álvarez-Fuentes1, Y. Jasso-Pineda1, J. M. Pinos-Rodriguez1, and M. A. Camacho-Escobar2, 1Universidad Autónoma de San Luis Potosí, San Luis Potosí, S.L.P., México, 2Universidad del Mar campus Puerto Escondido, Puerto Escondido, Oaxaca, México.

The presence of *Salmonella spp* in back yard poultry production in México is a very important issue for low income poultry producers in rural areas. However, broiler production is severe affected by gastro intestinal pathogens that have a negative effect on reproduction and production traits. The use of antibiotics is not an option because of high cost, natural treatment with medicinal plants could be the only option. A complete randomized experiment was performed to test the effect of the *Chrysactinia mexicana* plant extract to counteract the *Salmonella spp* challenge. 160 day old Plymouth Rock Barred chicks were assigned to the following treatments: T1 control; T2 control with *Salmonella spp* challenge; T3 control with *Salmonella spp* challenge and plant extract and; T4 control with *Salmonella spp* challenge and antibiotic. Plant extract was administered oral via 20 mg/ml during 21 days, on day 3 and 7 chicks were challenged with *Salmonella spp* 2 mg/kg oral via. On day 22 the birds were sacrificed and crop, gizzard, proventriculus and duodenum contents were collected in a sterile physiological saline solution to perform *Salmonella spp* CFU/ml count. There were differences (*P < 0.05*) in crop, gizzard, proventriculus and duodenum CFU/ml among the different treatments, the highest levels were observed in T2. Birds on treatments with the plant extract and antibiotic had similar (*P > 0.05*) values in colony forming-units in all variables, control treatment had the lowest (*P<0.05*) UCF/ml values. According with these results the use on the plant extract could be a toll for the backyard poultry producers by reducing the impact of bacteria in chick performance; nevertheless, more studies are warrant to elucidate the plant extract function.

**Key Words:** chick, *Salmonella*, digestive organs, plant extract

M31 **Immunomodulatory effects of probiotics on anticoccidial measures in broilers.** K. Stringfellow*1, D. Caldwell1, J. Lee1, A. Klein1, S. Pohl1, M. Mohr1, R. Beltran1, G. Schatzmayr2, S. Fitz-Coy3, C. Broussard1, and M. Farnell1, 1Department of Poultry Science, Texas A&I Life Research, College Station, 2Biomin GmbH, Herzogenburg, Austria, 3Intervet/Schering-Plough Animal Health, Summit, N.J.

Probiotic supplementation in poultry diets has been shown to improve gut health by stimulating innate and adaptive immunity. The hypothesis of this study was that probiotic administration would modulate the avian immune response to coccidial infections in vaccinated or monensin-treated broilers. On day-of-hatch, straight-run broilers were placed in floor pens with built-up litter. Experimental groups consisted of a negative control, probiotic alone, vaccine alone, probiotic with vaccine, ionophore (monensin) alone and an ionophore with probiotic. Broilers were challenged with *Eimeria* oocysts on day 14 and day 36 by feed-application. Peripheral blood was collected from each group on days 6, 22, 36 and 43. Heterophils and monocytes were each assayed for oxidative burst and the proliferation of lymphocytes was also measured. On day 6, heterophil oxidative burst was increased (*P < 0.05*) in the vaccine alone group, vaccine with probiotic group, and the ionophore with probiotic group, when compared to the negative control. Heterophil oxidative burst was also increased (*P < 0.05*) in the ionophore with probiotic group on day 22 and in all treatments on day 43. Monocyte oxidative burst was increased (*P < 0.05*) in the vaccine with probiotic group on days 36 and 43, compared to the negative control. An increase (*P < 0.05*) in monocyte oxidative burst was also observed on day 43 in the ionophore alone group. Lymphocyte proliferation was greater (*P < 0.05*) on days 22 and 36 in the ionophore with probiotic group, when compared to the negative control. Increases (*P < 0.05*) in lymphocyte proliferation were also seen in the vaccine alone and the ionophore alone group on day 43. These data support the potentiation of the avian mucosal immune system with probiotics.

**Key Words:** probiotic, vaccine, Ionophore, immunity, *Eimeria*

Increasing socio-political concerns with antibiotic usage have led to investigations of potential probiotic alternatives for food safety and growth promotion. Spore based probiotics are amenable to feed inclusion and extremely stable. We isolated several *Bacillus* spp from environmental and poultry sources and tested them for their ability to reduce *Salmonella in vitro*. In a preliminary *in vivo* trial, day-of-hatch chicks and pouls were randomly assigned to the following treatments (24 birds/trt): negative control and one of eight different probiotic candidates at 10⁷ g of feed (all experiments), tagged, weighed and orally challenged with *Salmonella typhimurium* (ST) (10⁵ cfu/bird). Body weight (BW) and ST recovery was performed 11 days post-hatch (dph). Total percent ST positive crop and cecal tonsils was significantly lower (*P* < 0.05) in at least three candidates as compared to controls. Additionally, pouls treated with PHL-NP122 had significantly higher (*P* < 0.05) body weight gain (BWG) as compared to controls. In a repeat trial, birds treated with PHL-NP122 had significantly lower (*P* < 0.05) total percent ST recovery than controls. Further, isolates PHL-MM65 and PHL-NP122 were evaluated in pouls raised under commercial conditions. At 7 dph, 480 pouls (30 pouls X 4 replicates/trt) from within the house were tagged, weighed and randomly assigned as: negative control, nitarson, PHL-MM65 or PHL-NP122. At 23 days, the pouls were weighed and BWG calculated. PHL-NP122 (727 g), and nitarson (726 g) were found to be significantly heavier (*P* < 0.05) than the negative control (695 g), while PHL-MM65 (668 g) was numerically (not significantly) heavier than the controls. In conclusion, PHL-NP-122 markedly reduced *Salmonella* in chicks and pouls and increased performance. The use of this isolate alone or in combination with other selected *Bacillus* isolates as probiotics has potential implications in poultry health and disease.

**Key Words:** *Bacillus*, *Salmonella*, probiotics

M33  Impact of light intensity on commercial broiler production, mortality and processing characteristics. A. Deep*,1, K. Schwean-Lardner*, B. Fancher†, and H. L. Classen†,1*University of Saskatchewan, Saskatoon, SK, Canada, †Aviagen North America Ltd, Huntsville, AL.

Manipulation of light intensity is an important management tool affecting broiler production and well being. Despite considerable research on light intensity, there is still debate on the optimum level to be used for intensively housed broilers. Two trials were conducted with the objective of investigating the effect of light intensity within the practical levels at confinement barns (1, 10, 20 and 40 lux) on production and processing characteristics of broilers raised to 35 d of age. Each light intensity treatment was replicated in two environmentally controlled rooms in each trial with approximately 950 Ross x Ross 308 chicks (equal number of males and females) per room. Data were analyzed as a randomized complete block design with trial serving as a block. All chicks were exposed to 40 lux light intensity and 23 h light for first seven days followed by treatment light intensity and 17 h daylength thereafter. Body weight and feed consumption were determined at 7, 14, and 35 d of age. At the end of each trial 60 birds (30 males and 30 females) per treatment were processed to determine the detailed meat yield. Body weight, feed consumption, feed conversion ratio and mortality were unaffected by light intensity (*P* > 0.05). Broilers exposed to dim light (1, 10 lux) had heavier carcass weight (*P* = 0.001) as a percentage of live weight in contrast to bright light (20, 40 lux). Thighs (*P* = 0.02) and drums (*P* = 0.02) decreased linearly with increasing light intensity from 1 to 40 lux. The 1 lux treatment resulted in heavier wings as compared to other treatments (*P* = 0.0001). All other processing characteristics were not affected by light intensity (*P* > 0.05). Overall, broiler production and mortality were not significantly affected by light intensity levels, but differences were noted in some processing characteristics (carcass weight, thighs, drums, and wings).

**Key Words:** broiler, light intensity, production, mortality, meat yield

M34  The in ovo injection of 25-hydroxycholecalciferol affects the tibiotarsus characteristics of broiler embryos subjected to a suboptimal incubation temperature regimen. A. T. Matthews*, L. W. Bennett, and E. D. Peebles, *Mississippi State University, Mississippi State*

Effects of the in ovo injection of 25-dihydroxycholecalciferol (D₃) on the tibiotarsus characteristics of broiler embryos subjected to a suboptimal incubation temperature regimen were determined. Tibiotarsus characteristics examined included their proportional weight, ash content, calcium content, and breaking strength. Ross 308 broiler hatching eggs were incubated under standard commercial conditions except on d 12 to 16 of incubation, in which the dry bulb temperature was lowered to 36.5°C. The following injection treatments were tested: non-injected, dry perforation, commercial diluent, 48 IU of D₃ added to diluent (1.4 µg/100 µl), and 96 IU D₃ added to diluent (2.8 µg/100 µl). An automated single egg injector with a blunt needle penetrated the large end of the egg with a depth of 2.49 cm to target the amnion for solution delivery. Eggs were incubated until d 20, when they were weighed and tibiotarsae were extracted for analysis. The 48 IU D₃ treatment significantly increased, while the 96 IU D₃ treatment significantly decreased, calcium concentration in whole tibiotarsae and in their ash component in comparison to all 3 control groups. No other treatment effects were noted. In conclusion, a d 16 in ovo injection of 48 IU of D₃ increases, whereas 96 IU of D₃ decreases, the tibiotarsal calcium content of broiler embryos.

**Key Words:** broiler, embryo, in ovo injection, tibiotarsus, vitamin D₃

M35  Effect of pre-incubation storage conditions on the two week livability and performance of broilers. S. M. Whipple*, J. R. Moyle, D. E. Yoho, F. D. Clark, and R. K. Bramwell, *University of Arkansas, Fayetteville*

Seven and 14 day mortality of broiler chicks is often associated with egg handling and hatchery and incubation conditions although the exact cause of this mortality is not fully understood. Therefore, three experiments were conducted to determine if factors which are known to affect embryo mortality would also affect 14 day chick livability. Egg storage length, in-vivo sperm storage length, and egg temperature fluctuations were the pre-incubation storage conditions. The first experiment looked at egg storage length in a hatching cooler on the livability and performance of broilers. The eggs were stored at 68°F in three time intervals; 0-5 days storage, 6-10 days storage, 11-15 days storage. Sperm storage in-vivo was the second experiment performed. Hens were inseminated to allow for groups of 0-5 days in-vivo sperm storage, 6-10 days in-vivo storage, and 11-15 days in-vivo storage. Lastly, the third experiment focused on fluctuating temperatures of eggs in storage. The three test groups for fluctuating temperatures were comprised of a control maintained at 70°F for three days, and two groups that were fluctuated...
between 65°F or 75°F for 24 hour intervals before finally brought back to control at 70°F. For all three trials, a two week broiler growout was performed to determine the effect these parameters had on livability and performance of broilers. Overall, there were no differences observed in the livability of the broilers or in their mean body weight, nor were there as the cause of death from necropsy data. Though these factors have been shown to decrease embryo livability there seems to be no relation to the seven and 14 day livability of broiler breeders hatched from eggs subjected to these conditions.

**Key Words:** egg storage length, sperm storage, broiler performance, egg storage temperatures, broiler livability

### M36 Effects of different turning frequencies during incubation on broiler embryo development. Y-M Lin* and J. T. Brake, North Carolina State University, Department of Poultry Science, Raleigh.

This study investigated the effects of two different turning frequencies on embryonic development in the broiler. Eggs were obtained from Ross 344 male x Ross 308 female broiler breeders at 34 wk of age. Eggs were weighed before preheating at 75°F for 12h prior to setting. Incubators were operated at an air temperature of 38.1°C and 53% RH until E 3 of incubation. From E 3 to E 15, the incubation air temperature was 37.5°C and then lowered to 37.4°C on E 16-E 17, 37.3°C from E 18-E 19, and 36.9°C thereafter. Each of 200 individually weighed eggs constituted a replicate. Eggs were turned either hourly (24X) or four times hourly (96X) to E 19 before transfer to hatching baskets in pedigree bags. Eggs were necropsied at E 14 of incubation to determine embryo length, and weights of the egg, embryo, yolk sac, and fluids. After the remaining eggs hatched at 20.5 d, chick BW and length were measured. Egg weight loss was greater but with greater variance for the 96X eggs at E 14, but chick weight, relative to initial egg weight, was less at hatching although the 96X chicks were longer. There was again greater variance in chick weight in the 96X chicks. The 96X turning altered the development of the chick embryo, which was observed in 14 d embryo weight and chick length at hatching as well as in the greater variance of several measurements, such as 14 d egg weight loss, relative 14 d egg weight, relative fluid and embryo weight, and relative chick weight.

**Key Words:** broilers, incubation, turning frequency

### M37 Reducing the growth rate in turkeys improves femoral bone quality. R. C. Van Wyhe*1, B. J. Powell2, R. C. Haut2, M. W. Orth1, and D. M. Karcher1, 1Department of Animal Science Michigan State University, East Lansing, 2Orthopaedic Biomechanics Laboratories, Michigan State University, East Lansing.

Selection for rapid growth in turkeys increased skeletal problems such as femoral spiral fractures. Based on broiler research, the hypothesis investigated in this study was that slowing growth of turkeys by reducing energy (E) and crude protein (CP) in the diet would result in increased femur integrity. Commercial turkeys were fed 1 of 3 diets: a control (C) (100% of NRC E levels and CP), 80% (80% of NRC E levels and CP), or 60% (60% of NRC E levels and CP) diet. All other nutrients met or exceeded NRC requirements. Control birds were grown to 20 wks of age, while the 80% and 60% groups were sampled when body weight matched that of C birds at wk 4, 8, 12, 16 and 20. Feed intake was measured and legs were collected every 4 wks. Feed intake and feed conversion were higher (P<0.0001) for 60% fed birds. Both femurs were extracted with 1 being measured, ashed, and mineral content evaluated while the other was torsionally broken to evaluate mechanical properties. Total length, shaft length, diameter, cortical thickness, and cortical density were measured for physical parameters. The total femur length was longer in the 60% fed birds at wk 8 and 12 compared to C (P<0.05); this significance was lost by wk 16. At wk 4, 8 and 12 ash content was higher in the C birds than in the 60% fed birds (P<0.05). At wk 16, the 60% fed birds had the highest femur ash (P<0.05). The mechanical testing parameters were failure torque (FT), shear strength (SS), and shear modulus (SM). The 60% diet produced the highest and best FT (P<0.05) except at 12 wks. The FT for the 80% diet was lower (P<0.05) than both the 60 and C diets. At wk 16 the SS was greater, therefore better, (P=0.01) for the 60% diet than the 80% and C diets. The SM test, another quantitative measure of the mechanical quality of bone, showed no significant differences based on diet, but the 60% diet produced the highest value at each age. In conclusion, reducing the energy and protein in the diet to 60% of NRC recommendations, thus slowing growth, improved bone strength, as measured by FT, and bone quality, as measured by SS, without altering bone length or ash content by the time birds reached market weight.

**Key Words:** femur, turkey, break, ash, mechanics

### M38 Optimization of protease dose with/without xylanase and amylase to increase amino acid digestibility in broilers fed diets with 10% DDGS. M. Argüelles-Ramos*, J. T. Brake3, P. W. Plumstead2, and L. F. Romero2, 1North Carolina State University, Department of Poultry Science, Raleigh, 2Danisco Animal Nutrition, Marlborough, United Kingdom.

An experiment was conducted to determine if the protease activity, or xylanase and amylase (X+A) activities contained in a multi-enzyme product (XAP) contributed to positive effects on amino acid digestibility that had previously been observed when XAP was included in broiler diets. A second objective was to determine if the protease dose that maximised amino acid digestibility in diets containing DDGS was different when protease was included alone, or in combination with X+A enzymes. The experimental design contained a full factorial with four doses of protease (0, 2500, 5000, or 10000 u/kg feed) included with or without a combination of X+A. The 8 test diets were fed to 4 replicate pens of 13 male Cobb 500 broilers from 14 d of age. At 21 d birds were killed and digested of the terminal ileum removed, freeze dried, and digestibility coefficients of amino acids determined using TiO2 as an indigestible marker. All data were analyzed by ANOVA using quadratic regression equations to describe the response in amino acid digestibility to incremental doses of protease. The addition of X+A to the control diet had no effect on amino acid digestibility. There was no significant interaction of X+A and protease dose. Increasing protease, either on its own, or in combination with X+A, resulted in a significant step-wise improvement in amino acid digestibility, which reached a maximum at ~5000 u/kg feed for the average of all amino acids, and ranged from 4120 u/kg for Threonine to 5120 u/kg feed for Isoleucine. Further increases in protease above these optimum levels, reduced amino acid digestibility again. These data confirmed that protease addition alone or in combination with X+A increased amino acid digestibility, which was maximized at ~5000 u protease/kg feed when diets contained 10% DDGS.

**Key Words:** protease, amino acid, digestibility, DDGS, broiler

One of the more difficult tasks when raising broiler breeder cockerels is controlling weight gain in the rearing house without inflicting excess stress. This is a period of time for the young male when many portions of their reproductive system are in the formative stages and, if neglected, can have long life effect on their reproductive performance. The objective of this study was to raise males under feed management programs which produced the recommended target body weight of 3.060 Kg for males at 12, 15, 18, 21 and 24 weeks of age. Males were placed at three week intervals so that all males were light stimulated at the same time but at different ages with the same body weight. All males were reared in the same light controlled house at the University of Arkansas Research Farm. Males were light stimulated and tested development, complete semen analysis, fertility and mating activity and behavior being recorded for each group of males. Results for mating behavior showed that younger males at the time of lighting were less successful at completing matings, crowed less often, as well as showed less wing flapping and neck flaring than older males. Males that were older at the time of lighting had higher fertility than younger males. Males that were 24 weeks old at the time of lighting had an overall fertility of 94.5%, compared to 91.8%, 91.6%, 79.2%, and 87.3% for the other ages respectively. This study found that males that were exposed to light at ages of less than 18 weeks old showed lower fertility than older males. Younger males also exhibited less overall mating activity than older males.

Key Words: broiler breeder, lighting, mating behavior, fertility

M40 Evaluation of feed form on live performance and meat yield of broilers from 15 to 42 days of age. C. K. Gehring, K. C. Behnke, S. L. Brantos, and W. A. Dozier, III, Auburn University, Auburn, AL, Kansas State University, Manhattan, USDA, Agricultural Research Service, Mississippi State, MS.

Providing high quality pellets to meat birds impacts the rate and efficiency of growth. Both utility cost for feed manufacturing and feed ingredient prices have reached market highs and obtaining optimum feed conversion is paramount to the broiler industry. Effective strategies are needed to reduce milling costs while not compromising broiler performance. This study examined the effects of feed form on live performance and meat yield of broilers from 15 to 42 d of age. One thousand six hundred Ross x Ross 708 male chicks were randomly distributed into 32 floor pens at 1 d of age. A three-feed program was fed from 1 to 14, 15 to 28, and 29 to 42 d of age. Common starter feed was provided from 1 to 14 d of age. On d 15, 4 dietary treatments were fed: A) High quality pellets with a pellet durability index (PDI) of 89%; B) Low quality pellets with a PDI of 66%; Different pellet qualities were obtained by varying temperature and the amount of fat added in the mixer; Feeds having a proportion of the formulated corn added post-pellet with a PDI of 89%; The amount of formulated corn was added at 20 and 30%, respectively, post-pellet from 15 to 28 and 29 to 42 d of age; and D) Mash (corn ground via a roller mill). From 15 to 28 d of age, broilers fed either A or B Treatments had 3% higher (P = 0.005) BW than those fed Treatment D. By 42 d of age, feeding Treatment A or B increased (P < 0.05) BW gain and FI by approximately 4% compared with Treatment D. Broilers fed Treatment C had similar cumulative BW gain and FCR compared with birds receiving Treatment A. Broilers provided Treatments A or B had increased (P < 0.05) carcass weight and breast weight by 107 and 37 g per bird, respectively, compared with Treatment D. These results indicate that feeding diets provided as mash form via roller mill grinding limited broiler growth and meat yield.

Key Words: pellet quality, feed form, broiler

M41 Effect of feeder space program during the growing and laying periods on the uniformity and livability of broiler breeder females. N. Lekrisisompong* and J. T. Brake, North Carolina State University, Department of Poultry Science, Scott Hall, Raleigh.

A study was conducted to examine how two feeder space allocations during the rearing period followed by two feeder space allocations during the laying period affected the uniformity and livability of broiler breeder females. Sixteen pens of 76 females each were equipped with either 4 tube feeders (7.0 cm/female) or 6 tube feeders (10.4 cm/female) from 1 to 21 wk of age. Thereafter, 7 males and 64 females were moved to each of 16 breeding pens, photostimulated, and fed sex-separate. The females were then fed from either 3 (6.2 cm/female) or 5 (10.3 cm/female) tube feeders (138 cm circumference pan) per pen to complete a 2 x 2 factorial design with four replicate pens per interaction cell. The four feeder number (feeder space) combinations produced were 4-3 (7.0-6.2 cm), 4-5 (7.0-10.3 cm), 6-3 (10.4-6.2 cm), and 6-5 (10.4-10.3 cm). These represented a small decrease in feeder space per female (7.0-6.2 cm), a similar feeder space (10.4-10.3 cm), an increase in feeder space (7.0-10.3 cm), and a decrease in feeder space (10.4-6.2 cm) as pullets were photostimulated. Individual female BW was determined at 6, 20, and 32 wk of age and uniformity assessed. There were no differences in the BW and uniformity (CV) of broiler breeder females due to feeder space during either rearing and/or laying periods. Increased mortality for the decrease in feeder space combination started immediately during the laying period, but increased mortality coincided with hot weather for the increase in feeder space combination. The best livability was from the least change in feeder space groups. These data indicated that either high or low feeder space as well as increased or decreased feeder space between the growing and laying periods did not affect broiler breeder female BW and uniformity but did affect livability.

Key Words: broiler breeder, feeder space, uniformity


The increasing price of bedding materials is putting a strain on broiler producers. As products such as pine shavings and rice hulls become more difficult to obtain, the law of supply and demand results in high prices of bedding materials. Alternative bedding materials are receiving more attention as traditional materials increase in price and decrease in availability. Gypsum is a by-product of the housing industry and has shown some promise as a bedding material. A trial was conducted to evaluate a 50:50 gypsum:pine shavings combination compared to pine shavings as a bedding material. Commercial straight run broilers were placed at a density of 0.70 ft² per bird in 6 floor pens per treatment containing 3 inches of bedding material. Broilers were fed standard commercial diets and managed according to the primary breeder guidelines. Bird and feed weights were obtained at 0, 7, 21 and 40 d of age. Mortality was monitored daily and ammonia volatilization, litter moisture and pH was determined at 21 and 40 d of age using a Draeger CMS sensor. No differences in broiler performance, livability or paw score were observed.
in this study. Ammonia concentration, litter moisture and pH were significantly lower in the gypsum treatment than the shavings treatment at both 21 and 40 day of age. Percent caking of the litter did not appear to be different between the bedding materials. These data suggest that gypsum could serve as a litter material for broiler production.

**Key Words:** litter, moisture, ammonia, pH


Over the years, it has been realised that malnutrition and starvation is a reality in Nigeria. Despite all efforts that have been made by scientists and the government, Nigerians continue to witness food shortage and a widening gap between the recommended and the daily animal protein intake level. Over 40 percent of Nigerian children are undernourished, which manifest in low weight and height at various degrees of stunting and higher susceptibility to disease infection. This shows the urgency at which we indeed need to maximise the value chain in animal production technology. Value chain analysis describes the activities that takes place in a business which could be grouped under two headings: Primary activities - those directly concerned with creating and delivering a product and support activities and Secondary activities - those that are not directly involved in production which may increase effectiveness or efficiency such as human resource management, procurement, technology development and infrastructure. This study focused on the important roles of primary and secondary activities in livestock production with a view to improve and maximize value chain in livestock production in Nigeria. These areas include: Government and regulatory bodies, Education and Research, Financing and Marketing and Producer Association. The study found that interventions of government are required in providing infrastructural facilities and enabling policy environment. The curriculum for animal production courses is expanded and research should be adequately funded by government and private farms. Credit facilities should also be made available to livestock farmers at concessionary interest rate and the formation of Producer Associations would also go a long way at enabling the farmers to obtain loan and overcome product marketing problems.

**Key Words:** value chain, food shortage, infrastructural facilities, credit facilities, producer associations

**M44 Maternal nutrition and management practices on leg health and bone traits of two strains of broilers.** P. E. Eusebio-Balcazar*1, E. O. Oviedo-Rondón1, J. Brake1, M. J. Wineland1, V. Moraes2, N. Leandro3, and A. Mitchell4 1North Carolina State University, Raleigh, 2Universidade Estadual Paulista, Jaboticabal, SP, Brazil, 3Universidade Federal de Goias, Goiania, GO, Brazil, 4USDA-ARS, Beltsville, MD.

This study was conducted to evaluate the effects of breeder nutrition and management on broiler leg health issues and bone traits. Broiler breeders of two strains (A, B) were housed in 16 pens and fed either corn (C) or wheat (W) based diets during rearing and production. Sigmoid late fast (LF) and sigmoid late slow (LS) feeding programs were used in rearing. At 23 wk, hens and roosters representing the BW distribution from each treatment were moved to a cage breeder house and the hens were placed at either 1 or 2 hens/cage. Hens were insemminated at 44 wk, eggs collected for 8 d and then incubated and hatched. All progeny were pedigreed to track individual breeder hen effects when broilers were placed in floor pens. Broilers were fed the same diet (C, W) as their parents. At 28 and 45 d, broiler gait scores (GS) and prevalence of leg problems were evaluated. Leg bones were collected at 49 d to calculate relative weights, as well as relative asymmetry (RA) of femur, tibias, and shanks. Bone mineral density (BMD) and mineral content (BMC) were determined with DEXA. Data was analyzed as a 2x2x2 factorial design with strain, diet type, feeding program, and cage space as main factors using GLIMMIX of SAS. Broilers from A strain had the poorest walking ability and male broilers from B strain had fewer severe valgus problems at 28 and 45 d. The highest percentage twisted legs was observed with strain A and W-fed broilers. Feed allocation programs did not cause significant effects on leg health. Broilers from A strain had higher BMD with heavier tibias and shanks, but no differences were observed for femur weights. The RA of tibia BMD was lower in B strain broilers. Broiler progeny from breeders fed C diets had heavier and longer bones with more BMC, independent of other factors. Broilers fed C from LS breeders had greater RA of femur BMD and shank width compared to those from LF breeders. Breeder nutrition and feed management practices may influence bone traits and locomotion problems in broiler progeny.

**Key Words:** broiler breeder, management, nutrition, bone

**Pathology/Processing and Products**

**M45 Effect of omega-3 fatty acid enriched eggs on serum lipid profile, blood glucose and blood pressure of healthy volunteers.** Z. Hayat*1,2, T. N. Pasha1, F. M. Khattak1, M. A. Jabbar1, and U. Arshad2 1University of Veterinary and Animal Sciences, Lahore, Pakistan, 2University College of Agriculture, University of Sargodha, Sargodha, Pakistan.

Enrichment of chicken eggs with omega-3 fatty acids through dietary modification is the most promising strategy to reduce the cholesterolemic effects of eggs and an alternate source of these vital fatty acids for humans. An experiment was conducted to determine the effects of eggs enriched in omega-3 fatty acids on the serum lipid profile, blood glucose and blood pressure in healthy volunteers fed on the uniform diet. Twenty normolipidemic and normotensive female students were randomly divided into four groups containing 5 subjects each. Group A was offered one control egg per day, group B two control per day, group C one designer egg per day whereas group D was given two control eggs per day for 21 days. Results demonstrated that blood glucose and blood pressure of volunteer were independent of dietary treatment. There were also non-significant effects of designer eggs on serum total cholesterol, HDL and LDL cholesterol. However, a mild HDL cholesterol elevating effect has been observed. Serum triglyceride concentrations showed a significant decrease ($P < 0.05$) due to consumption of omega-3 enriched eggs. Based on results obtained during the present study, it may be concluded that eggs enriched with omega-3 fatty acids has favorable effect on human health by lowering serum triglycerides.

**Key Words:** eggs, flaxseed, cholesterol, triglycerides, omega-3 PUFA
M46  The detrimental impact of setting broiler hatching eggs small ends up.  R. Keirs*,1, D. Rowe,2 and A. Garrity,3, 1College of Veterinary Medicine, Mississippi State University, Mississippi State, 2Experimental Statistics, Mississippi State University, Mississippi State, 3Merial Select, Inc., Gainesville, GA.

This study was initiated to elucidate and measure the impact on the hatching process under commercial conditions, when broiler eggs are set small ends up, (air cell down). On day of set 5,832 eggs (36 Trays) were selected from 3 farm buggies (96 trays) scheduled as a full set and hatch in the same machine. All were from a single 41 week old broiler breeder flock and divided into two treatments. Eggs from 18 trays were rearranged, individually placing them small ends up (SEUP) in their setter flats. The remaining eggs were individually arranged to assure all were conventionally placed small end down (SEDN). Trays were color coded by treatment and returned to their respective buggy for normal set procedures. During transfer at 459 hours of incubation the color coded treatment trays were excluded from ovo-injection. Trays were arranged midway in the hatcher in a randomized 6x6 Latin Square experimental design to facilitate removal of any systematic variation due to rows or columns. On pulling the hatch, treatment trays had viable chicks removed by hand leaving all remaining residue on their respective tray. Individual tray residue data was obtained utilizing the Hatching Efficiency Analysis System (HEAS) which list the ancillary data plus the recording of the non-fertilized, embryonic losses and associated maladies. There were a number of significant differences (P < 0.0001) exhibited. Estimated hatching efficiency (EHE) decreased 14.43%, early embryonic loss (EEL) increased 2.19% led to the developing preovulatory follicle, while ZPB2 and ZPC are synthesized by the granulosa cells of the preovulatory follicle. In turkey hens, differences in the mRNA expression of the ZP proteins are associated with the preferential binding of sperm to the germinal disc (GD) region and with differences in fertility among genetic strains of hens. In the current research the mRNA expression of ZPB1, ZPB2 and ZPC was investigated in four Cobb-Vantress broiler breeder hen strains designated as B, G, O and R. Total RNA was extracted from a liver sample, from a one cm² section of the granulosa layer around the GD and an equivalent sized nongerminal disc (NGD) area from the F1 follicle from 18 hens from each genetic strain. Minor groove-binding probes and primers for detecting ZPB1, ZPB2, and ZPC, were made for real-time PCR analyses. Expression of ZPB1, ZPB2, and ZPC was detected in all the genetic lines. Expression of ZPB2 did not differ between NDG and GD granulosa cells. In genetic strains B and ZPC expression was higher in the bursa of SH and thymus of LS, and hsp70 was lower for SS-MDV in bursa but not thymus at d0 (P = 0.04). From d4 to 14, MDV vaccine relative to C showed no change in iNOS in bursa or thymus, while NDV vaccine resulted in a decrease (P = 0.03) in bursa. Thymus had comparable expression between NDV and C. MDV+NDV resulted in increased (P = 0.03) iNOS in bursa and no change in thymus compared to C. These results help elucidate effects of incubation temperature and vaccination stressors on early immune system development in broiler chicks.

Key Words: Incubation, vaccination, H:L ratio, broiler


The avian inner perivitelline layer (IPVL) contains zona pellucida protein-B1 (ZPB1), zona pellucida protein-B2 (ZPB2) and zona pellucida protein-C (ZPC). ZPB1 is produced by the liver and transported to the developing preovulatory follicle, while ZPB2 and ZPC are synthesized by the granulosa cells of the preovulatory follicle. In turkey hens, differences in the mRNA expression of the ZP proteins are associated with the preferential binding of sperm to the germinal disc (GD) region and with differences in fertility among genetic strains of hens. In the current research the mRNA expression of ZPB1, ZPB2 and ZPC was investigated in four Cobb-Vantress broiler breeder hen strains designated as B, G, O and R. Total RNA was extracted from a liver sample, from a one cm² section of the granulosa layer around the GD and an equivalent sized nongerminal disc (NGD) area from the F1 follicle from 18 hens from each genetic strain. Minor groove-binding probes and primers for detecting ZPB1, ZPB2, and ZPC, were made for real-time PCR analyses. Expression of ZPB1, ZPB2, and ZPC was detected in all the genetic lines. Expression of ZPB2 did not differ between NDG and GD granulosa cells. In genetic strains B, G, and R ZPC expression was higher (P < 0.01) in NDG granulosa cells than GD granulosa cells. However, in genetic strain O the expression of ZPC did not differ between the NDG and GD granulosa cells. Further research is needed to determine if the higher expression of ZPC in the GD region of the largest preovulatory follicle of strain O hens results in higher levels of sperm binding in this region and thus enhanced fertility in these hens.

Key Words: inner perivitelline layer, fertility, reproduction

M49  Evaluation of selected Salmonella-vectorized Campylobacter-epitopes for reduction of Campylobacter-jejuni- in broiler chickens.  S. L. Layton*,1, K. Cole2, M. J. Morgan1, Y. M. Kwon1, D. J. Donoghue1, B. M. Hargis1, and N. R. Pumford1, 1University of Arkansas, Fayetteville, 2The Ohio State University, Columbus.

Campylobacter is a leading cause of bacterial gastroenteritis in humans and is often linked to contaminated poultry products. We have recently developed novel attenuated ΔaroA/htlA Salmonella enteritidis strains
In the USA, nicarbazin (NIC) is normally used in starter feeds. In recent years, broiler producers have observed increases in levels of coccidiosis during normal grow out periods and interest has been expressed in using NIC for longer periods to take advantage of its excellent anticoccidial activity. To better understand the efficacy and safety of NIC in grower and finisher feeds, a 42-day floor pen test was carried out where several NIC programs were administered from placement to 36 days-of-age.

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Key Words: nicarbazin, coccidiosis, extended feeding, performance, safety.
was carried out at Southern Poultry Research, Inc on male broiler chickens (Cobb X Cobb) in a floor pen trial. There were three groups, one control, non infected group fed with standard commercial broiler feed, one challenge control, Salmonella infected group fed with standard non medicated commercial broiler feed and one group challenged with Salmonella fed the same feed with the addition of B. subtilis at 0BE=5 CFU/g feed. Thirty out of 60 male chicks per pen were tagged for identification and then orally dosed with naladixic acid resistant fresh broth culture of Salmonella heidelberg on Day 1. The titration level was 7.5 X 105CFU/mL. Chicks received the same amount of inoculums: 0.1 ml per bird. On day 0 and day 42 drag swab samples were collected from all pens. Positive or negative presence of Salmonella was determined for these samples, no enumeration was performed. The results of the drag swab samples showed that 100% positive Salmonella drag swab samples in the challenge control group whereas the B. subtilis treated group had a significant reduced Salmonella positive drag swabs. Only 43% of the B. subtilis were positive for Salmonella. Use of probiotic B. subtilis can reduce the level of Salmonella in broiler chickens and improve food safety.

Key Words: Salmonella, probiotic, food safety, chicken

M55 Determining microbiological effects of detergent in cool vs. standard temperature water for washing of shell eggs. S. L. Christian*,1, M. T. Musgrove2, T. Stewart,2 L. Kerth1, and P. A. Curtis1, 1Auburn University, Auburn, AL, 2USDA-ARS, Athens, GA.

Research was conducted to compare wash water temperatures and detergents for reducing microbial populations. Using cooler wash water results to lower egg surface temperatures decreases the time needed to reach 7.2°C which is the minimum temperature to allow for growth of Salmonella. Two detergents for lower temperature washes were compared with a standard detergent. Treatments were unwashed eggs, standard detergent/49°C, standard detergent/25°C, B.W. Special/25°C, and ESP Source 200/25°C. Two experiments were performed once each day for three consecutive days. In experiment one, treatments were washed and sampled to enumerate and detect naturally occurring Enterobacteriaceae and aerobic microorganisms. A dozen eggs per treatment was washed for one minute, placed aseptically in foam cartons, and blown dry at 52°C for 30 sec. Eggs were cracked and composite samples were prepared by combining the contents of each treatment and stomacher blended for one min. A slurry of shells/membranes in diluents was prepared for individual eggs. Aerobic microorganisms and Enterobacteriaceae were enumerated from composite contents and individual shell/membrane slurries by plating aliquots onto APC agar and VRBG agar pour plates. In experiment two, the same treatments were applied to eggs inoculated with S. Typhimurium. Salmonella were inoculated by spread plating onto BGS supplemented with naladixic acid. On average, all wash treatments reduced populations of aerobic microorganisms by 0.8-1.5 log cfu/mL slurry and Enterobacteriaceae by 0.25-0.50 log cfu/mL slurry. Content populations were less than 0.25 log cfu aerobes/mL for all treatments; no Enterobacteriaceae were recovered. Salmonella were reduced by 1.0 log cfu/mL slurry by all treatments. Egg surface temperatures averaged 31°C for eggs washed at 49°C and 20°C for those washed at 25°C. In both experiments, eggs washed at 25°C were of equal or better microbiological quality than those washed at 49°C and resulted in lower egg surface temperatures.

Key Words: shell eggs, cool wash, Salmonella, Enterobacteriaceae
M56 The effect of heating rate on gelation properties and water holding capacities of egg white and whey protein isolate gels. P. N. Leksrisompong*, T. C. Lanier, and E. A. Foegeding, North Carolina State University, Department of Poultry Science, Department of Food, Bioprocessing and Nutrition Sciences, Raleigh.

The unique gelation properties and nutritional value of egg white protein (EWP) makes it one of the key ingredients in food applications that require gelation for texture formation. This study was conducted to determine how heating rate can be used to alter textural and water-holding properties of EWP and whey protein isolate (WPI) gels. Gels (15% w/v protein, pH 7.0) were formed by using a range of heating rates (X-Y°C/min) to achieve a final temperature of 80°C. The gelation process was followed using small strain rheology to determine gelation points. Viscoelastic properties of gels were characterized by determining mechanical spectra and fracture properties (fracture stress and strain) were measured by torsional deformation to fracture. Water holding capacity (WHC) was measured as the amount of water retained after a mild centrifugation.

For both proteins, gels prepared by the fastest heating rates were the weakest because there was insufficient time for complete gel formation; suggesting a diffusion controlled process. Extending holding time after rapid heating for only 5 min produced gels as strong as gels prepared by slower heating rates. Egg white gels reached a quasi-equilibrium state after 5 min of holding after rapid heating while WPI gels continued to change over X min of holding. Rigidity of gels determined at non-fracture strains showed protein-specific trends similar to fracture properties. There was no effect of heating rate on WHC of both proteins; indicating differences in the microstructural mechanisms for texture and water-holding. It was shown that both EWP and WPI form networks regulating water movement by a similar mechanism. In contrast, EWPs produce what appears to be an equilibrium gel network regarding textural properties more rapidly than WPI. These findings would be beneficial for large scale egg-based food processors, since processing time plays a major role in determined cost.

Key Words: egg, whey, heating rate, gelation properties, held-water

M57 The effects of dietary amino acid density regimes on broiler meat quality. R. A. Lilly*, M. W. Schilling, and A. Corzo, Mississippi State University, Starkville.

A randomized complete block design with 10 replications (n=320, 80 broilers per treatment) was used to evaluate the effects of feeding four levels (15.52% crude protein (CP), Deficient), (17.10% CP, Low), (20.21% CP, High), and (22.5% CP, Excessive) of increasing dietary amino acid densities on broiler breast and thigh meat quality. Body weight and feed consumption from each pen was determined at the end of each feeding phase and 8 randomly selected birds from each pen were harvested using commercial prototype equipment at 42 d. At 4 h postmortem, carcasses were removed from the chill tank and breast and thigh removal was performed. Color, pH decline, ultimate pH, proximate analysis, brine absorption, cooking loss and shear force values were measured on breast meat. Proximate analysis was also performed on the thigh section of the broiler. In addition, feed conversion, and carcass characteristics were evaluated. On average, no differences (P > 0.05) existed among CP treatments with respect to ultimate pH, pH decline, cooking loss, shear values, brine absorption and proximate analysis of breast meat. This demonstrates that crude protein treatments had minimal effects on product quality. However, the Low CP treatment yielded thigh meat with less (P < 0.05) moisture and protein and more fat (P < 0.05) than the High and Excessive CP treatments. In addition, Excessive and High CP diets had greater body and carcass weights when compared to the Deficient CP treatment. Carcass weights ranged from 1.78 to 1.91 kg. Additionally, as CP concentration increased in the diet, the feed conversion ratio decreased (P < 0.05). Breast meat yield was greater (P < 0.05) for the Excessive and High CP diets when compared to the diet that was deficient in protein. This reveals that Excessive and High CP diets can be fed to maximize meat yield and minimize feed conversion without negatively affecting breast meat quality. Results also revealed that a diet that is deficient in CP is detrimental to thigh meat quality, as demonstrated by decreased moisture and increased fat percentage.

Key Words: meat quality, crude protein, amino acid density, proximate compositions, carcass compositions


A study was conducted to determine the microbial quality and oxidative stability of ground raw chicken meat stored under frozen conditions. A study involving 2 x 2 factorial arrangement of two dietary fat sources [corn oil (CO) vs. lard (LD)] and two inclusion levels (low; 2% and high; 6%) was conducted, in which each of four dietary treatments was fed to 8 replicate pens of 9 birds (288 birds total) to 49 d of age. Upon processing, boneless-skinless breast and thigh meat (6 birds/pen) were ground separately, pooled by pen, formed into patties and sealed in trays with either oxygen permeable or impermeable films (4 replicate pens/dietary treatment/packaging type). Samples were analyzed for lipid oxidation (TBARS) and microbial spoilage (aerobic plate counts, pseudomonas spp. lactic acid bacteria, Yeast and Molds) following 3 and 6 months of frozen storage (-18°C), following 0, 3, 6, 12 and 15 d of storage at 2°C after thawing. After 3 months of frozen storage, thigh meat packed in impermeable packaging had lower (P < 0.05) APC and decreased rate of lipid oxidation than those packed in permeable packaging at 0 d of storage and breast meat at 0 and 3 d of storage. Following 6 months of storage, CO had lower (P < 0.05) microbial growth than LD in thigh meat with 3 and 6 d storage, while breast meat had lower (P < 0.05) microbial growth in LD. TBARS values increased during 15 d of storage and birds fed 2% fat had significantly (P < 0.05) lower lipid oxidation in breast meat than those fed 6% at 0 d of storage. TBARS values of thigh meat were higher in oxygen permeable packaging as compared to oxygen impermeable packaging at 12 and 15 d of storage. Interactions between inclusion levels and packaging types were observed for breast meat on day 1. Breast meat with 6% fat packed in oxygen permeable film showed higher (P < 0.05) lipid oxidation than those packed in impermeable film. Oxidative and microbial changes dominate spoilage of frozen ground meat. These changes can be minimized by alterations in fat sources and level, as well as oxygen permeability of packaging.

Key Words: shelf life, lipid oxidation, packaging, fat source, broiler

M59 Efficacy of oxalic acid to reduce Salmonella spp. at various stages of poultry processing. I. Sybirriou1, F. M. Arritt1, S. Kathiariou1, D. J. Hanson1, D. P. Smith1, J. B. Luchansky2, and K. G. Martino3, 1North Carolina State University, Raleigh, 2USDA Eastern Regional Research Center, Wyndmoor, PA, 3University of Georgia, Athens.

The microbiological safety of fresh eviscerated poultry has continued to be a major concern of the public and poultry industry due to

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the frequent foodborne illnesses caused by *Salmonella* spp. Oxalic acid (OA) was evaluated as an antimicrobial treatment at equivalent dip, scalding, and chilling time and temperature combinations for reduction of *Salmonella* spp. attached to raw chicken skin. Irradiated chicken skin samples were inoculated with a four strain cocktail of *Salmonella* spp. Bacterial cell attachment to the skin surface was achieved using a 10 minute contact time at 22°C prior to the application of OA treatments. To mimic common commercial processing practices, 1.0, 1.5, and 2.0 % OA treatments were applied at 22°C for 40, 30, 20, and 10 sec to simulate dipping, at 53°C for 1, 2 and 3 min to simulate scalding and 0.1, 0.25 and 0.5% at 3°C for 60, 45 and 30 min to simulate chilling of broiler carcasses. After treatment samples were stomached in buffered peptone water to neutralize the acid, serially diluted and plated on XLD agar using thin agar layer technique for acid injured cells. Replicates were performed and the results were compared to controls to determine log reduction and statistical significance. Statistically significant (P < 0.05) and microbiologically significant (>1 log) results were compared to the controls for all chilling and scalding time and temperature combinations. Dipping showed the least quantitative reduction in *Salmonella* spp. compared to chilling and scalding treatments, achieving less than a 1.2 log reduction for most combinations. OA may have potential for use as antimicrobial agent to reduce *Salmonella* spp. during poultry processing, thereby decreasing the safety risk associated with poultry and the subsequent economic losses related to foodborne illnesses and regulatory recalls.

**Key Words:** *Salmonella*, poultry, oxalic acid, antimicrobial, chicken skin

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**SCAD I**

**M60 Effects of direct-fed microbials on growth performance, gut morphology, and immune characteristics in broiler chickens.**

G. R. Siragusa1, H. S. Lilleyhoj2, K. W. Lee2, S. H. Lee2, G. X. Li2,3, S. I. Jang2, U. S. Babu4, M. S. Park2, D. K. Kim2, A. P. Neumann1, and T. G. Rehberger1, 1Danisco, Waukesha, WI, 2Animal Parasitic Diseases Laboratory, ANRI, ARS-USDA, Beltsville, MD, 3Immunology Branch, Center for Food Safety and Nutrition, US-FDA, Laurel, MD, 4College of Veterinary Medicine, Northeast Agricultural University, Harbin, China.

This study was conducted to compare growth performance, gut morphology, and parameters of local and systemic immunity in broiler chickens fed for 22 consecutive days with a diet supplemented with one of eight Bacillus spp. as a direct-fed microbial (DFM), a commercial product incorporating three DFMs, or a non-supplemented diet. DFM-fed birds showed altered intestinal morphometric measurements as revealed by increased villus height and crypt depth compared to non-DFM fed controls. In addition, serum levels of α-1-acid glycoprotein as an inflammatory marker were reduced in DFM-fed birds, while splenic lymphocyte proliferation, intestine intraepithelial lymphocyte (IEL) subpopulations, and cytokine mRNA levels in IELs were changes (increased, decreased, or unchanged) compared with controls depending on the DFM used. These results provide a rational scientific basis for future studies to investigate DFMs as immunopotentiating agents to enhance host protective immunity against enteric pathogens in broiler chickens.

**Key Words:** chicken, direct-fed microbials, immune response, growth performance, intestinal morphology

**M61 Effect of Bacillus-based direct-fed microbials on Eimeria maxima infection in broiler chickens.**


The effect of dietary Bacillus-based direct-fed microbials (DFMs) on growth performance, intestinal lesions, and innate and acquired immune responses were evaluated in broiler chickens following *Eimeria maxima* (EM) infection. Birds were orally gavaged with one of eight Bacillus subtilis strains (designated Bs2084, LSSAO1, 3AP4, Bs18, 15AP4, 22CP1, Bs27, and Bs278) or a multiple-strain DFM product (AVICORR) at days 1 and 2 post-hatch and were fed with the same DFM beginning at day 3. At day 21, the chickens were uninfected or orally infected with 5 × 103 sporulated EM oocysts and body weight gains, intestinal lesion scores, serum levels of nitric oxide (NO), α-1-acid glycoprotein, and coccidia-specific antibodies, and spleenocyte proliferation were determined at day 27. EM-induced reduction of body weight gain and intestinal lesions were significantly reversed by addition of 15AP4 or Bs27 into broiler diets compared with EM-infected birds on a nonsupplemented diet. Serum NO levels were increased in infected animals fed with Bs27, while the levels of α-1-acid glycoprotein were increased in animals given LSSAO1 or AVICORR. Serum antibody levels against a coccidial protein were increased in infected chickens fed with LSSAO1, while antigen-stimulated spleen cell proliferation was increased in animals given LSSAO1, 3AP4, Bs18, 15AP4, or Bs27 compared with the control diet-fed and infected controls. Finally, all experimental diets increased mitogen (Con A)-induced spleen cell proliferation in infected broilers compared with the birds fed control diet and infected animals.

In summary, dietary DFMs reduced the clinical signs of experimental avian coccidiosis and increased various parameters of immunity in broiler chickens.

**Key Words:** coccidiosis, *Eimeria maxima*, broiler chicken, immunomodulation, direct-fed microbials

**M62 Immunomodulatory effects of direct-fed microbials on the serum nitric oxide and macrophage phagocytic activity in broiler chickens.**

H. S. Lillehoj2, G. X. Li2, K. W. Lee2, X. Dong2, U. S. Babu2, G. R. Bauchan2, T. G. Rehberger1, and G. R. Siragusa1, 1Danisco, Waukesha, WI, 2Animal Parasitic Diseases Laboratory, ANRI, ARS-USDA, Beltsville, MD, 3Immunology Branch, Center for Food Safety and Nutrition, US-FDA, Laurel, MD, 4College of Veterinary Medicine, Northeast Agricultural University, Harbin, China.

Experiment purpose: Macrophage is a key player of host innate immunity. In order to investigate the underlying immunological mechanisms which are immunomodulated by direct-fed microbials (DFMs), macrophages isolated from the peripheral blood from DFM-fed broiler birds were evaluated using various in vitro immunossays. Experiment design: Two hundred forty 1-day-old broiler chicks were randomly placed into 10 groups. At 1 and 2 d post-hatch, 5.0 × 106 cfu...
**ABSTRACTS OF PAPERS**

**R. Siragusa** 1, 1, Center for Food Safety and Nutrition, US-FDA

Cells in the skin, and K55-, K1-, CD8-, TCR1-, TCR2-, Bu1-, MHC GD birds compared to control birds and GD chickens produced higher driven splenic lymphocyte proliferation was significantly depressed in anemia virus, and infectious bursal disease virus. Mitogen (ConA, LPS)-healthy birds had high antibody titers against CP, CS, Eimeria, chick intestine. Serological analysis demonstrated that both diseased and skin and intestine.

Immunofluorescence staining revealed Clostridium-like bacilli in the groups fed with 15AP4, 22CP1, Bs27, and Bs278 DFMs. Conclusions: This study documents immunomodulatory effects of certain DFMs on different aspects of macrophage function (innate immunity) upon continuous feeding. These results emphasize the need to better define underlying immune mechanisms which are immunoregulated by DFMs for the optimum application of DFMs as feed supplements in poultry production.

**Key Words:** phagocytosis, direct-fed microbials, macrophage, nitric oxide, innate immunity

**M63** Histopathology, immunohistochemistry and cytokine production associated with gangrenous dermatitis outbreaks in broiler farms. G. X. Li*2,4, H. S. Lillehoj2, K. W. Lee2, S. H. Jang2, P. Marc2, D. Ritter2, D. A. Bautista2, A. P. Neumann2, T. G. Rebberger2, and G. R. Siragusa1, 1Danisco, Waukesha, WI, 2Animal Parasitic Diseases Laboratory, ANRI, ARS-USDA, Beltsville, MD, 3Immunology Branch, Center for Food Safety and Nutrition, US-FDA, Laurel, MD, 4College of Veterinary Medicine, Northeast Agricultural University, Harbin, China, 5Mountaire Farms, Millsboro, DE, 6Carvel Research and Education Center; University of Delaware, Georgetown.

Gangrenous dermatitis (GD) is a disease with increasing economic importance. This study was undertaken to investigate pathological and immunological changes, and molecular diagnosis associated with gangrene dermatitis (GD) outbreaks in broiler chickens. Ten birds with clinical GD symptoms and 5 control birds which appear clinically- healthy were selected for sample collection to measure nitric oxide (NO), acute phase protein (AGP), tissues for histology and immunohistochemistry and cytokine transcripts. GD birds demonstrated typical clinical symptoms, gross lesions at necropsy including discoloration of skin around the breast, abdomen, and wings with congestion, necrosis, and emphysema (gas accumulation), discoloration of muscle with serosanguineous fluid, and fibronecrotic enteritis. Histopathological findings included hemorrhagic lesions, degeneration, and necrosis of parenchymatous cells, especially of skin, muscle, and intestine. Immunofluorescence staining revealed Clostridium-like bacilli in the skin and intestine. C. perfringens (CP) and C. septicum (CS) genomic sequences were identified by PCR in samples from skin, muscle, and intestine. Serological analysis demonstrated that both diseased and healthy birds had high antibody titers against CP, CS, Eimeria, chick anemia virus, and infectious bursal disease virus. Mitogen (ConA, LPS)-driven splenic lymphocyte proliferation was significantly depressed in GD birds compared to control birds and GD chickens produced higher levels of serum NO and L-1-AGP. Flow cytometric analysis of lymphocyte subpopulations showed K55-, K1-, CD8-, MHC II-positive cells in the skin, and K55-, K1-, CD8-, TCR1-, TCR2-, Bu1-, MHC II-positive cells in the intestine of GD birds. The expression levels of mRNAs encoding pro-inflammatory and chemokines were increased in GD birds. These results provide histological, immunological and molecular changes associated with GD infection in broiler birds, especially document changes associated with innate immune response to Clostridium pathogens in GD in broiler chickens.

**Key Words:** gangrenous dermatitis, clostridium septicum, Clostridium perfringens, immunopathology, innate immunity


A healthy gastrointestinal tract is critical for optimum broiler growth. A healthy gut allows maximum nutrient absorption and acts as the first line of defense against disease. Prebiotic fibers promote a balanced microflora by preferentially supporting Bifidobacteria and Lactobacillus species. These beneficial bacteria produce short chain fatty acids (SCFA) that reduce pH and support the gut mucosal barrier. Overgrowth of pathogenic bacteria, such as E. coli and Clostridium perfringens, is less likely when the gut microflora is established early post-hatch. Oregano essential oil (OEO) is a natural feed flavorant with potent anti-microbial activity that has been shown to improve broiler performance on farms with enteric challenges. This study investigated the effects of OEO combined with a unique, hemicellulose prebiotic fiber on performance of six pound broilers on a farm with a history of dermatitis. Two control houses (24,400 birds/house) received a rigorous in-feed anti-coccidial program with an antibiotic growth promoter (AGP). The two test houses (n=24,400 birds/house) received OEO (Regano® 500) and a new hemicellulose prebiotic fiber product (NutriFibe™ Complex). Results showed that the test group delivered growth and performance that was equal to the controls. Control birds weighed 6.16 lb at 42 d compared with 6.15 lb for the OEO-NutriFibe group. However, differences were observed in disease control. Birds in one control house showed signs of dermatitis at day 35, with a mortality rate of 3.1%. Death loss in the other control house was 1.9% with no evidence of dermatitis. Both OEO-NutriFibe test houses were free from dermatitis and had 2.3% and 2.9% mortality rates. These results show that OEO, in combination with a unique hemicellulose prebiotic fiber, delivered broiler performance that was equal to a rigorous chemical and AGP program. The absence of dermatitis in the test houses is an encouraging result and warrants further investigation.

**Key Words:** broiler health, gangrenous dermatitis, Clostridium, prebiotic fiber, gut health

**M65** Evaluation of the efficacy of NuPro®-yeast extract in reducing intestinal Clostridium perfringens levels in broiler chickens. R. Thansissery*, L. J. McLennan2, D. E. Conner1, K. S. Macklin1, P. A. Curtis1, and Y. O. Fasina1, 1Auburn University, Auburn, AL, 2SPARC-USDA-ARS, College Station, TX.

Necrotic enteritis (NE) disease is caused by Clostridium perfringens (CP), and costs the global poultry industry about $2 billion annually. Traditionally, NE is controlled with in-feed antimicrobial growth promotants. However, increasing consumer demand for drug-free poultry has fostered the search for non-antibiotic alternatives such as yeast extract
formulations known to have immunostimulatory properties. An experiment was conducted to evaluate the efficacy of NuPro®-yeast extract in reducing intestinal CP levels in broiler chickens. Day-old male broiler chicks (216) were obtained from a commercial hatchery and randomly assigned to 6 treatments in a battery cage trial. Treatment 1 (CX - control) consisted of chicks not challenged with CP and fed corn-soybean meal (SBM) diet with no Bacitracin Methylene Disalicylate (BMD) or NuPro® added. Treatment 2 (CM) consisted of chicks not challenged with CP and fed corn-SBM basal diet into which BMD was added at 0.055g/kg. Treatment 3 (CN) consisted of chicks not challenged with CP and fed corn-soybean meal basal diet supplemented with NuPro® at 2% level for the first 10 days of experiment. Treatment 4 (PCX), treatment 5 (PCM), and treatment 6 (PCN) consisted of chicks that were challenged with 3 mL of CP inoculum (10^7 CFU/mL) on three consecutive days (days 14, 15, and 16) during the experiment. Diets fed to chicks in PCX, PCM, and PCN were similar to diets fed to chicks in CX, CM, and CN treatments, respectively. Intestinal CP levels were estimated on days 1 & 7 post-challenge. On day 1 post-challenge, intestinal CP level for PCM (2.52 log_{10} CFU/mL) was lower (P < 0.05) compared to PCX (4.32 log_{10} CFU/mL), but similar to levels for PCN (3.29 log_{10} CFU/mL). A similar trend in CP levels was observed on day 7 post-challenge. Although dietary supplementation of NuPro® in PCN treatment reduced CP levels by 1.0-fold and 0.68-fold compared to PCX on day 1 and day 7 post-challenge respectively, these reductions were not significant. Higher inclusion levels of NuPro® (> 2%) may be needed to significantly reduce intestinal CP levels.

Key Words: NuPro®, yeast extract, C. perfringens, intestine, broiler chickens

M67 Quail ulcerative enteritis vaccination with non-attenuated lower intestinal and cecal coccidia. D. A. Anderson*1,2, 1Georgia Poultry Laboratory Network, Oakwood, GA, 2Prairie Poultry Services, Loveland, CO.

Quail ulcerative enteritis is a common disease of pen-raised bobwhite quail that results in high morbidity, excessive mortality, and chronic poor performance. Two strains of lower intestinal and cecal coccidia were selected and tested individually as potential vaccine candidates. Each of the two strains were administered orally to four repetitions of 100 day old bobwhite quail at 50, 100, and 200 sporulated oocysts per bird. Birds were monitored daily for ten weeks for morbidity, livability, and weight gain. Additionally, ten birds were sacrificed at 2, 4, 6, 8, and 10 weeks post-inoculation and examined for coccidial development and the presence of ulcerative enteritis. Protection (compared to sham inoculated controls), livability and weight gain were highest for birds receiving the 100 sporulated oocyst dose for both strains. Protection for all treatments against ulcerative enteritis ranged from 2-21% (Strain 1: 2-12%, Strain 2: 5-21%) as compared to sham inoculated negative controls. Both of these strains appear to have the potential for reducing the effects of ulcerative enteritis in pen-raised quail.

Key Words: quail, ulcerative, enteritis, coccidia

M66 Prevents necrotic enteritis by use of Bacillus licheniformis (GalliPro Tect) and improves performance in broiler chickens. I. Knap*, B. T. Lund, and E. U. Augustsson, Chr-Hansen, Hoersholm, Denmark.

Bacillus licheniformis can prevent necrotic enteritis in C. perfringens challenge studies. To understand both the mode of action of the NE preventing effect of Bacillus licheniformis and the performance under non- challenge condition, new studies were performed. Three C. perfringens challenge studies were carried out at Southern Poultry Research, Inc.; two cage studies and one floor pen study. In the studies different doses of Bacillus spores were tested from 8E+5 CFU/G to 8E+7 CFU/G. All challenge studies included a non challenged control group, challenged group without additive and a positive control with Virginamycin 15 g/t. Unmedicated commercial chicken feeds commonly used in the United States were used in all studies. Feed and water were available ad libitum throughout all trials. The Clostridia challenge was made using fresh C. perfringens broth culture given to the birds in 2 or 3 days. Weight gain, feed consumption, feed conversion, lesion scores, intestinal Clostridia counts and mortality were reported. In the non challenged study weight gain and FCR were measured. In all challenged trials a significant effect was seen of using B. licheniformis with regards to lesion score, mortality, weight gain and FCR. There was no significant difference between the B. licheniformis treatments and the Virginamycin treatment with regards to mortality and lesion score. A dose of 1.6E+6 CFU/G feed seems to be optimal to prevent necrotic enteritis. In a non challenged trial using a water application of the B. licheni-
**Nutrition III**

**M69**  **Salicornia herberbacea and Houttuynia cordata with multi-probiotics as antibiotic substitute for broiler production.**


An investigation was done with 175 broilers (1-day old Ross) to know the potentiality of Salicornia and Houttuynia Probiotics (SHP) and suitable level in replacing antibiotic. The groups were control (basal diet), antibiotic (basal diet + 0.05% OTC) and Hamcho and Eosungcho probiotics 0.5%, 1.0% and 2.0% with basal diet. The birds were arranged in a completely randomized design having 5 replications with 7 chicks per replication in wire case. Recorded data were analyzed by SAS package program. Addition of feed additives in the diet didn’t show negative effect on growth and feed conversion efficiency in broilers. Significantly highest protein percentage in broiler meat fed 2.0% SHP was recorded compared to control (P < 0.05). Crude fat significantly reduced in 1.0% HEP like antibiotic compared to 2.0% HEP and control group (P < 0.05). The TBA value of meat significantly reduced in 1.0% HEP like antibiotic compared to 2.0% SHP and similar with antibiotic fed broilers (P < 0.05). Mineral in meat (Fe and Mg) showed an increasing trend in the increasing level of SHP than other groups. Addition of 1.0% Hamcho and Eosungcho probiotics can be suitable to antibiotic for broiler production.

**Key Words:** salicornia and houttuynia probiotics, oxytetracycline (OTC), crude protein, abdominal fat, broiler chick

**M70**  **Lactylate in broiler diets reduces severity of subclinical clostridium infection.**

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The efficacy of lactylate (an ester of a fatty acid and the hydroxyl group of lactic acid), was tested during a clostridium infection in broilers, because of its distinct antimicrobial action. A dose response study was performed at Schothorst Feed Research. 1,188 Ross 308 one-day-old broilers were fed a starter diet from d0-9 followed by a wheat/barley based grower diet until day 37. Two controls (non infected (NINF) non treated) and infected (INF) non treated), eight diets with graded levels of lactylate (PURAMIX 30 produced by PURAC: 0.005%, 0.010%, 0.019%, 0.038%, 0.075%, 0.15%, 0.30% and 0.6% were fed to INF and one (0.30% PURAMIX 30) to NINF broilers. On d9, INF birds were orally inoculated with 10,000 sporulated E. maxima oocysts in 1 ml saline and at d14 with 108 cfu C. perfringens in 1 ml liver broth, whereas NINF birds receive the sterile media at the same time. Clostridium lesions were scored at 15 and 16 days of age. Production performances were measured during an entire 37-day growth period. PURAMIX 30 did significantly decrease severity of lesions (P < 0.05; 1.6 vs. 0.9), based on a linear dose response relationship (Y=1.75-1.48x; r2 = 0.93) up to an inclusion level of 0.6% PURAMIX 30. A dose of 0.6% resulted in a significant lower mortality rate (P < 0.05) while 0.3% did numerically decrease mortality. PURAMIX 30 tended to increase body weight (BW) in NINF birds but not in INT birds. No effect was observed on feed intake (FI). Higher dose levels of PURAMIX 30 were therefore effective in preventing Clostridium infections in broilers, showing a numerical lower % of birds scored positive and lesions that were significantly less severe. PURAMIX 30 (lactylate) was effective to control Clostridium infections in broilers. It reduced incidence and severity of necrotic lesions. Although PURAMIX 30 did not significantly affect production performance, mortality rate was significantly reduced.

**Key Words:** broiler, clostridium, lactylate, production performance, lesions

**M71**  **Individual and combined toxicity of melamine (M) and cyanuric acid (CA) in male turkey poults fed dietary treatments from hatch to 21 days.**


An experiment was conducted to determine the individual and combined toxicity of melamine (M) and cyanuric acid (CA) in turkey poults fed dietary treatments from hatch to 21 days since previous research suggests that the combination of M and CA acid may be more toxic than M alone. Two hundred and fifty male poults were purchased from a commercial hatchery and assigned to 10 dietary treatments with five replicate pens of five poults per treatment. Dietary treatments included a PC diet with no M or CA (diet 1), basal diet supplemented with 0.5, 1.0 and 1.5% CA (diets 2-4), basal diet supplemented with 0.5, 1.0, and 1.5% CA (diets 5-7), and basal diet supplemented with 0.5% M+0.5% CA, 1.0% M+1.0% CA, and 1.5% M+1.5% CA (diets 8-10). Recent studies in our laboratory determined that ≥ 1% M was toxic to poults, whereas up to 3% CA was not toxic to poults. In the current study, significant treatment related mortality (48%) was observed in poults fed 1.5% M. Gross pathological lesions of birds that died from this treatment group were uniform with poults having pale and enlarged kidneys. Feed intake and body weight gain were decreased (P < 0.05) in poults fed ≥ 0.5% M (P < 0.05). In contrast, no toxic effects were observed in poults fed up to 1.5% CA (P > 0.05). Treatment related mortality (8%) was observed in poults fed the combination of 1.5% M and 1.5% CA, and gross lesions were similar to those observed in poults fed 1.5% M. Feed intake and body weight gain were not negatively affected (P > 0.05) by any combination of M+CA. Results suggest that the combination of M+CA, at these concentrations, did not result in increased toxicity compared with M alone, and it also appears that the presence of CA in diets containing M moderate the effects of M on growth performance and mortality.

**Key Words:** melamine, cyanuric acid, turkeys, kidney

**M72**  **Effect of dietary nucleotide supplementation on performance, gastrointestinal tract development and histology of broilers challenged with Coccivac®-B.**

B. Jung* and A. B. Batal, University of Georgia, Athens.

An experiment was conducted to determine the effects of dietary nucleotide supplementation on broiler performance, intestinal tract development and histology under high stocking density and Coccivac®-B challenge. Five hundred and twenty 1-d-old Cobb 500 male broiler chicks were placed in floor pens with recycled pine wood shavings and a stocking density of 0.62ft2/bird. Five replications of 26 chicks were randomly allotted to the 4 treatments. The experiment was a 2 × 2 factorial design; two supplemental levels (0 and 0.25%) of Torula yeast as source of nucleotides and either a challenge with Coccivac®-B at 4d of age or no challenge. The birds were only fed the diet with nucleotide supplementation until 13d of age after which time the birds were fed.
a common grower diet until 31d of age. Performance was measured at 9, 13, 23, and 31d of age and intestinal weight, histology, and serum citrulline levels were measured at 13d of age. From 10 to 13d of age (6 to 9d post-challenge) the challenge with Coccivac®-B significantly decreased (P < 0.05) performance as compared to the non-challenge birds. When the birds were challenged the addition of 0.25% Torula yeast to the diet significantly increased body weight gain and feed conversion as compared to the birds fed the control diet. Overall, from 0 to 31d of age, the birds challenged with Coccivac®-B caught up to the growth rate of the non-challenge birds. There was no interaction between Coccivac®-B challenge and dietary nucleotide supplementation on BW gain, feed intake or feed conversion at all measured days. The birds challenged with Coccivac®-B had significantly heavier jejunal and ileum relative weight (g/kg of body weight) as compared to the non-challenged birds. The level of citrulline in the serum of birds significantly decreased due to the Torula yeast addition under both the challenge and non-challenge conditions. In conclusion, the addition of 0.25% Torula yeast (as a nucleotide source) to the diet improved the performance of birds challenged with Coccivac®-B from 6 to 9d post-challenge.

Key Words: nucleotides, broilers, intestinal weight, Coccivac®-B

M73 Use of the precision-fed rooster assay to determine the efficacy of exogenous enzymes. J. Brandon* and A. Batal, University of Georgia, Athens.

The beneficial effects of exogenous enzyme addition to poultry diets have been well documented. However, the results have been highly variable depending on the method used to measure the bioefficacy of the exogenous enzyme in ovo. The most common methods employed to assess the bioefficacy of exogenous enzymes in vivo are performance trials and metabolism studies, such as the precision-fed rooster assay. There has been criticism of the use of the precision-fed rooster for enzyme analysis because the ingestion of small amounts of exogenous enzymes may have the ability to increase the excretion of the endogenous compounds which would not be accounted from in the precision-fed rooster assay. Thus, the bioefficacy of 12 different enzymes mixed in a complete diet (as well as a control diet with no enzyme, for a total of 13 treatments) were evaluated using two precision-fed rooster TME assays alongside a more conventional chick digestibility trial. The first rooster assay was a traditional precision-fed rooster assay in which 8 birds per diet were fasted for 24 hr then crop intubated with 35 g of the test diet and excreta was then collected for 48 hrs. In the second precision-fed rooster assay the roosters were primed on the experimental diets, they were allowed ad libitum access to the experimental diets for 5 days prior to the fasting and crop intubation. Nine hundred and ten 18 d of age male chicks (7 replications per treatment, 10 chicks per replication) were fed the same experimental diets for 7 days and excreta was collected at 18 d of age for the determination of AME. Priming the roosters on the experimental diets increased the TME value of the diets, regardless of enzyme addition. This was also evident by the fact that the primed birds excreted about 2 g less excreta then the non-primed roosters. Based on the data to date priming the birds had more of an impact on increasing the TME of the diets than the enzyme addition.

Key Words: enzymes, TME, AME, roosters, chicks

M74 Evaluation of sodium bisulfate toxicity in diets of broiler chickens. P. Post*1, J. L. Bray1, and J. Pitts1, 1Stephen F. Austin State University, Nacogdoches, TX, 2Jones-Hamilton Co., Salisbury, MD.

An experiment was conducted to evaluate the affects of different feed grade sodium bisulfate levels on performance parameters and potential toxicity in broiler chickens. Placement of the birds was within one Per tersime battery cage unit. The battery cage unit was divided into 24 individual pens, containing five birds per pen. Each pen was randomly assigned one of the six treatment groups; each treatment group had four replications. Birds were reared from 0 to 21 days. All treatments received a diet containing 0.75% sodium bisulfate and water ad libitum throughout the study. All feed added was weighed collectively as a pen on days 10, 13, 18 and at the completion of the study. Feed conversion and average body weight was collected on each of these days. On day 10, all birds received a simulated shock of sodium bisulfate via oral gavage (0.5 ml/bird). The same procedure was repeated on day 18 at twice the previous volume (1.0 ml/bird) and birds were observed until the completion of the study. At the completion of the study, average body weights were not significantly different between the treatments on days 10, 13, 18, and 21. Treatment 4 had a significantly lower feed conversion than treatment 5 on day 21, but neither treatment was significantly different from the remaining treatments. The results from this study indicate a shock treatment of feed-grade sodium bisulfate up to 12.50%, of the total diet, has no adverse affects on the health and performance of commercial broiler chickens reared up to 21 days.

Key Words: toxicity, sodium bisulfate, performance, nutrition, broilers


A follow-up study was conducted to evaluate the effect of the accuracy of post pellet fat application (PPLA) in low energy diets on broiler performance. Fat application is routinely used to monitor feed quality and explain shrink at feed mills and poor application of fat is believed to affect bird performance and production cost. A previous study indicated under-application of fat in the starter and grower phases did not affect broiler performance. The study was designed to test the effect of over-application and under-application of poultry fat in the post pelleting application process in low energy broiler diets. A total of 1,024 male broiler chicks were randomly assigned to one of four treatment diet series with 8 replicate pens per treatment and 32 birds per pen. Fat was applied post pelleting to a common corn-soy diet to produce three treatments (P80, P100, and P120) with fat levels at 80, 100, and 120% of target, respectively. A fourth treatment (M100) compared the addition of 100% of the dietary fat in the mixer prior to pelleting. Diets were formulated to contain a total of 6.8, 7.0, and 6.9% fat in the starter, grower, and finisher feeds, respectively. BW and feed consumption were determined at 14, 35, and 42 d of age and adjusted feed conversion (AdjFCR) calculated by including the weights of all dead birds. Feed was analyzed for crude fat and the percentage total fat fed to the birds was calculated for each diet. Results showed that the birds received 74%, 106%, 116%, and 84% of target in the starter feed, 77%, 101%, 119%, and 87% of target in the grower feed, and 86%, 101%, 119%, and 107% of target in the finisher feed for the respective P80, P100, P120, and M100 treatments. There were no effects on BW at 42 d of age. The overall AdjFCR of birds fed the P80, P100, P120, and M100 diets were 1.78, 1.77, 1.75, and 1.80. The over application of fat (P120) tended to improved AdjFCR in broilers that were fed lower energy diets. The results of this study did not indicate the under application of fat (P80) produced poorer AdjFCR with males that reached 2.738 g BW at 42 d.

Key Words: post pellet fat application, broilers, pellet, poultry fat
M76 Utilizing glycerol in swine and poultry Diets: Feed manufacturing considerations. E. F. Mader*, A. C. Fahrenholz, J. Wilson, and L. J. McKinney, Kansas State University, Manhattan.

Two studies were conducted to evaluate the effects of utilizing glycerol in swine and poultry diets on pelleting performance. In Exp. 1, a corn-soy based swine grower diet containing either 0, 3, 6, and 9% glycerol was pelleted using a California Pellet mill (Master Model HD, Series 2000). Prior to the pellet die, each diet was steam conditioned for 30 seconds to 65, 77 and 88 °C in an atmospheric conditioner. Production rate was held constant and electrical energy and pellet quality were measured. In Exp. 2, the objective was to validate results from the first experiment held constant and electrical energy and pellet quality were measured. In the first experiment, there was an interaction between glycerol and conditioning temperature. For all diets containing glycerol, roll skid occurred and the pellet mill plugged as conditioning temperature approached 88 °C. This was consistent across replications. This did not occur when diets were conditioned to 65 and 77 °C. Electrical energy consumption tended to decline as conditioning temperature increased. The addition of glycerol did not significantly influence KWH/Ton. However, pellet quality increased linearly (P<0.01) with increasing levels of glycerol. Results from Exp. 2 were consistent with the first experiment, in that there was an interaction between condition temperature and the addition of glycerol. Additionally, the addition of glycerol improved (P<0.05) pellet durability. The studies suggest that addition of glycerol positively affects pellet quality. However, conditioning temperatures must be reduced diets contain glycerol.

Key Words: glycerol, pelleting, pellet quality, feed, feed manufacturing

Environment and Management II

M77 Prevalence and distribution of Salmonella in organic and conventional broiler poultry farms. W. Q. Alali*, 2S. Thakur 2, R. D. Berghaus1, and W. A. Gebreyes3, 1University of Georgia, Griffin, 2North Carolina State University, Raleigh, 3The Ohio State University, Columbus.

The objective of this cross-sectional study was to compare the prevalence of Salmonella and antimicrobial resistant Salmonella, as well as investigate the distribution of this pathogen in organic and conventional broiler poultry farms. Fecal, feed, and water samples were collected from birds at 3 weeks and 8 weeks of age for 2-flock cycles. One house was sampled per farm at 3 organic and 4 conventional broiler farms from the same company in North Carolina. All samples were analyzed for the presence of Salmonella using selective enrichment techniques. Further phenotypic (antimicrobial susceptibility) and genotypic (PFGE) testing were performed. The overall prevalence (across all farms and sample types) of Salmonella in organic farms was 8.3% (13/300) compared to 28.7% (115/401) in conventional farms. Salmonella prevalence in fecal samples were 5.6% (10/180) and 38.6% (93/241) from organic and conventional farms, respectively. From feed, 5% (3/60) and 27.5% (22/80) of the samples were positive for Salmonella from organic and conventional farms, respectively. None of the water samples were positive for Salmonella. In preliminary testing to characterize selected (n=33) Salmonella isolates by their antimicrobial susceptibility and PFGE patterns: the two most predominant resistance phenotypes were: 1) single resistance to streptomycin (39.4%;13/33), and 2) multi-drug resistance to 6 antimicrobial agents: Ampicillin-Amoxicillin/Clavulanic acid-Streptomycin-Cephalothin-Cefiofur-Cefoxitin (R-type AmAxSt-CeCFCx; 48.5%;16/33). Genotypic analysis using PFGE showed a highly clonal nature of the isolates within the two types of farms. The results of our study suggest that within this poultry company, that prevalence of fecal Salmonella may be lower in certified-organic birds than in conventionally-raised birds.

Key Words: Salmonella, organic, broiler, antimicrobial resistance, PFGE


The newly hatched chick may be exposed to significant levels of Campylobacter from various sources in the hatchery and grow-out environments. Once the Campylobacter reach the ceca of the young chick they are able to multiply to high levels in a relatively short time period. This creates a situation where the young chick is contaminating the environment by excretion of large numbers of Campylobacter through cecal and fecal droppings which can result in the contamination of other birds in the grow-out facility. In this study, Campylobacter coli, naturally gentamicin resistant, was introduced into the day-of-hatch chicks through various body openings (mouth, nasal passage, eye and cloaca) at three different inoculum levels (approximately 20, 200 and 2000 CFU/bird) to determine which of the routes and numbers of Campylobacter would result in the highest level of colonization in the chicks. Two replications with 160 birds per replication and one replication with 110 birds were challenged via the different routes. Exposed birds colonized with greater than 104 Colony Forming Units (CFU) occurred readily with all four routes of entry if the original inoculum level was at least approximately 200 CFU/bird or greater. The nasal passage was the least likely route of colonization. This data suggests that Campylobacter can readily colonize day of hatch chicks via various routes and contaminate the environment through shedding in feces. Therefore, multiple intervention strategies may be required to interrupt exposure and/or colonization with Campylobacter.

Key Words: Campylobacter, colonization, routes, broiler chicks
**M79** *Salmonella* Enteritidis growth characteristics utilizing different enrichment broths which contain other *Salmonella* serovars and extraneous microflora. N. A. Cox*, S. L. Branton, J. L. Purswell, H. A. Olanrewaju, S. D. Collier, and G. T. Pharr. USDA-ARS Poultry Research Unit, Mississippi State, MS.

Field experience indicates *S. Enteritidis* (SE) can be difficult to isolate from broiler breeder flock environmental samples even when hatchery progeny chicks are positive. The objective was to evaluate non-stressed and stressed SE marker (SEM) growth in buffered peptone water (BPW), universal preenrichment broth (UP), and tetrathionate broth (TET) with other *Salmonella* and non-*Salmonella* microflora present. In experiment 1, enrichment broth tubes were inoculated with log 1.8 cfu/ml of SEM and divided into four sets with three tubes per set. For experiment 2, a log 1.8 cfu/ml of SEM was inoculated onto 2.54 cm² hatchery paper trayliners and left exposed to desiccation for 48 h before placement into broths. Set 1 served as a control; set 2 contained the SEM with log 2 cfu/ml of *S. Kentucky*, *S. Typhimurium* and *S. Enteritidis* (field strain) cocktail; set 3 contained a 1:3 ratio of enrichment broth to fecal material; while set 4 contained hatchery fluff match as set 3. For the non-stressed SEMs, growth in BPW averaged log 8.5, 4.9, 2.3, and 2.9 cfu/ml for the control, cocktail, feces, and fluff sets, respectively. Growth in UP averaged log 8.7, 3.9, 3.6, and 4.9 cfu/ml for the control, cocktail, feces, and fluff sets, respectively. Growth in TET averaged log 8.1, 2.5, 1.5, and 2.8 cfu/ml for the control, cocktail, feces, and fluff sets, respectively. For the stressed SEMs, growth in BPW averaged log 8.1, 3.9, 4.8, and 5.1 cfu/ml for the control, cocktail, feces, and fluff sets, respectively. Growth in UP averaged log 8.2, 3.7, 4.9, and 5.4 cfu/ml for the control, cocktail, feces, and fluff sets, respectively, while growth in TET averaged log 8.1, 4.6, 6.7, and 5.6 cfu/ml for the control, cocktail, feces, and fluff sets, respectively. No significant difference in SEM growth was observed in pure culture. Adding other *Salmonella*, feces, and fluff significantly reduced SEM growth in each enrichment broth. Further investigations on factors that affect SE growth during cultivation may enable cultivation method developments that enhance SE recovery.

**Key Words:** *Salmonella* Enteritidis, growth, fluff, feces, cultivation

**M80** Effect of broiler rearing environment on transmission of F strain Mycoplasma gallisepticum from turkeys to layers and broilers. S. L. Branton*, J. D. Evans, S. A. Leigh, J. L. Purswell, H. A. Olanrewaju, S. D. Collier, and G. T. Pharr. USDA-ARS Poultry Research Unit, Mississippi State, MS. Mississippi State University, Mississippi State.

Four commercial turkeys at 9 WOA were placed in each of five pens and four commercial layer pullets at 10 WOA were placed in each of three floor pens. Turkeys in each of two adjacent pens at the inlet end of the house were eyedrop inoculated with live *Mycoplasma gallisepticum* (MG) vaccine (Fort Dodge) on May 04. Four weeks (June 04) later four commercial layers (14 WOA) were added to one of the pens containing the MG inoculated turkeys. Then, an additional four weeks later (July 02) 16 broilers (56 DOA) were added to the same pen. All birds were maintained through August 18 (turkeys 24 DOA) at which time all birds in all pens were weighed, bled, cultured for MG from the choanal cleft, euthanized and examined for gross lesions. Only one bird died during the entire experimental period (not in an MG inoculated pen) and 12 of 52 total birds in the study showed either serologic or cultural evidence of MG exposure. MG was isolated from four birds. No birds showed any evidence of MG infection.

**Key Words:** broiler, turkey, *Mycoplasma gallisepticum*


The effects of environmental temperature, light intensity and their interaction on growth performance and carcass characteristics of broilers were investigated in 2 trials. The experiment consisted of a 3 x 3 factorial arranged in a randomized complete block design with trials being replicated over time. The 9 treatments consisted of 3 levels (Low=15.6, Moderate=21.1, High=26.7 °C) of temperatures and 3 levels (0.5, 3.0, 20 lx) of light intensities both from d 8 to 56 d of age. Five hundred and forty Ross x Ross 708 chicks were randomly distributed into 9 chambers at 1 d of age. Birds were provided a four phase-feeding program (Starter: 0 to 14, Grower: 15 to 28 d, Finisher: 29 to 42 d, and Withdrawal: 44 to 56 d). Relative humidity of 50% was maintained as scheduled throughout experimentation. Broilers subjected to high temperature (P ≤ 0.05) had poorer BW, BWG, FI, FCR, carcass weight, and Pectoralis major and minor weights compared with values observed at low and moderate temperatures. Temperature x light-intensity interactions (P ≤ 0.05) were observed for BWG, FI, FCR, carcass weight, and Pectoralis major and minor weights. Plasma corticosterone concentrations were not affected by temperature, light intensity or their interaction, suggesting an absence of physiological stress. These results indicated that moderate temperatures and light-intensities improved broiler live performance, while high temperature and high light-intensity may have a negative effect on broiler live performance.

**Key Words:** temperature, light-intensity, stress, meat yield, broiler

**M82** Field evaluation of vaccine deposition accuracy comparing two commercially-available *in ovo* injection systems. C. Williams*. Pfizer Animal Health, Durham, NC.

The location of *in ovo* injection and vaccine deposition has been shown to be critical to the efficacy of Marek’s disease (MD) vaccine protection against MD viral challenge. Vaccine deposition into the amniotic sac, subcutaneous (SQ) or intramuscular (IM) regions of the embryo is required for MD vaccine efficacy. Vaccine deposition onto the air cell or into the amnion/chorioallantoic fluid results in chicks that are not adequately protected against subsequent MD viral challenge. A study was conducted in two commercial broiler hatcheries to evaluate the ability of the Embrex®, Inovoject® System (Pfizer Animal Health, Research Triangle Park, NC) and the IntelliJECT® (Avitech, Salisbury, MD, distributed by Merial) to accurately and properly deliver an *in ovo* vaccine. A standard MD vaccine diluent mixed with a protein staining dye was delivered through each machine to simulate *in ovo* vaccination. The location of the dye within the egg was used to determine if proper vaccine delivery occurred. Each egg was also evaluated for proper embryo development (live eggs). Proper vaccine delivery included eggs where the vaccine was injected into the amnion, SQ, or IM regions of the embryo. Injections to all other embryonic compartments were determined as improper. In Hatchery A (Chickmaster Day 19), a total of 1171 live eggs were injected by the
Inovoject System and 1138 live eggs were injected by the Intelliject. The Inovoject System vaccinated 94.62% at the proper site of injection (SOI) while the Intelliject only delivered 61.16% of the vaccine to the proper SOI. In Hatchery B (Jamesway Day 18), 926 live eggs were injected by the Inovoject System and 910 live eggs were injected by the Intelliject. The Inovoject System vaccinated 91.04% at the correct SOI while only 71.98% of the eggs injected by the Intelliject were vaccinated at the correct SOI. The results of this study clearly demonstrate that proper vaccine delivery was statistically greater ($P < 0.05$) with the Inovoject System than the Intelliject at both day 18 and day 19.

Data on file Study Report No. 01-09-1100 & 07-09-1100.

Key Words: in ovo, Marek’s, site of injection


*Thevetia peruviana* is evergreen flowering shrubs widely grown as ornamental shrubs or hedges. They are cultivated throughout tropical and subtropical regions of the globe, common in the southern United States. The plant has medicinal use and highly nutritious, but raw thevetia cake is toxic to broilers (Atteh et al 1994). Currently, there is no human dietary or commercial demand for the seed. Studies at our station have shown nutrient compositions of *Thevetia peruviana* is comparable in quality to soybean. Crude protein (47.50%), fat (0.08%), crude fiber (5.20%), calcium (0.23%), phosphorus (0.53%). However, cystein and lysine are limiting amino acid when compared to chick amino acid requirements. Fatty acid profile showed that the seed has high palmitic acid (20.39%), oleic acid (48.90%), and linoleic (19.27%). Antinutritive factors reported include Thevetin A (40.48g/kg), and Thevetin B (97.7g/kg) which have detrimental effects on performance of poultry. Some processing methods were applied to detoxify thevetia seeds. These involve fermentation, ensiling in urea, and acid hydrolysis. The rationales behind the methods are described. The studies showed that all the methods have the potential to reduce the negative effects of these antinutritive factors, though low palatability of thevetia cake reduced the feed intake of birds and the processed thevetia still contain a residual toxic compound which result in depressed of growth rate and feed conversion ratio. There is need for further improvements before it can become useful for poultry feed.

Key Words: antinutritional factor, broiler, processing, *Thevetia peruviana*

### Processing and Products

M84 Organoleptics and consumer acceptance of eggs from hens fed flax seed and two different antioxidants. Z. Hayat*1,2, G. Cherian1, T. N. Pasha1, F. M. Khattak1, and M. A. Jabbar1, 1University of Veterinary and Animal Sciences, Lahore, Pakistan, 2University College of Agriculture, University of Sargodha, Sargodha, Pakistan, 3Department of Animal Sciences, Oregon State University, Corvallis.

Hens were fed on diets containing 10% flax seed (Flax), flax seed + vitamin E (Flax + Toc), flax seed + butylated hydroxy toluene, BHT (Flax + BHT) and 0% flax seed (Control). The eggs laid by the experimental hens were subjected to sensory evaluation and consumer acceptance through trained and untrained panelists. Fresh eggs collected within 24 hrs were hard-boiled, coded with three digit random number and were offered to 10 trained panelists in 4 testing sessions. The trained panelists rated Flax, Flax + Toc and Flax + BHT eggs to be different from control eggs ($P < 0.001$). On the other hand, untrained panelists were blinded and were asked to distinguish flax-fed eggs from control eggs. Majority (75-80%) of the panelists could not distinguish flax-fed vs. control eggs for aroma and flavor. A consumer preference test was also conducted to gauge end-user response to n-3 fatty acid-enriched eggs. Consumer acceptance testing could not find any significant difference ($P > 0.05$) between control and flax-fed eggs. These results suggest that flaxseed when incorporated at 100g/kg in layer diet can produce eggs which are acceptable to untrained panelists and consumers. However, trained panelists are able to detect the difference in flavor, aroma, of flavor in n-3 fatty acid-enriched eggs incorporated through flax seed. Moreover treatments with antioxidants were not able to enhance the acceptability of n-3 fatty acid enriched eggs by trained panelists.

Key Words: eggs, flaxseed, antioxidants, sensory evaluation, consumer acceptance

M85 Dietary inclusion level effects of distillers dried grains with solubles on broiler meat quality. M. W. Schilling, V. Battula, R. E. Loar II, V. Jackson, S. Kin*, and A. Corzo, Mississippi State University, Mississippi State.

A completely randomized design with 7 replications (n=280) was utilized to evaluate the effects of feeding various levels of distillers-dried-grains-with-solubles (DDGS) (0, 6, 12, 18, and 24 %) on broiler breast and thigh meat quality. At 42 d of age, broilers were harvested in a pilot scale processing plant with commercial prototype equipment, and the breasts were deboned from the carcass at 4 hr postmortem. The right half of each breast was evaluated for ultimate pH, instrumental color, cooking loss, proximate analysis, and tenderness. The left half of each breast was utilized for consumer acceptability testing. In addition, thigh meat was evaluated for proximate composition, fatty acid composition, and TBARS. Breast meat from broilers that were fed DDGS had a higher ($P < 0.001$) pH than those from the control diet. In addition, the 18 and 24 % DDGS treatments yielded breast meat with higher ($P < 0.001$) pH values than the 6 % DDGS treatment. No differences existed ($P > 0.05$) among breast meat from the different treatments with respect to cooking loss, instrumental color and consumer acceptability, but breast meat from the control (0 % DDGS) treatment had slightly lower ($P = 0.018$) shear force than breast meat from the 18 and 24 % DDGS treatments. In addition, no differences ($P > 0.05$) existed among proximate composition of breast and thigh meat from the control and DDGS treatments. However, as DDGS concentration increased, there was a linear increase ($P < 0.0001$) in inlinoleic and polysaturated fatty acids, which indicates a greater potential for lipid oxidation which was confirmed by TBARS values that were greater ($P < 0.05$) for the 18 and 24 % DDGS treatments at Day 5 when compared to the control and 6 % DDGS treatments. Overall, data suggest that all treatments yielded...
high quality breast meat and that thigh meat quality was similar among treatments containing 0 to 12 % DDGS, but higher inclusion levels led to thigh meat that was more susceptible to oxidation.

Key Words: distillers dried grains with solubles, meat quality, proximate composition, fatty acid composition, TBARS

M86 Sodium reduction in processed poultry. T. Isakson* and S. Rao, Nu-Tek Products, Minnetonka, MN.

Fresh chicken and turkey are naturally low in sodium, but many processors sell “enhanced” products which are marinated in salt water. Salt is used in Poultry applications to enhance flavor, suppress microbial growth, solubilize and emulsify proteins to improve water holding capacity and increases water retention. Reducing sodium content in marinated chicken breast presents problems in functionality and flavor attributes. The study was conducted on marinating using chicken breast fillets. The marinade was a simple salt and phosphate formula, designed to result in 0.8% salt and 0.3 % sodium triphosphate in the marinated product. The two variables was a control using regular salt (sodium chloride) and Nu-Tek Low sodium salt (salt and modified potassium chloride). A target marinade level of 20% of meat weight was used. Evaluations of marinated meats for Green Wh, % pick up and cook weight were measured. Chicken samples were evaluated using an attribute rating scale which had the panelists evaluate appearance, texture, chicken flavor, salt flavor and salt intensity, off-flavors and overall acceptability. A randomized complete block design was used. A total of 41 panelist participated. Results showed no significant differences were found within any attribute across the samples control and reduced sodium.

Key Words: sodium reduction, processed poultry, salt, reduced sodium

M87 Application of chlorine dioxide to lessen bacterial contamination during broiler defeathering. M. E. Berrang*, R. J. Meinersmann, N. A. Cox, and P. J. Fedorka-Cray, USDA-ARS-RRC, Athens, GA.

Due to escape of contaminated gut contents, the number of Campylobacter spp. recovered from broiler carcasses increases during feather removal. Chlorine dioxide (ClO2) is approved for use as an antimicrobial treatment during poultry processing. A chlorine dioxide generator was placed in a commercial broiler slaughter plant and plumbing was set up such that either city water (control) or 50 ppm ClO2 could be applied as a spray during feather removal. A study was designed to test if application of ClO2, during feather removal could prevent the expected increase in Campylobacter numbers on carcasses. Flocks were tested to determine Campylobacter status; three replications were conducted each using carcasses from different Campylobacter positive flocks. In each replication, ten carcasses were collected from the shackel line immediately before and after de-feathering with and without ClO2 for a total of 40 carcasses per replication. Carcasses were subjected to a whole carcass rinse and the rinseate was cultured for the number of Campylobacter and E. coli per mL of rinse. Before feather removal, log 1.79 CFU Campylobacter and log 3.20 CFU E. coli were detected per mL of carcass rinse. After control de-feathering the Campylobacter numbers increased to log 3.59 CFU per mL while E. coli numbers did not change significantly. Chlorine dioxide de-feathering moderately the increase in Campylobacter resulting in log 2.98 CFU per mL, significantly fewer than on control post pick carcasses. E. coli numbers, at log 2.77 CFU per mL, were also lower in rinses of treated post pick carcasses than control carcasses. Application of ClO2 during feather removal may have potential as a means to mitigate the increase in bacterial contamination associated with broiler de-feathering.

Key Words: campylobacter, chlorine dioxide, E. coli, broiler, defeathering

M88 Influence of washing time on residual contamination of carcasses sprayed with lauric acid-potassium hydroxide. A. Hinton Jr.*, J. A. Cason, R. J. Buhr, and K. Lilliebjeelke, Russell Research Center, Athens, GA.

A series of experiments were conducted to examine reductions in bacterial contamination of broiler carcasses washed for various times in a spray cabinet with a 2% lauric acid (LA)-1% potassium hydroxide (KOH) solution (w/v). Forty eviscerated carcasses and 5 ceca were obtained from the processing line of a commercial poultry processing facility. An inoculated cecal paste was prepared by mixing 5 g of cecal contents with 0.3 mL of a bacterial suspension containing 107 cfu/ml each of antibiotic resistant strains of Escherichia coli, Salmonella Typhimurium, and Campylobacter coli. A 0.1 g portion of the inoculated cecal paste was applied to the skin of each carcass and allowed to dry for 15 min. Inoculated carcasses were then placed into 4 groups of 10 carcasses, and groups were washed for 0, 5, 15, or 30 s at 100 psi (689 kPa) in a spray cabinet with the LA-KOH solution. Washed carcasses were rinsed for 15 s with sterile, deionized water to remove excess LA-KOH before whole carcass rinses were performed for 2 min in 200 mL of sterile phosphate buffered saline. Total plate count bacteria (TCP) and antibiotic resistant E. coli, Salmonella Typhimurium, and C. coli were enumerated in carcass rinsates, and the pH of rinsates was measured. Results indicated that significantly fewer bacteria, from all enumerated groups, were recovered from carcasses washed in LA-KOH for 5 s than from unwashed carcasses. Furthermore, significantly fewer TCP bacteria and Salmonella Typhimurium were recovered from carcasses washed for 15 s than for 5 s, and no C. coli were recovered from carcasses washed for 15 or 30 s. The pH of rinsates from carcasses washed for 0, 5, 15, or 30 s was 7.16, 8.12, 9.05, and 9.44, respectively. Findings indicate that increasing the time that carcasses are spray washed with LA-KOH can significantly decrease carcass contamination and that microbicidal surfactants may deserve consideration as potential sanitizers in poultry processing operations.

Key Words: lauric acid, potassium hydroxide, spray washing, broilers, carcasses


This study was conducted to evaluate the dietary interaction of calcium and phosphorous at varying inclusion levels in the ration of laying hens and their effects on performance characteristics and egg qualities. One hundred and eighty (180) of twenty four (24) weeks old layers were randomly allotted into nine pens to give a total of twenty (20) birds per pen. Nine dietary rations were formulated and fed to birds in each pen accordingly. The proportion of calcium to phosphorous were varied from low, medium to high inclusion in the experimental feed. The laying hens were fed and served water ad libitum twice daily.
Result revealed that birds in pen 1, 2 and 7 fed feed containing medium calcium-high phosphorous, high calcium-medium phosphorous and high calcium-low phosphorous performed best, better and good respectively in terms of egg production, egg weight, egg shell thickness and feed intake. Cost-benefit analysis was also found to follow the same order. Birds in pen 4 however, fed feed containing medium calcium-low phosphorous had the least performance. The study thus concludes that medium to high inclusion of calcium and phosphorous or vice-versa are important for high performance of laying birds.

Key Words: dietary interaction, egg qualities, cost-benefits, calcium, phosphorous

M90 Utilization of roasted fluted pumpkin (Telfeiria occidentalis) pod husk waste by broiler chickens in humid tropical environment.
S. O. Omoikhoje*,1 S. O. Obohi1, D. O. Obasoyo2, E. T. E Ehehba1, and C. O. Isidahomen1, 1Ambrose Alli University, Ekpoma, Edo, Nigeria, 2Bendel Feed and Flour Mill, Ewu, Edo, Nigeria.

The most effective approach to control the spread of M. gallisepticum (MG) is by strict biosecurity measures, continuous surveillance and eradication of infected flocks. The continuous expansion of the poultry industry worldwide in restricted geographical areas and the economical losses due to MG outbreaks makes it crucial to identify and better control of the vectors responsible for the transmission of the disease. This study is designed to evaluate the susceptibility and tissue distribution of MG in chickens, sparrows and pigeons to determine the role of the later two species in MG transmission. Twenty six chickens, pigeons, and sparrows were experimentally inoculated with a field strain of MG and monitored for development of clinical signs, seroconversion by hemagglutination inhibition, shedding by culture, and MG distribution in their tissues by immunohistochemistry. All chickens showed mild respiratory signs, seroconverted (GMT=494) and shed MG in their tracheas. MG antigens were observed in pigeon’s conjunctiva and trachea. In conclusion, pigeons and sparrows are partially susceptible to MG infection and did not maintain a steady carrier state or seroconverted similar to chickens and hence may play a role in MG transmission between poultry farms as biological vectors although infection may be temporary.

Key Words: Mycoplasma gallisepticum, pigeon, sparrow, immunohistochemistry, shedding

In an 8-week feeding trial, four broiler starter and finisher diets that contained 0, 10, 20 and 30% roasted fluted pumpkin pod husk waste meal were randomly assigned to a total of 144 broilers in a completely randomized design to assess their performance and economics of production. The results showed that only the average liveweight and daily weight gain were significantly (P < 0.05) highest in broilers fed 20% fluted pumpkin pod husk waste than those on other dietary treatments. Cost of total feed consumed per bird (N) and cost per kilogram live weight gain (N) were reduced by fluted pumpkin pod husk waste meal inclusion with 20% inclusion translating to the highest profit per bird. It therefore infers that 20% level of inclusion of roasted pumpkin pod husk waste meal is adequate in broiler diets for enhanced growth performance and optimum profit.

Key Words: broilers, carcass yield, cost benefit, growth, pumpkin pod husk

SYMPOSIA AND ORAL SESSIONS

Tuesday, January 26, 2010

SCAD II

T91 Infectivity and tissue distribution of mycoplasma gallisepticum in chickens, sparrows, and pigeons. S. Gharaiheh*,1,2 and A. Hailat2, 1University of Georgia, Athens, 2Jordan University of Science and Technology, Irbid, Jordan.

Within the table egg sector of the poultry industry, live attenuated vaccines such as FVAX-MG® are available to reduce economic losses associated with Mycoplasma gallisepticum (MG)-induced disease. Though FVAX-MG® is commonly applied via spray, vaccination may also occur via eye-drop and consequently, the realized vaccine inoculum can vary with the specific route of application. To assess the effect of the variation in realized inoculum of FVAX-MG®, Hyline W36 layer hens (n=480) were equally divided between two identical but isolated facilities and placed individually in layer cages. At 11 woa, the birds in each facility were eye-drop vaccinated with FVAX-MG® at either 1X or 10-3X of the manufacturer’s recommended dosage. Through 51 woa, eggs were collected and weekly hen production was determined. The birds (10% sample) were also bled periodically throughout the study and the serological response was determined via serum plate agglutination (SPA) assays utilizing two commercial antigens. To assess protection from pathogenic MG challenge, all birds were challenged at 45 woa with the virulent MG strain Rlow. Results indicate that egg production was not affected by FVAX-MG® dosage, nor did MG strain Rlow challenge appear to affect egg production with either treatment. The rates of serologic response did, however, differ with treatment as 100% of the 1X FVAX-MG®-treated birds seroconverted by 2 wks post-vaccination (p.v.) or 13 woa and maintained this level throughout the study. Lower rates of seroconversion were observed among the 10-3X FVAX-MG®-treated birds. At 2 wks p.v. (13 woa), only 12.5% (commercial antigen A) or 16.67% (commercial antigen B) of the birds within this treatment seroconverted, but 75% of the birds demonstrated a serologic response
**Key Words:** Mycoplasma gallisepticum, table egg layer, mycoplasmosis, attenuated live vaccine

**T93 Detection and differentiation of avian reoviruses using SYBR-Green I based two-step real-time RT-PCR with melting curve analysis.** J. J. Giambrone*, K. Guo, and T. V. Dormitorio, Auburn University, Auburn, AL.

Avian reoviruses (ARVs) can cause reduced profits to the chicken industry. Improved viral detection and differentiation are needed for ARVs. A SYBR-Green I based real-time PCR quickly detected and differentiated ARVs strains (S1133, 2408, CO8, 1733, JR1, 3005, ss412, and two vaccines: ChickVac™and V.A. Vac®). All ARV strains from North America belong to the same serotype, however, at least 2 subtypes were shown using cross viral neutralization (CVN). The JR1, a trypsin resistant strain, and the 3005 strain are from Europe. A multitude of subtypes have been isolated worldwide. Subtype differences can make production and use of correct vaccines complicated. CVN tests are time consuming and require a collection of viruses and antibodies. The Reverse transcriptase PCR followed by restriction fragment polymorphism (RT-PCR-RFLP) can show differences and group ARVs. We developed a (SYBER-Green I based 2 step real time PCR) to speed up differentiation and grouping. It was faster and more sensitive than other methods. Three primers were used. They were from the σC-encoding gene located in the S1 genome, which codes for the attachment protein. The σC protein induces neutralizing antibody, is the determinant for ARV serotypes, and has a higher mutation rate than the other genes. Melting curve analyses determined the melting peak temperature (Tm) of each region. Results indicated that each ARV strain had a specific profile of Tm combination in the three regions. The ss421, CO8, and 3005 strains resided in different subtypes as shown by CVN. Using our test, they demonstrated more variations in Tm profiles than the other strains, indicating that our test corrected with the CVN. However, more isolates must be subjected to this test and compared with CVN to confirm the validity of our test for subtype differentiation.

**Key Words:** avian reovirus, detection, differentiation, real-time RT-PCR, melting curve

**T94 Viruses isolated from proventriculitis cases in Mississippi broiler flocks.** T. N. Tabor*, R. Mackey, F. Wilson, and A. Banda, Poultry Research and Diagnostic Lab., College of Veterinary Medicine, Mississippi State University, Pearl.

Samples of proventriculus were collected from broiler flocks that exhibited enlargement and flaccidity of this organ. At the histopathological studies, mild to marked chronic proventriculitis was observed in most of the sections with the presence of inflammatory infiltrates in the lamina propria and follicular lymphoid hyperplasia. Viral isolation was carried out by inoculation of proventriculus macerates in chicken embryonated eggs and chicken embryo kidney cell cultures (CEKC). Embryonic lesions suggestive of avian reovirus were observed after five days post inoculation. Several samples induced cytopathogenic effect characteristic of avian adenovirus and reovirus in the inoculated CEKC cultures. The presence of avian adenovirus group I and avian reovirus were confirmed by PCR and RT-PCR amplifications, and by sequencing and phylogenetic studies.

**Key Words:** viruses, proventriculitis, broilers, Mississippi

**T95 Determination and analysis of the full-length chicken and turkey parvovirus genomes.** L. Zsak* and J. M. Day, Southeast Poultry Research Laboratory, Athens, GA.

Recently, we reported the application of a molecular screening method to detection of novel viruses in intestinal samples of chickens and turkeys exhibiting characteristic signs of enteric disease. Using this technique, we successfully identified novel parvovirus DNA sequences in intestinal homogenates of affected birds. Sequence analysis of the left end of the genome, including the complete nonstructural gene (NS), suggested that the chicken parvovirus (ChPV) and the turkey parvovirus (TuPV) represented new members of the Parvovirus family. The aim of this study was to determine the complete nucleotide sequence of the chicken and turkey paroviruses and to provide additional data for classification of these novel paroviruses. The complete ChPV genome was found to be 5,257 nt long and its organization resembled that of the other known paroviruses. The genome was flanked by two identical inverted terminal repeats of 206 nt and contained two major ORFs encoding the NS protein and at least two capsid proteins (VP1 and VP2). Similarly to members of the boca parovirus genus, the chicken parvovirus also had a third, middle ORF of 306 nt. ChPV and TuPV appeared to be closely related when their genomes were compared at the nucleotide or amino acid levels. The nucleotide identity for the coding region was 80.1% between ChPV and TuPV and the amino acid similarity was 89.3% and 95.1% for the NS and VP1 genes, respectively. Our data indicate that ChPV and TuPV are independent members of the Parovirus family and they form a separate genus within the Parovirinae subfamily. Based on the significant genome sequence differences between ChPV and TuPV, these viruses can represent individual species in a new avian parovirus genus.

**Key Words:** parovirus, chicken, turkey, poultry, enteric diseases

**T96 Protection induced by infectious laryngotracheitis virus (ILTV) vaccine alone and combined with infectious bronchitis virus (IBV) and Newcastle disease virus (NDV) vaccines.** A. Vagnozzi*, M. Garcia, S. Riblet, and G. Zavala, Poultry Diagnostic and Research Center, Department of Health Population, College of Veterinary Medicine, University of Georgia, Athens.

The Infectious Laryngotracheitis (ILT) is the causative agent of a viral respiratory disease of chickens, which is responsible for relevant economic losses in the poultry industry. For the control of the disease, two different attenuated ILTV vaccines have been used worldwide; the chicken embryo origin (CEO) vaccines and the tissue culture origin vaccines (TCO). In spite of the extensive use of ILTV vaccination, the disease is still a problem in areas of intense broiler production. Several factors may influence the ILT vaccination failures. One factor that has not been clearly evaluated is the possible interference of vaccination with ILTV vaccination. The objective of this work was to determine the role that NDV and IBV vaccinations play in the protection induced by ILTV vaccines. Protection induced by the ILTV vaccines (CEO and TCO) was evaluated alone and in combination with NDV (B1) and IBV
Infectious bursal disease (IBD) is an immunosuppressive disease in chickens which causes economic losses in the poultry industry. IBD is caused by infectious bursal disease virus (IBDV), a member of the family Birnaviridae. Humoral immunity present in commercial broiler chickens due to vaccination programs results mostly in antigenic drift due to positive selection of antigenically different viruses. These mutations in the viral genome occur randomly and can result in antigenic escape strains. The result is that these antigenically different IBDV evolve in poultry flocks over a period of time and can become established in the field. We analyzed the antigenic makeup of IBDV field isolates using reverse genetics in combination with a panel of monoclonal antibodies (mAb), and determined the nucleotide (nt) sequence and amino acid (aa) sequence. The objective of this study was to analyze a database (mAb), and determined the nucleotide (nt) sequence and amino acid (aa) sequence. The placement of numerous isolates in the phylogenetic tree showed differences between the nt based PT and the aa sequence based PT. In addition, it was observed that most of the sequences (aa as well as nt) did not group with known IBDV subtype strains (Boot strap value >75, 1000 repetitions). Moreover, the mAb panel pattern (mAbpp) of 245 IBDV isolates. To this end, phylogenetic trees of the aa and nt sequences were calculated by bioinformatics tools and compared with each other. The placement of numerous isolates in the phylogenetic tree (PT) showed differences between the nt based PT and the aa sequence based PT. In addition, it was observed that most of the sequences (aa as well as nt) did not group with known IBDV subtype strains (Boot strap value >75, 1000 repetitions). Moreover, the mAb panel pattern (mAbpp) of each isolate was added to the phylogenic tree. The obtained results showed that the mAbpp did not correlate with the location in the phylogenic tree. This indicates that grouping of IBDV isolates based on similarities might result in a false classification of the field isolate. The analysis of the aa sequences revealed that changes in the third and fourth hydrophilic peak of VP2 [aa 270-285 (3rd), aa 316-325 (4th)] were most prominent. These results indicate that the selection pressure in the field favored IBDV with mutations in these regions resulting in viruses which might become established in the field.

Key Words: IBDV, antigenicity, reverse genetics, variant strains, bioinformatics

T97 Analysis of the molecular background of changes in the antigenicity of IBDV field strains. V. Durairaj* and E. Mundt, University of Georgia, Athens.


Recombination among IBV strains circulating in the field is a major source of molecular variation. These recombinant viruses can emerge as variant viruses or unique serotypes of IBV sometimes capable of causing disease even in vaccinated birds. It is thought that modified live vaccines that are extensively used in the field can be the source of genetic material for recombination with field viruses. Previously we showed that many of the circulating IBV field viruses are recombinant viruses containing genetic material from several different IBV types. In this study we were interested in examining these recombinant viruses for the presence of vaccine strain sequences to determine if vaccines are playing a role in recombination and at what level. The full-length genome of several selected field viruses were sequenced and analyzed for vaccine-strain sequences. The presence and genomic location of the vaccine sequences were identified. The implications of vaccine recombination for future emerging IBV strains will be discussed.

Key Words: laryngotracheitis, vaccination, interference, protection, viral shedding

T99 Determination of the full length sequence and analysis of the properties of an APMV 8 wild bird isolate during replication in chickens and ducks. A. Warke1, D. Stallknecht1, S. M. Williams1, N. Pritchard2, and E. Mundt*1, 1Department of Population Health, College of Veterinary Medicine, University of Georgia, Athens, 2Merial Select, Inc., Gainesville, GA.

Based on hemagglutination inhibition (HI) tests, avian paramyxoviruses (APMV) are divided into nine distinct serotypes all of which are members of the genus Avulavirus in the family Paramyxoviridae. Out of these serotypes, NDV a member of the APMV-1 serotype induces one of the most economically important poultry disease. Such NDV isolates are designated as velogenic. Less severe NDV forms are designated as mesogenic while lentogenic NDV isolates are mostly asymptomatic in poultry and are routinely used as live vaccine strains. Whereas a large body of knowledge is available about the pathogenicity of APMV-1 isolates other APMV isolates belonging to other subtypes are not well investigated. To close this gap appropriate infection experiments in chickens and ducks were performed and the pathogenic potential of the virus has been investigated. Specific pathogen free (SPF) chickens and pekin ducklings were experimentally infected with APMV-8 to compare their pathogenic potential in two avian species. After infection no clinical signs were observed in chicken and ducks. Microscopical examination of several organs revealed signs of viral replication in both species as indicated by lesions in lung, trachea, small intestine, and pancreas. The analysis of the immune response showed that both species developed antibody titers as measured by HI assay. The intracerebral pathogenicity index was zero and the mean death time in embryonated eggs > 90 h, both values are indicative for a lentogenic phenotype of the virus. Furthermore, the full length genomic sequence was determined. The sequence comprises 15342 nucleotides. The genome encodes in single open reading frames for 6 proteins in the orientation 5'-NP-P-M-F-HN-L-3. The genomic organization was determined with the analysis
were processed into 20% homogenates in sterile PBS. A stepwise
Intestinal tracts from turkey farms with histories of enteric disease
entire turkey gut RNA virus community—an RNA virus metagenome.
understanding of viral enteric disease and the effect viruses have
development of molecular diagnostic tests, and would lead to a better
complete viral flora present in the poultry gut would facilitate the
viruses have been detected in the intestinal tract of poultry, and have

**Key Words:** APMV8, full length sequence, pathogenicity

**T100** Forensic investigation of a 1986 natural outbreak of osteo-
metaplasia in commercial brown layers reveals a novel ALV-related
genome. T. M. C. Barbosa*1, S. Cheng1, M. Ramirez2, S. Hafner3,
and G. Zavala1, 1Poultry Diagnostic and Research Center, Department
of Population Health, University of Georgia, Athens, 2Laboratorio de
Patología Aviar, Escuela de Medicina Veterinaria, Universidad Nacional
de Costa Rica, Heredia, Costa Rica, 3Pathology Section, USDA FSIS,
Eastern Laboratory, Russell Research Center, Athens, GA.

The avian leukosis-sarcoma viruses (ALSVs) induce a variety
of neoplasms in chickens, such as B-cell lymphomas, myelocytomas,
erythroleukemia, and other types of neoplasia, including osteopetrosis.
The mechanism of induction of osteopetrosis lesions by ALVs is not yet
fully understood. We have isolated and identified unique ALV-related
proviral DNA sequences in an archived chicken bone affected with
osteopetrosis. The osteopetrotic bone was obtained from a 46-week-old
brown layer affected during an outbreak of osteopetrosis in Costa Rica
in 1986. Analysis of proviral DNA in the 23-year-old osteopetrotic bone
revealed unique exogenous ALV-related sequences which were named
BLOV (Brown Layer Osteopetrosis Virus). The S’ and 3 ’ long terminal
repeats (LTR) in the proviral DNA were identical to each other. The U3
regions in the LTRs were most similar to equivalent sequences in ALV-J,
while the U5 was identical to known endogenous ALV-E sequences.
The predicted BLOV envelope protein was most similar to the envelope
of myeloblastosis associated virus type 1 (MAV-1), although the percent
nucleotide identity with MAV-1 was relatively low (90.4%). The vari-
able and hypervariable regions displayed several mutations, which made
difficult to draw similarities with other ALV representative strains. The
gp37 (transmembrane or TM) envelope protein showed three uncommon
leucine to serine mutations. Several recombination events may have
contributed to the emergence of BLOV, since each analyzed segment
was similar to a different ALV. BLOV may represent a unique ALV
based on distinctive characteristics of its predicted envelope protein
compared to previously reported ALVs.

**Key Words:** avian leukemia virus, osteopetrosis, chicken, bone,
sequencing

**T101** Identification of RNA viruses in the turkey gut using
metagenomics. J. M. Day* and L. Zsak, USDA/ARS Southeast Poultry
Research Laboratory, Athens, GA.

Poultry enteric disease is marked by diarrhea, stunting, increased time
to market, immune dysfunction and increased mortality. Numerous
viruses have been detected in the intestinal tract of poultry, and have
subsequently been implicated in enteric disease. Knowledge of the
complete viral flora present in the poultry gut would facilitate the
development of molecular diagnostic tests, and would lead to a better
understanding of viral enteric disease and the effect viruses have
on poultry performance in general. This study aimed to identify the
total turkey gut RNA virus community—an RNA virus metagenome.
Intestinal tracts from turkey farms with histories of enteric disease
were processed into 20% homogenates in sterile PBS. A stepwise
centrifugation and filtration process was used to remove large particles
and bacteria. This was followed by ultracentrifugation to pellet virus-
sized particles. The pellet was resuspended and treated with RNase
and DNase to remove non-viral RNA and DNA. RNA was extracted
from the treated pellet and cDNA was generated using the Invitrogen
SuperScript Choice System. This cDNA was used in high-throughput
pyrosequencing using Genome Sequencer FLX Titanium technology
(Roche). Contigs were assembled using the qsAssembler software (454
Life Sciences). Using the contigs as queries, the BLAST non-redundant
(nr) protein database (GenBank) was searched using the blastx program.
The blastx output was analyzed and contigs were assigned to taxa using
MEGAN. The analysis produced 6526 contigs ranging in size from
97 to 2578bp. 788 contigs were similar to RNA viral sequences,
including the dsRNA viruses (Reoviridae and Picornaviruses), and the
ssRNA viruses (Caliciviridae, Leviviridae, Picornaviridae, and
Astroviridae). The majority of the viral contigs (620) were similar to
database sequences from the Picornaviridae order. The data was used to
design novel RT-PCR primers targeting the turkey picornaviruses and
caliciviruses, and the sequences were identified via RT-PCR in archived
enteric material. These results validate this metagenomic approach to
identifying known and novel RNA viruses in the poultry gut.

**Key Words:** turkey, metagenomics, virus, enteric, pyrosequencing

**T102** Production and characterization of monoclonal antibo-
dies against a hemagglutinin 6 of a low pathogenic avian influenza
virus. L. A. Gay*, R. Hogan, F. Michel, and E. Mundt, University of
Georgia, Athens.

Global surveillance of avian influenza viruses (AIVs) remains of para-
mount importance given the ability of these viruses to cross species
barriers and travel large distances in a relatively short amount of time.
Detection of AIV can be accomplished either by virus isolation,
detection of the nucleic acid by RT-PCR or by screening serum samples for
antibodies. Since the virus is present in a given host for only a short
time, looking for longer lasting virus-specific antibodies is the more
practical approach for piecing together the epidemiology and ecology
of AIV. Principal diagnostic tools which can be used to detect AIV
specific antibodies include the hemagglutination inhibition (HI) assay,
the enzyme-linked immunosorbent assay (ELISA), and the agar gel
precipitation test (AGPT). Between these tests, ELISA is advantageous
because it is rapid, efficient, and it can be automated. Additionally, with
a competitive ELISA (cELISA), it is possible to detect antibodies in
serum regardless of the species from which the serum originated. This
can be accomplished through the use of a monoclonal antibody (mAb)
that is specific for the protein of interest. In this study, the HA6 protein
was expressed in a baculovirus system, purified, and used to immunize
deeply BALB/c mice. One mouse was selected and four mAb-secreting
hybridomas were established. The characterization of the mAbs showed
that all four mAbs bind to a linear epitope within the HA1 portion as
analyzed by Western blot. The binding sites of the MAbs were mapped
using plasmids encoding truncated forms of the H6-HA1. Transfection
of eukaryotic cells revealed that the MAbs bind to the last 100 amino
acids of the HA1 protein. Further experiments showed that the MAbs
were neither able to induce hemagglutination inhibition nor were they
able to neutralize the appropriate virus isolate. Experiments towards the
development of the cELISA showed that only one MAb was a candidate
for the establishment of the serologic test.

**Key Words:** avian influenza, hemagglutinin, monoclonal antibody,
cELISA, serology
T103  Characterization of an avian influenza virus PB2 mutant of A/duck/PA/1969 (H6N1) generated by reverse genetics.  L. A. Gay* and E. Mundt, University of Georgia, Athens.

Influenza reverse genetics systems, in which infectious virus is produced from viral cDNA, facilitate manipulation of the viral genome. For this reason they have proven to be valuable tools in the advancement of our understanding of the determinants of viral pathogenicity. We constructed an eight-plasmid reverse genetics system for the low pathogenic avian influenza virus field isolate A/duck/PA/1969 (H6N1) using the pHW2000 plasmid (Hoffmann et al., 2000). Individual plasmids were screened for functionality by transfecting co-cultured MDCK and 293T cells with the experimental plasmid containing one segment along with the other seven segments from A/WSN/33 (WSN). Finally, two viruses which were recovered from plasmids were characterized to determine the EID50, TCID50, plaque titer, and mean death time (MDT) of embryonated chicken eggs. One recovered virus, which possessed a PB2 gene with the same sequence as the wild-type virus, showed the same growth characteristics in MDCK cells and in embryonated chicken eggs as the wild-type virus. A second recovered virus contained a mutation in the PB2 gene which resulted in the exchange of Asn to Ser at position 100. The region containing the mutation in the PB2 protein is located in the N-terminal signal peptide sequence. The mutation-containing virus was more lethal to chicken embryos, as evidenced by a faster MDT at a lower virus titer. Our results clearly indicate that the N100S mutant has enhanced replication activity, contributing to more rapid viral replication. Additionally, this indicates that PB2 alone or in its interaction with PB1 plays an important role in viral replication and probably pathogenicity.

Key Words: avian influenza, reverse genetics, H6N1, PB2

T104  Inadequate protection of ducks and geese against H5N1 high pathogenicity avian influenza virus by a single vaccination.  D. L. Eggert* and D. E. Swayne, Southeast Poultry Research Laboratory; United States Department of Agriculture/Agriculture Research Service, Athens, GA.

Ducks and geese are an important sustainable food source in developing countries. Few studies have been conducted to test vaccine efficacy in either ducks or geese. This study was conducted to investigate whether a single vaccination could protect White Pekin ducks and White Chinese geese against challenge from A/chicken/Indonesia/7/03 (H5N1) or A/chicken/Indonesia/7/04 (H5N1), respectively. One week old White Pekin ducks and 1 week old White Chinese geese were bled and vaccinated subcutaneously with 200 µL of an individual vaccine. Three weeks post-vaccination, animals were challenged intranasally with 200 µL of 10^6 EID50 A/chicken/Indonesia/7/03 (H5N1). Oropharyngeal and cloacal swabs were taken on days 0, 1, 2, 3, 4, 7, 10 and 14 post-challenge. Blood was taken for serum before vaccination, 3 weeks post vaccination and 2 weeks post challenge. Ducks and geese were euthanized at 2 weeks post challenge. Our study showed greater oropharyngeal shedding compared to cloacal shedding in both ducks and geese. No mortality was observed with ducks, but was observed in the sham group for geese. Vaccines used resulted in varying decreases in the amount of virus shed, but no vaccine completely blocked virus shedding for either ducks or geese. Vaccines were observed to have no effect on the total number of ducks or geese orally or cloacally shedding virus. The vaccine made using the challenge virus as the seed strain was by far the most protective in limiting the quantity and time window of virus shedding. Mixed results were observed when cross HI titers were examined and then compared to mortality and shedding data for both ducks and geese. Use of single vaccination is not sufficient to protect White Pekin ducks and White Chinese geese against HPAI (H5N1). More research is needed to discern and test suitable vaccine candidates to develop appropriate vaccines and vaccination regimens for ducks and geese given the species differences from gallinaceous poultry.

Key Words: highly pathogenic avian influenza, H5N1, vaccine, ducks, geese

T105  Passage of low pathogenic avian influenza virus in chickens results in phenotypic and genotypic changes associated with transmission.  D. Diagolenski*, L. Jones, R. A. Tripp, M. S. Thompkins, and E. Mundt, University of Georgia, Poultry Diagnostic Research Center, Department of Infectious Diseases, Athens.

To better understand the mechanisms of LPAIV transmission and adaptation serial passages of LPAIV isolates were performed in chickens. Sequences of the HA and NA genes were determined for the stock viruses and at each subsequent passage. Three groups of 3-week-old SPF chickens were infected with three different LPAIV, one wild bird isolate (H51), and two chicken isolates (H52, H53). At 1 d pi, 5 contact birds were added to each group. In addition, subsequent passages in chickens for each virus were performed. Tracheal and cloacal swabs were taken at 2, 4, 7, and 9 d pi., and used for virus isolation (VI) in embryonated SPF eggs. LPAIV positive allantoic fluid was detected by hemagglutination assay. Existence of HI antibodies was tested on serum samples taken before and 21 d after infection. The NA and HA genes of the appropriate virus of VI positive swab and allantoic fluid samples were sequenced and amino acid (aa) sequences were deduced. During passage of the wild bird isolate, H51 transmission was not observed during early passages of the virus. In later passages of the H51 virus, transmission was observed as indicated by VI and seroconversion. In contrast, the passage of the chicken H53 isolate resulted in an immediate transmission during passage 1 as evidenced by VI and serology. Interestingly, the first passage of H52 virus resulted in no transmission but was observed at passage 2 in a single contact bird. During the 3rd passage, transmission was observed in three contact birds. This indicates a further adaptation during passage. Sequence analysis of the H51 transmitted viruses revealed several mutations in the aa sequences of the HA1 protein which includes one exchange resulting in a more basic HA1/HA2 cleavage site and one aa exchange in the globular head region resulting in a potential N-glycosylation site. A significant deletion in the NA protein was observed. The observed mutations in the HA and NA of the H53 isolate were lower in number and resulted in no apparent significant changes.

Key Words: avian influenza, transmission, sequences

T106  Generation and characterization of monoclonal antibodies against the neuraminidase 1 of a highly pathogenic avian influenza virus, and application to a multispecies N1 ELISA.  R. Nichols*,1 A. Mundt1, J. Hogan2, F. Michel2, E. Mundt1, and M. Garcia1, 1Department of Population Health, University of Georgia, Athens, 2Department of Pathology, University of Georgia, Athens.

The gene encoding neuraminidase 1 subtype (N1) from the HPAI virus Indonesia/PA/7/2003 (H5N1) was amplified and cloned. The N-terminal signal peptide sequence was replaced with a signal peptide
sequence from Leucania separata nucleopolyhedrovirus (LsNPV), and an RGS-His tag sequence was added at its C-Terminus. A recombinant baculovirus was generated (N1-BV) and used to infect Sf9 cells. The recombinant N1 protein (N1-Bac) was secreted into the cell culture supernatant and was purified by affinity chromatography. Using N1-Bac, a panel of 16 mouse monoclonal antibodies (MAbs) specific to the recombinant N1 protein was generated. The specificity of the MAbs was tested by indirect ELISA and an indirect immunofluorescence test (IFA) using N1-BV infected Sf9 cells. Chicken cells infected with avian LPAI viruses encoding for neuraminidase subtypes N1 – N9 were evaluated by IFA. 15 of the 16 MAbs demonstrated specificity for the N1 subtype. One notable exception was MAb N1-27, which appears to have broad reactivity for N1 – N9. To determine the nature of the epitopes recognized by the MAbs, Western blot analysis was conducted. This analysis demonstrated that while 14 of the 16 MAbs showed no reactivity to N1-Bac, two of the MAbs, N1-8 and N1-9, remained reactive by western blot. Further, these N1 MAbs will be used to evaluate the specificity and sensitivity in competing with N1 antibodies and in the establishment of a competitive ELISA assay.

Key Words: influenza, neuraminidase, monoclonal antibodies, characterization, competitive ELISA

Nutrition IV

**T107 Growth response, carcass evaluation and hematology of broilers fed graded levels of enzyme treated cocoa bean shell based diets.** M. D. Olumide*1, A. O. Akinsoyinu1, A. A. Mako2, O. A. Ogunwole1, and O. A. Adebiyi1, 1University of Ibadan, Ibadan, Oyo State, Nigeria, 2Tai Solarin College of Education, Ijebu Ode, Ogun State, Nigeria.

Cocoa bean shell (CBS) is a waste from cocoa processing industries in Nigeria and it constitutes a serious disposal problem. Previous trials revealed that addition of enzyme reduces theobromine (an anti-nutrient in CBS). Hence this study focused on evaluating the growth response, carcass characteristics and hematological parameters of broilers fed graded levels of enzyme treated CBS based diets.

A total of one hundred and fifty day old broiler chicks were randomly distributed to five dietary treatments with 30 birds per treatment, replicated thrice with each replicate having 10 birds in a completely randomized design. The treatments were: A (0% CBS-control diet); B (5% CBS with enzyme); C (10% CBS with enzyme); D (15% CBS with enzyme) and E (20% CBS with enzyme). Each of the diets was fed ad libitum to the experimental birds. The trial lasted 8 weeks. The performance indices like: feed intake and weight gain, carcass characteristics and hematological indices were the parameters evaluated. There were significant differences (P < 0.05) in feed intake, weight gain; carcass characteristics and white blood cells of broilers fed the experimental diets. The result revealed that enzyme treated CBS can effectively replace up to 15% maize in the diets of broilers without a deleterious effect.

Key Words: broiler, cocoa bean shell, hematology, carcass, performance

**T108 Effect of adding protease & xylanase feed enzymes activities on broilers fed corn-SBM-DDGS diets.** J. Arce1, E. Avila2, E. Rosales3, S. Charraga1, and S. R. Fernández2, 1Universidad Michoacana de San Nicolas de Hidalgo, Morelia, Mich, Mexico, 2Universidad Nacional Autonoma de Mexico, Mexico City, Mexico, 3DSM Nutritional Products Mexico S.A. de C.V., Guadalajara, Jal, Mexico.

In order to evaluate the broiler performance when feeding diets with DDGS added with protease and xylanase activities; 1,900 1-day-old Ross 308 male and female (50% ratio) broilers were randomly allocated to 4 treatments with 9 or 10 replicates, being the experimental unit the floor pen with 50 chicks each (25 males + 25 females). Bird density was 10 broilers/m2. Water and feed were provided ad libitum; management and health were handled as recommended by Ross broiler manual guidelines. Based on former research showing an amino acid (AA) release effect of 4% for protease activity (Ronozyme ProAct) and a ME release effect of 60 kcal/kg for the xylanase effect (Ronozyme WX), treatment 1 (T1) was a Corn-SBM-DDGS diet (5% DDGS for starter and 10% DDGS for grower-finisher feeding phases respectively) formulated to fulfill the Ross 308 nutritional requirements but -0.1% Av P 10 kcal ME/kg + 185 ppm Ronozyme P-(CT), and on top of this; 4% amino acid values (from requirement) and 60 kcal ME/kg (70 kcal total from requirement); treatment 2 (T2) was as 1 + 200 ppm Ronozyme ProAct (protease activity); treatment 3 (T3) was as 1 + 150 ppm Ronozyme WX (xylanase activity); and treatment 4 (T4) was as treatment 1 + 200 ppm Ronozyme ProAct + 150 ppm Ronozyme WX. Data was analyzed as an unbalanced CRD. Regarding weight gain (WG), kg/bird, T4 showed the highest (P < 0.001) value (T1 2.582b, T2 2.599b, T3 2.612b, T4 2.659a). Also T4 showed better (P < 0.01) feed conversion (FC) than T1 (T1 1.918b, T2 1.880ab, T3 1.888ab, T4 1.864a). Mortality was not affected by treatment. Under the experimental conditions of the present trial, the combination of protease and xylanase activities (Ronozyme ProAct + Ronozyme WX) yielded the best results regarding broiler productive performance.

Key Words: broiler, DDGS, feed enzymes, protease, xylanase

**T109 Broiler response to animal by-products and combined enzymes in corn-soy feeds and when ME and P are sub-marginal.** E. T. Moran* and R. Lehman, Auburn University, Auburn, AL.

Microbial challenges accentuate intestinal mucin and need for threonine as well as serine, glycine and proline. Enzymes arising during croprophy are envisaged to provide digestive advantages. Associated proteases enhance serine, glycine and proline release from poorly available animal proteins. Their access likely facilitates mucin formation and intestinal integrity. Multiple microbial enzymes (0.05% Avizyme®1502 + 0.01% Phyzyme®XP) that included a protease adept at structural proteins were supplemented to corn-soy based formulations for sex-separate reared broilers 0-3 and 3-6 wks of age and compared against two nutritionally equivalent feeds that maximized meat (5-4%) and feather (2-2%) meal contents. Essential nutrient requirements were assured with the control of each type formulation. Formulation and enzyme treatments were also compared when ME was reduced 100 kcal by decreasing added fat and 0.10% available P by concomitantly lowering dicalcium phosphate. All chicks received Coccidiovac®D in lieu of a coccidiostat prior to pen placement on used litter, no antimicrobi-
A combination of dietary phytase, amylase, xylanase and protease increased carcass yield and breast weight, and decreased abdominal fat deposition of broiler chickens. L. F. Romero1, C. Gilbert2, and E. T. Moran, Jr2. Danisco Animal Nutrition, Marlborough, United Kingdom, 2Auburn University, Auburn, AL.

This study examined the response of broilers to continuous supplementation of an enzyme complex containing xylanase, amylase and protease (Avizyme 1502; Danisco Animal Nutrition; minimum activities: X=300 U/kg, A=400 U/kg, P=4,000 U/kg), together with phytase (Phyzyme XP; Danisco Animal Nutrition; 500 FTU/kg). Corn-soybean meal feeds were either nutritionally complete (positive control) or had fat and dicalcium phosphate reduced (negative control) to decrease ME (-170 kcal/kg, or -150 kcal/kg in grower and finisher), available P (-0.13%) and Ca (-0.17%). Enzymes were added to the negative control. The first limiting essential amino acids were generously supplied relative to estimated energy. A total of 360 males were grown to 8 weeks of age. Carcass yield, abdominal fat, and skinless boneless meat yields were measured. Treatments consisted of 8 replicate pens with 15 birds. Data were analyzed by ANOVA. Reported differences were significant at P < 0.05. The enzyme complex increased body weight gain from 0 to 56 d (4,663 g/bird) compared to the negative control (4,280 g/bird), to a similar level as the positive control (4,624 g/bird). Feed conversion ratio was also reduced by the enzyme complex (2.07 g/g) compared to the negative control (2.17 g/g). An increment on carcass weight and carcass yield in response to enzyme supplementation was evident compared to the negative (+12.2% and 1.0%, respectively) and positive (+3.5% and 1.0%, respectively) controls. Even though percentage of breast yield was not significantly affected by enzyme inclusion, absolute breast weight increased compared to the negative (+118 g/bird; +11.0%) and positive control (+63 g/bird; +5.7%). Additionally, enzyme inclusion decreased the percentage of abdominal fat compared to the positive control (-19.0%). Exogenous enzymes can provide economic benefits through improvements of carcass yield and composition. These effects may be driven by increased energy and amino acid availability, and can be expressed when the most limiting amino acids in the diet are adequately supplemented.

Key Words: broiler, carcass yield, phytase, carbohydrase, protease

T112 Evaluation of performance characteristics, hematology and serum biochemistry of broilers fed graded levels of enzyme treated cocoa bean shell based diets. R. A. Hamzat1, M. D. Olumide2, A. A. Mako2, E. O. Uwagboe3, O. I. Abiola- Olagunju1, O. A. Adeyi1, A. O. Akinosuyin4, O. A. Ogumwole2, and O. M. Odetola5. 1Purdue University, West Lafayette, IN, 2University of Ibadan, Ibadan, Oyo State, Nigeria, 3Tai Solarin university of education, Ijebu-Ode, Ogun State, Nigeria, 4Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria, 5Federal College of Animal Health and Production Technology, Ibadan, Oyo State, Nigeria.

Competition exists between man and his livestock for conventional feed ingredients like maize. This has necessitated the search for alternative ingredients. Large quantities of Cocoa bean shell are produced and wasted annually by farmers and associated processing industries in Nigeria. This trial is therefore focused on the use of graded levels of enzyme treated cocoa bean shell based diets on the performance, hematology
Extensive research has demonstrated that Hemicell® improves guar meal utilization by broiler chickens in corn-soy based ration. This study investigated the diet containing 5 and 7% guar meal. Diet added with Hemicell®, LLC, Plymouth, MN experiments varied from 5.00 to 14.67%. In 10 of the 11 trials, the average all trials, individual weights of all birds were determined at the conclusion of enzyme treatment. Body weight, feed consumption and mortality were measured at the end of the experimental period of eight weeks. The feed intake and weight gain were monitored. The serum and hematological parameters studied were total protein, albumin, globulin, Cholesterol, glucose, creatinine, red blood cell, white blood cells, hemoglobin and packed cell volume. Significant differences were observed in the feed intake and weight gain of birds fed graded levels of enzyme treated cocoa bean shell, while no appreciable variations exist in the hematological values of the birds fed graded levels of enzyme treated CBS (P ≥ 0.05). CBS with addition of enzyme could effectively replace maize up to 15% without any deleterious effect on the birds.

Key Words: competition, graded level, enzyme treated, cocoa bean shell, hematology

T113 Hemicell (β-mannanase) improves growth performance of broiler chickens feed with guar meal diets. A. Maqbool1,2, T. Cao2, and F. Jin1, 1Shahzor Feeds (Pvt) Ltd, Lahore, Pakistan, 2Noveltech, LLC, Plymouth, MN, 3ChemGen Corp, Gaithersburg, MD.

Extensive research has demonstrated that Hemicell® improves guar meal utilization by broiler chickens in corn-soy based ration. This study demonstrated that Hemicell® can improve broiler growth performance in no soybean meal diet, and guar meal is the major source of beta-mannan, a non-starch-polysaccharide. The birds were placed in floor pens and provided with Corn, canola meal and sunflower meal based diets. Guar meal was added at 0, 3, 5 and 7% in the diets. Liquid Hemicell® was sprayed on the feed post-pelleting at rate of 100 ml per metric ton for the diet containing 5 and 7% guar meal. Diet added with Hemicell® had reduced 90 Kcal ME/kg feed. There were total of eight treatments. A total of 2,400 birds (grown from 0 days to 56 days of age) were randomly assigned to 24 pens with 100 birds per pen and 3 replications per treatment. Body weight, feed consumption and mortality were measured at 21, 28 and 39 days of age. Weight gain, feed to gain ratio and gain cost were calculated. There are clear trends that diets containing guar meal at 5 to 7% inclusion rates, Hemicell® improved (P < 0.05) both weight gain and feed efficiency. There were no significant differences in mortality among the treatments. These data demonstrated that Hemicell® improved live performance of broilers feed with guar meal and without soybean meal with at least 90 Kcal/Kg increase in ME.

Key Words: broiler, grau meal, Hemicell, β-mannanase, ME value

T114 Effect of Hemicell feed enzyme on uniformity of turkeys, a meta-analysis. M. E. Jackson*, Chemgen, Fayetteville, AR.

Eleven pen trials were conducted with market turkeys to determine the effect of b-mannanase enzyme (Hemicell®) on live weight uniformity. In all trials, individual weights of all birds were determined at the conclusion of the study and pen CV’s were determined. Average CV’s within experiments varied from 5.00 to 14.67%. In 10 of the 11 trials, the average CV was lower with Hemicell, differences being stastically significant (P < 0.05) in 8 of the 11 trials. When averaged across trials, pens provided with Hemicell had a CV of 7.75% compared to the controls with an average CV of 10.60% (P < 0.05). These experiments clearly demonstrate that Hemicell improved flock uniformity in market turkeys.

Key Words: Hemicell, β-mannanase, turkeys, uniformity, meta-analysis

T115 The effect of lighting program on the efficacy of Peniophora lycii fungal and Escherichia coli bacterial phytases for broilers. A. Liem*,1, N. E. Ward2, M. Y. Shim1, and G. M. Pesti1, 1University of Georgia, Athens, 2DSM Nutritional Products, Inc., Parsippany, NJ.

Both fungal (Peniophora lycii) and bacterial (Escherichia coli) phytases have been used commercially to improve phytate phosphorus utilization by broilers. The crop represents an important location for phytate degradation. If feed stays longer in the crop, phytases active at crop pH should have an advantage. Lighting programs may affect crop size and feed retention time. The objectives of this study were to determine the relative P replacement values for a fungal and a bacterial phytases under “constant” (23L:1D) and intermittent (1L:3D) lighting programs. The 18d experiment was conducted at 2 different times, with half of the treatments run at each time. There were 9 dietary treatments: corn and soybean meal based mash diets with 3 levels of non-phytate phosphorus (nPP) (0.22, 0.30, 0.38%) and a 0.17% nPP diet to which three levels each of commercial heat stable P. lycii and E. coli phytases were added (0.5x, 1.0x, 2.0x, with x = respective company recommendation phytase units to replace 0.10% aPh). All the Hubbard by Ross broilers were subjected to 23L:1D for the first 6 d, then half were switched to 1L:3D. 90 pens were allocated to each treatment. Birds under 1L:3D were lighter (417±8 v 448±7, Mean ± SEM, P<0.003) and had improved feed conversion (1.23±0.01 v 1.28±0.01, P<0.001). Birds fed P. lycii phytase were heavier (439±5 v 404±11, P<0.07) and had similar FCR (1.25±0.01 v 1.26±0.01, P=0.58) compared to birds fed E. coli phytase. Percentage excised crop weight was increased by 1L:3D (0.37±0.006 v 0.33±0.004, P<0.0001). Bone ash % was higher (31.00 ± 0.27 v 30.25±0.28, P=0.0009) and excreta PP % was lower (0.26 ± 0.022 v 0.321 ± 0.022, P=0.0317) for birds fed the P. lycii phytase. The largest difference between photoperiods in excreta PP was found in birds fed 0.5x P. lycii phytase (Phytase Source x Lighting; P=0.05). Observed differences in response to different phytases were similar for both fungal and bacterial phytases for broilers.

Observed relative P replacement by 1x levels of dietary phytase

<table>
<thead>
<tr>
<th>Light</th>
<th>Phytase</th>
<th>18 d Body Weight</th>
<th>AOAC Tibia Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>1L:3D</td>
<td>P. lycii</td>
<td>0.14%</td>
<td>0.11%</td>
</tr>
<tr>
<td>23L:1D</td>
<td>E. coli</td>
<td>0.09</td>
<td>0.10</td>
</tr>
<tr>
<td>23L:1D</td>
<td>P. lycii</td>
<td>0.09</td>
<td>0.10</td>
</tr>
<tr>
<td>1L:3D</td>
<td>E. coli</td>
<td>0.05</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Key Words: P. lycii phytase, E. coli phytase, lighting program, phytate phosphorus, relative P replacement
T116  Phytate hydrolysis in broilers as affected by phytase source, phytase dose, and dietary Ca:NPP ratio.  P. W. Plumstead³,², A. B. Leytem⁴, P. Kwanyuen¹, and J. T. Brake¹. ¹North Carolina State University, Department of Poultry Science; Scott Hall, Raleigh, ²Danisco Animal Nutrition, Marlborough, United Kingdom, ³USDA-ARS, Raleigh, NC, ⁴USDA-ARS, Kimberly, ID.

Advances in HPLC analytical techniques, now allow a direct estimation of phytase enzyme effects in vivo by measuring the disappearance of the myo-inositol hexakisphosphate (phytate) substrate from the digesta. This research evaluated effects of phytase source (A. niger v. E. coli, or phytase dose (500 vs. 1000 FTU/kg feed) on phytate hydrolysis in the gizzard and terminal ileum of broilers. A second objective was to establish if phytate hydrolysis was affected by the dietary Ca:available P (AvP) ratio. The experimental design was a 4x4 factorial with four diets of a control with no phytase (A), 500 FTU/kg A. niger phytase (B), 500 FTU/kg E. coli phytase (C), or 1000 FTU/kg E. coli phytase (D). Each diet was also formulated to contain four different ratios of Ca:non phytate P (NPP) by altering the limestone concentration. The 16 test diets were fed to 4 replicate pens of 13 male Ross 308 broilers from 14 d of age. At 21 d birds were killed and the contents of the gizzard and terminal ileum freeze dried and ground. Phytate in the feed and digesta was analyzed by HPLC and the digestibility of phytate in the ileum calculated relative to TiO2. Phytase addition in diets B, C, and D reduced gizzard phytate concentration by 34%, 62%, and 76%, respectively (P < 0.05). There was no interaction of Ca:NPP ratio and diet on phytate hydrolysis. Increasing the Ca:NPP ratio had no effect on phytate concentrations in the gizzard but reduced ileal phytate hydrolysis. The phytase disappearance by the terminal ileum was increased from 9.3% in diet A with no added phytase to 36.8%, 44.9%, and 64.4% in diets B, C, and D, respectively. These data suggest that the E. coli phytase was more effective at hydrolyzing phytate than A. niger phytase, with further significant increases in phytate hydrolysis obtained when the E. coli phytase dose was increased from 500 to 1000 FTU/kg feed.

Key Words: phytase, phytate, calcium, NPP, broiler

T118  Ontogenic development of the gene expression for sodium-dependent phosphate transporter and its response to phosphorus supply in broilers.  O. A. Olukos³, S. A. Adeokun, K. M. Ajuwon, and O. Adeola, Purdue University, West Lafayette, IN.

Broiler chicks were used to study the ontogeny of sodium-dependent phosphate transporter (NaPi-IIb) in duodenum, jejunum and ileum and its response to P supply. The birds were allocated at 1-d old to 4 treatments in a randomized complete block design, each treatment had 7 replicate cages with 8 birds per replicate cage. The diets met all nutrients requirements except P. Non-phytate P was 2.5, 3.5, 4.5 and 5.5 g/kg. Seven birds were euthanized at day old without feeding to determine the baseline NaPi-IIb mRNA expression in duodenum, jejunum and ileum. One bird from each cage was also euthanized at d 7 and 14. Mucosa scraping was collected from the duodenum, jejunum and ileum in the birds and the expression level of NaPi-IIb relative to GAPDH was determined by RT-PCR. There were significant effects of age and section of small intestine on NaPi-IIb expression (P < 0.01) but no diet effect. Expression of NaPi-IIb increased (P < 0.01) with age at both duodenum and jejunum but was not different for ileum. At d 0 and 14, NaPi-IIb expression was greatest at the jejunum (P < 0.05). On d 7, NaPi-IIb expression in the jejunum was greater in basal diet than P-supplemented diet. Total tract P retention increased with age (P < 0.05) and decreased linearly with P level in the diet (P < 0.01). In conclusion, dietary P affected NaPi-IIb expression differently at different sections of the small intestine and age of broilers. Its implications in strategies for reducing P excretion are being further investigated.

Key Words: broilers, phosophorus, phosphate transporter


The presence of fumonisins, especially fumonisin B1 (FB1) in corn, is a big concern in the poultry industry. Specially in Brazil, where it has been reported that levels as low as 5 mg/kg (ppm) of FB1 cause statistically significant differences in the weight of the birds that consume feeds contaminated with this toxin, compared with the control group that is free of contamination. In Mexico it has been reported that this situation is not present with the inclusion of 100 ppm of this toxin. The scientific literature specifies that minimum levels of 250 ppm are required to cause the problem of weight reduction in animals. It has been published that aluminosilicates are being incorporated into diets for human consumption to reduce the effects of aflatoxins. Just as well, the aluminosilicates have been incorporated into diets for birds to reduce the effects of aflatoxins, since more than 20 years ago. Recently it has been reported that the aluminosilicates have been incorporated as non nutritious additives in diets for human consumption directed to reduce the effect of the FB1. The purpose of this work is to evaluate the capacity of 5 commercial products, to adsorb fumonisin B1 at levels of 200mg/kg, in in vitro assays. The assays were performed with the HPLC technique. The pH of the contact solution was 2.0; contact time: 3.0 hours. The obtained average results were: Product A: 98 %, Product B: 73 %, Product C: 71 %, Product D: 55 % and product E: 43 %.

Key Words: poultry, aluminosilicates, fumonisin B1, assays, HPLC

T120  Effects of multi-mycotoxin-contaminated feed on reproductive performance, egg quality and physiological response in broiler breeders and the efficacy of a mycotoxin-deactivating product.  V. H. Stark*, I. Rodrigues¹, U. Hofstetter¹, K. Griessler¹, D. Schatzmayer¹, and C. W. Kang². ¹BIOMIN Holding GmbH, Herzogenburg, Austria, ²Animal Resources Research Center, College of Animal Biosciences & Technology, Konkuk University, Seoul, Korea.

This trial was performed with the aim of evaluating the effects of the addition of 2.5 kg Mycofix® Plus (MPL) per ton of feed to broiler breeders diets contaminated with a mixture of 2 000 ppb OTA and 5 000 ppb ZON or to diets contaminated with 10 000 ppb ZON on reproductive performance, egg quality and physiological response in broiler breeders (ROSS 308). A total of 100 broiler breeders were enrolled in this study. Birds were divided into 20 groups (5 treatment x 4 replicates x 5 birds each) and fed five experimental diets containing mycotoxins with MPL for 8 weeks (Table 1). Egg production, egg weight and egg mass of groups fed diets containing mycotoxins were significantly (P < 0.05) reduced or tended to be reduced as compared to that of control group. The decrease in egg production, egg weight and egg mass was alleviated by the concomitant feeding of MPL. Egg weight in T1 and T2 were significantly (P < 0.05) lower than the egg weight of control group, however, this parameter was significantly (P < 0.05) improved in T2 in comparison with T1. Eggshell thickness of mycotoxin-contaminated groups (T1 and T3) were significantly (P < 0.05) decreased as compared with that of the
control group but improved by the supplementation with MPL. Fertility and hatchability of groups fed diets containing mycotoxins tended to decrease as compared to that of the control group but was improved by the combination feeding of MPL. Broilers fed ZON and OTA contaminated diets (T1) and ZON-contaminated feeds (T3) presented significantly \( P < 0.05 \) heavier livers. Supplementation with MPL improved this parameter in both T2 and T4 groups. The addition of 2.5 kg MPL/t to multi-mycotoxin contaminated broiler breeders diets had a positive impact on egg production, egg weight and egg mass; eggshell thickness and eggshell strength; fertility and hatchability and relative liver weight.

### Table 1 Experimental Design

<table>
<thead>
<tr>
<th>Treatments</th>
<th>OTA (ppb)</th>
<th>ZON (ppb)</th>
<th>Mycofix® Plus (kg/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T1</td>
<td>2000</td>
<td>5000</td>
<td>-</td>
</tr>
<tr>
<td>T2</td>
<td>2000</td>
<td>5000</td>
<td>2.5</td>
</tr>
<tr>
<td>T3</td>
<td>-</td>
<td>10000</td>
<td>-</td>
</tr>
<tr>
<td>T4</td>
<td>-</td>
<td>10000</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**Key Words:** ochratoxin, zearalenone, Mycofix, breeder

### T121 Effects of broiler breeder nutrition and feeding practices on gastrointestinal tract development of progeny embryos.

V. Morales*1,2, E. O. Oviedo-Rondón1, N. M. Leandro1,2, P. E. Eusebio-Balcazar1, M. J. Wineland1, J. Brake1, R. Malheiros1, J. Whitley1, and J. Jornigan1, 1North Carolina State University, Raleigh, 2Universidade Estadual Paulista, Jabaicatuba, SP, Brazil, 3Univesidade Federal de Goias, Goiania, GO, Brazil.

The effects of trace mineral (TM) source as well as broiler breeder nutrition and feeding practices on gastrointestinal tract (GIT) development were evaluated. Cobb 500 breeders were housed in 16 pens of 81 females each, and fed either corn (C) or wheat (W) based diets during rearing and production. Two feeding programs, sigmoid late fast (LF) and sigmoid late slow (LS) were used until peak egg production. At 23 wk, 69 females that represented the BW distribution from each pen were placed in a two-thirds slat breeder house where feeder space either remained the same (S) or was increased (M). Breeders were fed diets with either inorganic TM or with an organic source (Mintrex® P) to replace 30% of Cu, Zn, and Mn from 56 to 62 wk. Final dietary levels of Cu, Zn, and Mn were 25, 125, and 125 ppm, respectively. Embryo progeny (7/treatment) were sampled from 18 to 21 days of incubation to obtain embryo weight with and without yolk; whole GIT, gut, liver, gizzard, and proventriculus weights. Gut length was measured and yolk percentages were calculated. Data was analyzed as 2x2x2 factorial design considering diet type, feeding program, feeder space, and TM source as main effects. Diet type, feeder space, and source of TM did not affect \( P > 0.05 \) the variables evaluated, but gizzards were heavier in chicks from breeders fed according to the LS program. The heaviest \( P < 0.05 \) GIT and gizzards were observed in chicks from breeders fed C on the LS program. It was concluded that breeder feeding programs and diet type may affect GIT development in broiler progeny.

**Key Words:** gut development, maternal effects, nutrition, organic trace minerals

### Nutrition V

**T122 Effect of different processing techniques on protein quality of hatchery waste meals.** A. Mahmud*, Saima, M. Z. Khan, and M. A. Jabbar, University of Veterinary and Animal Sciences, Lahore, Pakistan.

Due to ever increasing human population, more area is being used for cash crop and there is shortage of traditional feed items such as maize, wheat and soybean meal for poultry. This situation has necessitated using non-conventional feedstuffs as replacement for the conventional ones. Hatchery waste, when processed appropriately, has the potential for increasing the viable economic profitability of the poultry operation. In Two experiments, the chemical and protein quality of hatchery waste was evaluated by using different processing techniques i.e., cooking, autoclaving and extrusion. The protein contents of the cooked, autoclaved and extruded HW meals were 43.67, 45.10, and 38.64%, respectively. Microbial analysis of the raw HW depicted high microbial counts (TCC) to the minimum as compared to other heat treatments. Protein quality of cooked, autoclaved and extruded HWM was measured in terms of protein efficiency ratio (PER) and net protein utilization (NPU). The weight gain in group consuming reference diet with casein as protein source showed significantly \( P < 0.05 \) higher weight gain (86.5 g) as compared to the other experimental groups. The PER results from all processing techniques along with NPU data supported an overall conclusion that processing HW with cooking and autoclaving is comparable in terms of NPU but significant difference is due to less CP % in extruded group. Autoclaved proved more beneficial in terms of PER. But overall values of PER and NPU revealed that processing of HWM can generate nutrient rich, palatable ingredients that was comparable to the traditional ingredients for better broiler performance.

**Key Words:** hatchery waste, microbial count, NPU, PER, protein quality

**T123 Dietary addition of L-valine for commercial broilers.** M. T. Kidd*, W. A. Dozier III, P. B. Tillman, R. E. Loar II, and A. Corzo1, 1Mississippi State University, Mississippi State, 2USDA-ARS Poultry Research Unit, Mississippi State, MS, 3Ajinomoto-Heartland LLC, Chicago, IL.

Previous research has evaluated broiler responsiveness to increasing levels of L-Thr, but research addressing increasing levels of L-Val is sparse. An experiment was conducted with Ross TP16 male broilers from 28 to 42 d of age to assess dietary L-Val inclusions of 0.00, 0.52, 1.04,

Cobb 500 fast-feathering d-old male chicks were obtained from a commercial hatchery after being vent-sexed, and were randomly placed into 176 floor pens (12 birds/pen; 2,112 total chicks). From placement, all pens were fed one of three possible dietary amino acid density treatments: high (H), moderate (M), or low (L). The feeding phases consisted of a starter (0-14 d, in crumbles), grower (14-28 d, in pellets) and finisher (28-42 d, in pellets) phase diets, for a total of 17 possible treatment combinations. Prior to formulation of the experimental diets, all ingredients from vegetable origin. However, Val and Ile may be co-limiting for broilers fed diets containing animal protein meals. This study examined growth responses and meat yield of broilers provided diets varying in digestible Val and Ile concentrations from 28 to 42 d of age. Primary ingredients consisted of corn, soybean meal, and feed-grade poultry by-product meal (2.5% inclusion). Six hundred and thirty-two Ross × Ross TP16 male chicks were randomly distributed into 96 floor pens at 1 d of age. At 28 d of age, all pens were equalized with 15 birds (0.09 m²/bird) and fed experimental diets until 42 d of age. Eight diets (12 replicate pens per diet) were evaluated. Broilers fed Diet 5 had similar (P ≥ 0.05) BW gain, carcass weight and yield, and total breast meat weight and yield as Diet 1. Broilers fed Diet 5 grew faster (P ≤ 0.05) and had higher breast meat yield (P ≤ 0.05) than birds provided Diets 3, 7 and 8. Broilers fed Diet 5 accreted more breast meat (P ≤ 0.001) on a weight basis than birds consuming Diets 3 and 7. These results indicate that Val and Ile are co-limiting when fed diets containing poultry by-product meal.

Key Words: threonine, valine, isoleucine, amino acid, broiler
A single factorial design was conducted to study the effects of dietary vitamin on aying performance. The four vitamin levels were: the current average industry level in China (Local), optimum vitamin nutrition level (OVN®), NRC (1994) with Hy.D® (25-hydroxy-cholecalciferol), and NRC (1994). Total 1,800 Lohmann pink-shell layers at 25 wks of age were assigned randomly into 4 treatments with 10 replicates per treatment and 45 layers per replicate. The hens were free access to feed and water for 39 wks, a long time that the hens suffered both the great Wenchuan earthquake and high temperature stresses in summer. Hen-day laying rate (HDLR), feed intake (DFI), egg weight (EW), feed conversion rate (FCR), and hen mortality rate (HMR) were determined on the basis of replicate weekly. The HDLR was 84.10, 93.43, 91.92 and 89.91% for Local, OVN®, NRC with Hy.D®, and NRC level respectively. (P < 0.01). The DER and CER of NRC with Hy.D® was the lowest with significant difference from the other treatments (P < 0.05), while DFI of NRC with Hy.D®, and NRC level higher significantly than Local (P < 0.05). The EW of OVN® was higher significantly than that of the other treatments (P < 0.05), while that of NRC with Hy.D® or NRC higher significantly than Local(P < 0.05). The HMR of NRC was the highest with significant difference than the other treatments, while that of OVN® was the lowest with significant difference to Local, but no significant difference to NRC with Hy.D®. The results suggested that OVN® could increase the abilities of hens for egg laying and anti-stress with the best laying performance and lowest mortality. With the addition of Hy.D®, the anti-stress ability and the laying performance also were improved. The NRC level was not enough for hens to anti stresses with the highest mortality, while the local level was not enough for supporting the egg laying because some vitamins were absent.

Key Words: dietary vitamin, layer hen, performance, OVN®, Hy.D®

T127 Effects of dietary vitamin level on the egg quality and vitamin contents in egg of laying hens. H. Zang1, K. Zhang1*, X. Ding2, J. M. Hernandez2, and D. Yao3, 1Institute of Animal Nutrition, Key Laboratory for Animal Disease-Resistance Nutrition of China Ministry of Education, Sichuan Agricultural University, Yaan, Sichuan, PR, China, 2DSM Nutritional Products Ltd., R&D Animal Nutrition and Health, Warmsisweg, Kaiseraugst, Switzerland, 3DSM (China)Limited, PuDong Area, ShanHai

A single factorial design was conducted to study the effects of dietary vitamin on the egg quality and vitamin contents in eggs. The four vitamin levels were: the current average industry level in China (Local), optimum vitamin nutrition level (OVN®), NRC (1994) with Hy.D® (25-hydroxy-cholecalciferol), and NRC (1994). Total 1,800 Lohmann pink-shell layers at 25 wks of age were assigned randomly into 4 treatments with 10 replicates per treatment and 45 layers per replicate. The hens were free access to feed and water for 39 wks. Dirty egg rate (DER) and cracked egg rate (CER) were determined on the basis of replicate weekly. Egg weight (EW), egg-shape index (ESI), egg specific gravity (ESG), egg-shell strength (ESS), egg-shell thickness (EST), and Haugh unit (HU) were determined with 10 eggs per replicate monthly. The egg samples were freeze-dried and then was analyzed the vitamin contents at the middle of trial. The DER and CER of OVN® was the lowest with significant difference to the other groups (except for CER of NRC with Hy.D®), while the DER and CER of NRC with Hy.D® was also significantly lower than NRC, or DER of Local. There was no significant difference for DER and CER between Local and NRC. Compared to Local, the EW of OVN® was higher significantly, but the ESI, ESG, EST, and HU lower significantly. There were no significant differences for EW, ESI between NRC with Hy.D® and NRC, but the ESG, EST were increased significantly with the addition of Hy.D® in NRC, while HU decreased significantly. Compared to Local, Local increased significantly the ESI, ESG, EST, and HU except the EW. All the egg quality indexes for four treatments were the normal. OVN® increased all kinds of vitamin in egg as compared to Local(P < 0.05). 25-OH-D3 content in egg of NRC with Hy.D® was significantly higher than NRC (P < 0.05). The results suggested that OVN® could increase the egg weight and vitamin contents in egg without detrimental effects on egg quality. The addition of Hy.D® could improve the egg quality and 25-OH-D3 content in egg. Local could improve the egg quality and some vitamin contents in egg.

Key Words: dietary vitamin, egg quality, egg vitamin content, OVN®, Hy.D®

T128 Supplementation of canthaxanthin to broiler breeders diet on breeder chick hatchery parameters and egg yolk TBARS. A. P. Rosa1, A. Scher1, V. Duarte1, L. Boemo1, T. N. N. Vieira1, J. A. G. Ferreira Jr.1, and J. O. B. Sorbara2*, 1Universidade Federal de Santa Maria - Department of Animal Science, Santa Maria, RS, Brazil, 2DSM Nutritional Products, São Paulo, SP, Brazil.

The objective of this study was to determine the effect of the supplementation of Canthaxanthin to broiler breeder diet on hatchery parameters and evaluate the antioxidant potential of Canthaxanthin through the determination of TBARS on egg yolks with different storage time and during incubation process. The experiment was carried out at Universidade Federal de Santa Maria (UFSM) in Brazil, from June to December 2008. 20 incubations were carried out with eggs from 360 females COBB 500 with 45 weeks of age. The experimental design was in a CRD with two treatments (control and Control+6ppm of Canthaxanthin, CAROPHYLL Red®10%) and six replicates of 30 female and 3 male each. The eggs were incubated following standard incubation procedures, and at 21 days the hatchability parameters were assessed. To evaluate the antioxidant potential of Canthaxanthin eggs were stored at 0, 4, 8 and 12 d. After storage period the yolk was collected for TBARS analysis. During incubation yolks or vitelline sacs of embryos were collected at 0, 7, 14 and 18 d of incubation for TBARS analysis. When Canthaxanthin were supplemented Hatchability improved from 83.03% to 86.03 (P = 0.0001); Hatchability of Fertile Eggs improved from 91.30 to 93.69 (P = 0.0001); Fertility improved from 90.94% to 92.02% (P = 0.0171); Total Embryo Mortality during incubation reduced from 5.46% to 3.72% (P = 0.0029). TBARS (MDA mg1 protein) of egg yolks during different storage time reduced from 13.53 to 10.70 (P = 0.0024); from 20.87 to 15.54 (P = 0.0002); from 20.73 to 14.61 (P = 0.0003); and from 28.97 to 16.86 (P = 0.0001) at 0, 4, 8 and 12 d of storage. TBARS (MDA mg1 protein) of egg yolks during different incubation time reduced from 21.14 to 11.27 (P ≤ 0.0001) at 0 d of incubation and from 16.69 to 15.36 (P ≤ 0.0001) at 7 d of incubation. At 14 and 18 d of incubation no statistical response were detected. In conclusion the supplementation of CAROPHYLL Red® in the broiler breeders diet significantly improve all hatchability parameters evaluated in this trial. The results can be partially explained by the antioxidant effect of the Canthaxanthin.

Key Words: antioxidant, breeder, canthaxathin, hatchery, incubation
T129  Omega-3 enrichment of table eggs. M. Hidalgo*1 and H. Hidalgo2, 1Facultad de Veterinarias, Universidad Santo Tomas, Santiago, Chile, 2Facultad de Ciencia Pecuarias y Veterinarias, Universidad de Chile, Chile.

A study was conducted in laying hens to determine egg enrichment with omega-3 fatty acids (N-3 FA) using fish oil. Special attention was taken to the deposition of the long chain N-3 FA (EPA, DHA) present in fish oil. For the experiment; 1,152 laying hens (42-53 weeks of age) where divided into 4 experimental groups. Each group consisted in 288 laying hens (6 replicates of 48 birds each). All dietary treatments consisted in a corn-based diet with the addition of different fish oil levels to achieve different levels of N-3 FA. Diets were formulated to be isocaloric and isonitrogenous. The control diet was supplemented with 2.5 % vegetable oil and was formulated to be low in N-3 FA metabolites. The experimental diets consisted in a corn-soy diet with the addition of 4% fishmeal. The different levels of N-3 FA were achieved by supplementing the fish meal diet with; 3% fish soap stock, 3% fish oil or 6% fish oil. The experimental groups were allocated in an open house facility during the summer months. Productive parameters were measured (egg production, feed consumption, egg weight, egg mass, body weight, FCR and egg grading). At the end of the experimental period (12 weeks), vitelum samples were taken for determination of lipid profile by HPLC. In general, productive parameters were better in the groups consuming the higher levels of N-3 FA. A progressive deposition of N-3 FA was observed as the level of N-3 FA increased in the diet. N-3 FA was increased by 69, 91 and 158%, respectively, over the control diet. This increase on the levels of N-3 FA was observed for all the N-3 metabolites including the long chain N-3 FA. Supplementation of the diets with fish oil decreased the Omega-6 levels consequently increasing the N-3:N-6 ratio in the eggs. Supplementation of layer diets with fish oil allows the enrichment of eggs with N-3 FA (EPA, DHA).

Key Words: length of feeding, growth, tropics

T130  Effect of different length of feeding period on performance of two slow-growing chickens strains used for roaster production in the tropics. Y. E. Attia1, S. I. El Sharkawy2, F. A. Mohamed2, M. D. Sahledom3, and S. E. Aggrey*4, 1University of Alexandria, Damanhour, Egypt, 2Al-Azhar University, Cairo, Egypt, 3Nar Secondary School of Agriculture, Damanhour, Egypt, 4University of Georgia, Athens.

Our goal was to determine the effect of length of feeding period for the starter, grower and finisher periods for Golden Montazah (GM) and Gimmazih (Gim) chicken strains in Egypt. Two hundred and seventy day old chicks of each strain were randomly distributed into 3 feeding period: long starter period- long grower and short finishing period of (5-5- 3 wks LSGSFP); medium starter period- medium grower and long finishing period (4-4-5 wks; MSGGLFP), and short starter- long grower and medium finishing period (3- 6- 4 wks; SSLGMFP). Each treatment was fed in 3 replicates (30 chicks per replicate). The starter, grower and finisher diets were 20% CP with 3000 kcal ME/kg, 18% with 3000 kcal ME/kg and 16% with 3100 kcal/ kg diet, respectively. We concluded that GM and Gim chickens should be fed on the starter, grower and finisher diets for 5, 5 and 3 wks, respectively to achieve the best growth. Feed conversion ratio and economic efficiency were the best of GM and Gim chickens fed longer starter and grower feeding period (5-5-3 wks). There was no significant effect of length of starter, grower and finisher period on dressing, breast, thigh, pancreas, spleen, liver, and heart yields.

Key Words: whole sorghum, cereal grains, finisher broiler chickens, AMEn, retained energy
In many parts of Africa, Asia, and Latin America, the availability of portable water cannot be taken for granted. A great deal of time and effort is usually dedicated to having access to water sources of good quality. The quality of the water source should be given high priority in the proper management of the environment of poultry farms. Minerals occur naturally in water and should be present in trace quantities. This work was carried out to determine the level of minerals present in the water sources of fifty poultry farms in four states in the south-western part of Nigeria. The parameters measured were: pH, hardness, levels of chloride, manganese, phosphate, calcium, iron, cadmium, sodium, lead, magnesium, and total solids. The results showed that magnesium, calcium, iron, cadmium, chloride, phosphate, alkalinity and total solids did not exceed standard levels. Manganese was high in five samples, ranging from 0.5mg/l to 6.3mg/l, instead of the W.H.O. recommended value 0.50mg/l. The water hardness was high in fifteen farms, ranging from110-400mg/l. The W.H.O. recommended value is 100mg/l. Cadmium and lead were absent in 18 and 23 samples respectively. The pH of three samples was 6.90, which is lower than the recommended value of 7.0 - 8.0. The high manganese content may affect the flavor of the water and negatively affect the water lines. The low pH detected may cause the water to be unpalatable, corrosive to equipment, incompatible with medicines and vaccines and have negative impact on poultry performance. Extreme hardness could diminish the effectiveness of water-administered medications, disinfectants and cleaning agents. It is recommended that water analysis should be done at least twice a year, to determine the mineral content of poultry water sources.

Key Words: poultry, water, minerals, acidity, hardness

T133  Feeding char to broilers to reduce ammonia volatilization from broiler litter. A. Tasistro, C. Ritz*, D. Kissel, and B. Fairchild, University of Georgia, Athens.

Chars obtained by the pyrolysis of biomass can be transformed into activated carbons, which have been used to remove ammonia from air—mostly through its interaction with the carbons’ oxygen functional groups via hydrogen bonding. The passage of chars through the digestive tract of the chicken may result in changes that bring about lower ammonia emissions from the manure. In this study, we measured ammonia volatilization from litter when broilers were fed standard diets containing 0, 1.6, 2.3, and 5.1% char. Char was produced by pyrolyzing pine chips at 400°C for 30 minutes. Broilers were raised in floor pens with new litter at a density of 0.75 ft² per bird to replicate commercial conditions and to generate ammonia from the manure. Ammonia volatilization was measured weekly in the second half of the growout using a Draeger CMS sensor. The addition of char in broiler feed brought about a significant exponential decrease in NH3 concentration in the air that averaged 70% at rates of char between 2% and 5%. No adverse effects of char on broiler performance were detected. Further investigation into the use of char for ammonia reduction in poultry systems is warranted.

Key Words: char, ammonia, broiler, emission


Organically modified clays (OMC) are sometimes used commercially as mycotoxin binders. Two chick studies and an in vitro binding study were conducted testing the efficacy and safety of organoclays in binding ochratoxin A (OTA). In vitro mycotoxin binding was conducted at physiological conditions of the stomach (pH 3.0) followed by the intestine (pH 6.5) at 1000:1 binder:toxin ratio. Study 1 and 2 consisted of either 250 or 200 day-old male broiler chicks assigned to 10 or 8 treatments, respectively, with 5 replicate pens of 5 chicks each. Study one was conducted with OMC-1, 2, 3, & 4 either fed alone (0.5% dietary inclusion) or in combination with 2 ppm OTA. Study two was conducted with OMC-3, 4, & 5 either fed alone (0.5% dietary inclusion) or in combination with 1 ppm OTA. Chicks were placed in battery-brooders and fed experimental diets for 21 days. On day 21, 3 birds per replicate were euthanized with CO2, weighed, and blood was drawn from 2 birds per pen for serum chemistry analysis. Kidneys were removed and weighed from 3 birds per pen for determination of relative kidney weight (RKW). In vitro binding results showed that all products bound OTA greatly (95-98%). Feeding 1 or 2 ppm OTA reduced (P < 0.05) body weight gain (BWG) and feed intake, with 2 ppm OTA having a much greater effect. RKW increased (P < 0.05) in chicks fed 1 or 2 ppm OTA. OMC-1, 2 and 3 significantly increased (P < 0.05) the toxic affects of OTA on BWG and RKW when combined with 2 ppm OTA. A similar toxic affect on serum uric acid (UA) was observed (increased; P < 0.05) when OMC-1 was added to 2 ppm OTA. However, an increase (P < 0.05) in serum UA and aspartate aminotransferase were also observed when OMC-1 was fed alone, suggesting a possible toxicity of product alone. When 1 ppm OTA was fed, the only significantly (P < 0.05) increased toxicity observed was for feed conversion in birds fed OMC-4 plus OTA. In conclusion none of the products ameliorated the toxic affects of OTA, with some increasing toxicity. In vitro OTA binding may not be a good predictor of in vivo efficacy.

Key Words: organoclay, ochratoxin binding, in vivo, in vitro, chicken

T135  Turkey hen performance on river sand and pine shavings bedding. R. M. Hulet* and T. I. Cravener, The Pennsylvania State University, University Park.

Turkey hen pullets (Hybrid Converter) were randomly assigned to pens containing either sand or pine shavings for bedding at day of age. Both bedding materials were added to the pens at a depth of 10.16 cm. Pullets (1056) were placed into eight initial pens for the first 12 days and then randomized into 24 pens (5.4 birds/m²) until six weeks of age. All birds were re-sorted into the 24 pens at 42 days to equalize the body weights and then reared to 131 days of age. Birds were weighed at 0, 12, 27, 42, 84, and 131 days. Litter moisture and scores were taken at 12 and 18 wks, as well as lung dust scores at 12 wks. Body weight was significantly less for birds brooded on the sand compared to the pine shavings at 12, 27, and 42 (2.20 and 2.43 kg, respectively) days of age. After resorting and growing in the finisher period, no differences in body weight were found at 131 days of age between the birds on the sand and pine shavings treatments (10.77 and 10.85 kg, respectively). Differences in feed intake between litter treatments for the first six weeks were consistent with the...
body weight differences. At 42 days, mortality was significantly greater for the birds on the sand treatment (11.5%) compared to those on the pine shavings (1.9%), but not significantly different from 42 to 131 days of age. No significant differences in litter scores or litter moisture were found between the two treatments. While sand was not a satisfactory substitute for pine shavings during brooding, sand did seem to perform equally well to pine shavings during the turkey finishing period.

Key Words: litter, sustainability, switchgrass, foot pad

T136  Green energy from turkey litter. G. H. Shahani†1, D. Prouty†1, H Sietsema2, and R Sietsema2, 1Heat Transfer International, Kentwood, MI, 2Sietsema Farms, Allendale, MI.

Heat Transfer International of Kentwood, Michigan has commercialized the world’s first fixed-bed, starved air low temperature gasifier plant to convert turkey litter to green energy at Sietsema Feed Farms in Howard City, Michigan. Approximately 35 T/d of turkey litter is gasified in a primary retort. The resulting syngas is subsequently oxidized in a separate chamber. By employing a patented heat exchange - turbine module, 8000 lb of steam and 465 KW of electricity are produced at extremely high thermal efficiency. The plant began start-up and commissioning in September 2009, with full-scale production in November 2009. HTI’s technology simultaneously addresses three issues important to the turkey industry: environmental, energy and economics. HTI’s modular process converts turkey litter to a densified ash that can be used for odorless fertilizer or cement additive, reducing concerns for nutrient run-off from over-application of animal manure. The process produces green energy in a very cost effective manner. The key advantages of this technology are low capital and operating cost, minimal maintenance and reliable, round-the-clock operation. HTI’s technology is ready for widespread commercial deployment in the poultry and meat industries.

Key Words: gasification, litter, energy, electricity, steam

T137  Evaluation of chopped switchgrass as a sustainable litter material. J. D. Davis†1, J. L. Purswell†1, and A. S. Kiess3, 1Agricultural and Biological Engineering, Mississippi State University, Mississippi State, 2USDA-ARS Poultry Research Unit, Mississippi State, MS, 3Poultry Science, Mississippi State University, Mississippi State.

Litter materials for broiler production, such as pine shavings, rice hulls, and peanut hulls, are becoming increasingly costly and limited in availability. Alternative materials such as recycled paper and sand have been previously researched, but adoption in commercial practice has been limited. A local, sustainable source of litter material would be beneficial and alleviate availability concerns. Switchgrass is a fast-growing forage plant capable of producing 8-12 tons/acre in Mississippi. In this study, hammer-milled switchgrass hay was compared to pine shavings to determine its suitability as a litter material. Twenty pens, measuring 1.2 × 1.5 m, containing either pine shavings or switch grass were used (10 pens per litter treatment). Twenty broilers were placed in each pen (10 males : 10 females), for a total of 400 broilers for the experiment. Live weights were obtained at 7, 14, 28, 35, 41, and 49 d; feed intake was measured at 14, 28, 35, 41, and 49 d. All birds were processed and carcass weights and foot pad scores were obtained. Statistical analysis was performed with PROC MIXED, with significance considered at α = 0.05. The following production responses were not different between chopped switchgrass and pine shavings: mean body weight (P = 0.89), adjusted feed conversion (P = 0.23), body weight gain (P = 0.85), and mortality (P = 0.47). Mean foot pad scores were improved on chopped switchgrass when compared to pine shavings (1.30 vs. 1.39, P = 0.03).

Key Words: alternative bedding, broccoli, growth, river sand litter, pine shavings

T138  Alternative bedding for broilers: From vegetative buffers to fuel. R. M. Hulet†1, P. H. Patterson1, T. L. Craver1, and T. A. Volk2, 1The Pennsylvania State University, University Park, 2SUNY-ESF, Syracuse, NY.

The performance of 864 straight run broilers was evaluated when reared on four types of bedding: conventional pine shavings and three biomass materials from a vegetative buffer project, including poplar shavings, chopped willow and chopped miscanthus grass. Ross x Cobb chicks were randomly placed in 24 pens (36/pen; 0.07 m²/bird) at day old (4 bedding treatments × 6 reps). Birds were fed the same commercial starter from 1-14 d (22.6% CP), grower from 14-28 d (19.9% CP), and finisher from 28-42 d (18.3% CP). Birds and feed consumption were weighed at placement, 14, 28 and 42 d. Body weight and feed intake were significantly less at 14 d for the willow bedding, but all were equal at 42 d. Feed conversion and mortality were not significantly different at any age. When processed at 42 d, female carcass weight was significantly greater for the poplar treatment, while no significant difference was observed for males or when genders were combined. The gizzard weight of females was significantly higher for the pine treatment. At 42 d the use of willow and poplar bedding resulted in significantly better litter scores than the pine shavings bedding. After 42 d of use, willow litter was found to be significantly higher in percent solids, and grass in total N. On an as-is basis, significant differences were found in stoichiometric fuel analysis for percent carbon, hydrogen and oxygen, but not for overall gross energy value. Considering the increasing expense and decreasing availability of conventional pine shavings for bedding, alternatives that allow similar broiler performance are desirable. These alternative bedding materials can be part of an overall sustainable system, grown by the producer (while providing benefits as vegetative buffers), harvested to use as a less expensive and readily available bedding and possible fuel on source.

Key Words: alternative bedding, biomass, fuel, litter


Previous work on ammonia emissions indicate that ammonia (NH3) emitted from broiler facilities dissipate rapidly during hot weather. The NH3 concentrations were found to be less than 1 ppm at 100, 300 and 500 ft approximately 60, 85 and 90% of the time. The summer study examined ammonia concentrations at various distances from the house during hot weather when maximum air was being exhausted from the houses. The objective of the current study was to evaluate ammonia concentrations downstream of a broiler operation during winter conditions. Open-path laser spectrometers were placed 300 and 500 ft from the houses. Data were collected during the last 4 weeks of a 56 day grow-out cycle. Ammonia concentrations were considerably lower (the highest concentration being 1.3 ppm) during this study than those observed in hot weather.
weather (the highest concentration being 2.9 ppm). At 300 ft, the NH3 concentrations were less than 0.2, between 0.2 and 0.5 and greater than 0.5 ppm for 53, 27 and 18% of the time during the study. At 500 ft, the NH3 concentrations were less than 0.2, between 0.2 and 0.5 and greater than 0.5 ppm for 54, 34 and 12% of the time during the study. While nuisance complaints continue to be an issue for the poultry industry, these data show that the ammonia concentrations at this operation were well below the reported EPA odor-detection threshold values of 5-50 ppm.

Key Words: emissions, climate, odor


Management of the darkling beetle Alphitobius diaperinus, in poultry facilities has been a challenge due to the lack of efficacious products. The objective of these studies was to evaluate a bait formulation of the entomopathogenic fungus Beauveria bassiana for control of darkling beetle in poultry facilities. Broiler houses with darkling beetle populations were used in the studies. All farms had a history of poor performance with existing beetle control products. The population of darkling beetles was sampled and enumerated during the last week of the flock, the houses were de-caked and prepared for the next flock and treatments were applied 7 to 10 days prior to flock placement. Treatments were applied by delivering 6 lbs of bait directly under each feed line using a drop spreader applicator. Following treatment, paper was put down and feeders lowered to the floor of the houses. Seven houses were used in the study with beetle population evaluations done at pre-treatment, 7 to 14 days post flock placement 21 to 35 days post placement and just prior to the flock end. Mean pre-treatment adult counts ranged from 250 to 350+ per sample and mean larvae pre-treatment counts ranged from 550 to 650 per sample. Reduction in beetle numbers ranged from 95% to 100% at the 7 to 14 day samples in all houses. Samples taken at 21 days post placement ranged from 95.5% to 98% for adults and 85.5% to 89% for larvae. Final population evaluations at the end of the flock were evaluated and scored for larvae at each sampling period. Larval evaluations at the start of the study averaged near 1000 larvae per square foot of breeding area with a mean score of 3. The larval numbers followed a linear decrease through the study decreasing to a score of 1 by day 12 and reaching 0 at day 25.

Key Words: darkling beetles, Beauveria bassiana, bait, Alphitobius diaperinus, bio-pesticide


Studies evaluating the efficacy of Beauveria bassiana, balance HF5ES were conducted in Iowa and North Carolina where balEnce was applied directly to areas with fly larvae at a rate of 4e8 conidia per square foot of breeding area. Treatments were applied 2 times per week at a rate of 3 oz balEnce HF23 per 1000 square feet of manure surface. Study 1: A pullet building 50 x 200 ft. with 20 inches of manure in the pit was used in the study. Day zero of the study was 7 days post chick placement. Monitoring of fly numbers was conducted weekly by using a sticky ribbon held in front of a person as they walked down a single isle in the pit of the house. The study length was 45 days. Adult fly counts were taken at day -1, day -2 with first treatment at day 0 and subsequent fly counts taken weekly. Adult fly numbers peaked at 74 on day 5 and 75 on day 14 of the study. From day 14 to day 18, adult numbers were reduced from 75 to 6 flies per tape. Adult fly numbers remained below 10 through day 28 and from day 28 to day 45 the adult fly numbers ranged from 0 to 3 per sampling period. Study 2: The second study was conducted in 3 high rise layer houses that had recently under gone a spring clean out. Manure was removed from the pits, leaving a 6 inch base under each cage row. Each house was equipped with stirring fans in the pits. Monitoring was conducted by evaluating 10 areas in the house for larval activity and rated using the following scale: 0= no larvae, 1= 1-10 larvae per sq. ft, 2 = 11-100 per sq. ft, 3 = 101-1000 per sq. ft. and 4 1001+ per sq. ft. 10 areas per house were evaluated and scored for larvae at each sampling period. Larval evaluations at the start of the study averaged near 1000 larvae per square foot of breeding area with a mean score of 3. The larval numbers followed a linear decrease through the study decreasing to a score of 1 by day 12 and reaching 0 at day 25.

Key Words: broiler, chicken, lighting, photoperiod, intensity

T142 Effects of increasing-dim and bright, and shorter-bright split-dark lighting on broiler performance. R. J. Lien*, J. B. Hess, and S. F. Bilgili, Auburn University, Auburn, AL.

To determine effects on performance, broilers of 2 strains were exposed to increasing lighting programs meeting either US or EU guidelines, or a fixed duration program with a split dark period meeting EU guidelines. Forty males of tray pack (TP) or breast meat yield (BM) strains were placed by strain in each of two 1.5 by 3.7 m pens in 12 light controlled rooms. Four rooms were provided an increasing-dim (ID) treatment (1-7 d, 23L:1D; 8-14 d, 12L:12D; 15-21 d, 14L:10D; 22-28 d, 17L:7D; 29-35 d, 20L:4D; 36-48 d, 23L:1D; 2 FC to 7 d and 0.25 FC thereafter). Four rooms were provided an increasing-bright (IB) treatment (1-7 d, 23L:1D; 8-14 d, 12L:12D; 15-21 d, 14L:10D; 22-28 d, 16L:8D; 29-45 d, 18L:6D; 46-48 d, 23L:1D; 2 FC throughout). Four rooms were provided a shorter-bright split-dark (SBSD) treatment (16L:4D:2L:2D and 2 FC throughout). At 20 d, BW was greater (P<0.05) in SBSD treatment than ID or IB. At 6, 20, and 34 d, TP strain BW was greater than BM. At 47 d, an interaction decreased BW in BM strain exposed to ID and IB, but not SBSD treatment. Feed consumption was reduced by ID and IB treatments, relative to SBSD. Consumption was generally unaffected by strain. Treatments did not affect FC, but FC was consistently better in TP than BM strain. At 47 d, an interaction resulted in markedly improved FC by TP strain due to ID treatment, while strain differences were less in IB and SBSD treatments. Uniformity was unaffected by treatment but was consistently greater in the TP than BM strain. Mortality averaged 2.3% and was unaffected by treatment or strain. Carcass weight and yield were unaffected by treatment. Carcass weight was greater in TP strain than BM, but carcass yield was unaffected. Breast weight and yield were increased in SBSD treatment relative to ID and IB, while leg and wing weights and yields were generally less. Leg and wing weights were increased in TP relative to BM strain, but breast weights did not differ. Breast yield barely favored BM over TP strain but differences were less than due to lighting treatments.

Key Words: broiler, chicken, lighting, photoperiod, intensity
T143  Microbial community composition, pathogen prevalence, and environmental conditions within cage and cage-free egg laying facilities. A. D. Kent, A. R. Green*, C. Chu, G. T. Sales, and R. S. Gates, University of Illinois, Urbana.

While the largest portion of US egg production currently comes from cage facilities, the cage-free sector has shown continued increase in recent years. Differences in housing type would be expected to impact the diversity and composition of microorganisms, though no studies were found in the literature characterizing microbial ecology among housing types. In this study, samples of air, water, surfaces, eggs, and feces were collected from laying hen facilities, 2 houses each of 3 different management systems (caged manure belt, caged high rise, and cage-free floor raised). Environmental variables (temperature, relative humidity, carbon dioxide, and atmospheric ammonia levels) were measured simultaneously. Automated ribosomal intergenic space analysis (ARISA) was used to identify variations in microbial community composition. Bacterial community composition from each sample source was significantly different among the three housing systems, suggesting that management strategy and house environment influence microbial community structure. Differences in microbial communities associated with water, dust and fecal samples were particularly pronounced for facilities using manure belt and high-rise systems. Management and environmental factors such as flock size, space allowance, ammonia concentrations, and relative humidity were strongly correlated with the observed differences in microbial community composition.

Key Words: pecan fiber, induced molt, egg production

T144  Determining proper levels of Pecan Natural FiberTM product needed to molt Leghorn hens. P. L. Ruszler*, D. M. Denbow1, J. Nizio2, and C. L. Novak3, 1Virginia Polytechnic Institute and State University, Blacksburg, 2Southeastern Reduction Co., Valdosta, GA, 3Land O’Lakes Purina Feeds, Kansas City, MO.

Replacing a part of the daily diet fed to laying hens with Pecan Natural FiberTM (PNF), a by-product of pecan processing, can be an effective molting tool. To determine the amount of diet replacement, hens 168 wk of age, assigned to 7 treatments (tmt) of 21 hens each were compared with 3 tmt fed a low nutrient (LN) 10% CP/1980 ME/kg molt diet, 3 tmt fed a low nutrient (LN) 10% CP/1980 ME/kg molt diet, plus a control diet. The high nutrient molt diet was replaced with either 15% PNF for 2 wks & 10% for 2 wks (HMax), 15% PNF for 2 wk & 10% for 1 wk plus 5% for 1 wk (HMED) or 15% PNF for 1 wk plus 10% for 1 wk & 5% for 2 wk (HLow). The same PNF combinations were fed in the low nutrient molt diets with tmt LMax, LMed & LLow, respectively. All were fed a 15% CP/2800 ME/kg layer diet at 29 days. The control was a 4-day feed withdrawal molt & limit fed the HN molt diet to day 33, followed by the layer diet full fed. Egg production reached 50% by 8 wk and all tmt peaked between 10&12 wk. Body weight loss averaged 21% for the HN tmt & 19% for the LN tmt. Egg production ceased during weeks 2&3, but the LN tmt laid 2% more eggs than the HN tmt in wk 4 having consumed 6g more feed/hen. Hens fed LN molt diets laid 94 vs. 89 eggs/hen for the HN molt diets at 28 wk, eating 112g & 107g/hen, respectively. Hens fed the Low PNF replacement molt diets laid 103 vs. 93 eggs/hen for hens on Max PNF diets while the Med PNF diets produced 80 eggs/hen at 28 wk eating 109g, 113g & 106g/hen of feed, respectively. The controls laid 90.9 eggs & ate 104.3g of feed/hen. The best performing diets at 28 wk were LLow, LMax, and HLow; those hens laying 105.2, 100.8 & 100.8 eggs/hen & eating 110g, 117g, & 107g of feed/hen resulting in ingredient costs of 63, 68, & 64 cents/doz eggs, respectively. Lower levels of PNF product used in concert with properly balanced low nutrient diets resulted in the optimum molting procedure under the conditions of this study.

Key Words: pecan fiber, induced molt, egg production

T145  Impact of egg warming prior to incubation upon broiler embryo development to 36 hours. C. M. Rhyne, G. Broadhead, H. R. Cutchin Evans, K. M. Mann, and M. J. Wineland*, North Carolina State University, Raleigh.

The objective of these trials was to determine the effect of egg warm-up temperature and duration of warm up prior to incubation upon embryo growth. A series of 9 trials were conducted. Only fresh eggs were used from a collection 1 hour after the initial collection of the day from a Cobb 500 flock for trials 1-6 and from a Heritage flock for trials 7-9. Immediately after collection eggs were stored for 3 days at 18.3°C. After the 3 days of storage the eggs were randomly assigned to 6 groups of 15 eggs each. Two groups were placed in one of 3 force draft incubators for warm up temperature(temp) treatment maintained at 18.3, 23.9 or 29.4°C. Within each warm up temperature there were 2 duration groups, one group was warmed for 8 hours and the other for 12 hours (trials 1-4), in trial 5-6 eggs were warmed for 12 or 16 hours and in trials 7-9, eggs were warmed for either 12 or 20 hours. After warm up, the eggs were incubated for 36 hours at 37.5°C. Four viable embryos from each treatment group (temp and duration) were removed from the egg and examined under a microscope for the number of somites present. Only embryos that could be examined within a one hour time period were used. There was a significant difference in the number of somites for duration of warm up (10.17 versus 11.93 in trials 1 to 4 but no effect by warm up temperature. In trials 5 and 6 there was no effect due to warm up temperature on the number of somites. Trial 6 demonstrated a significant effect due to duration of warm up (10.75 versus 11.58) and trial 5 approached significance for duration. Trials 7 to 9 where the Heritage broiler eggs were used, the embryos exhibited no significant effect due to duration but in 2 of the 3 trials there was a significant effect due to temperature during warm up. The evidence of the trials suggests that there can be effects of either duration of warm up prior to incubation as well as the warm up temperature but that it may also be related to strain of the broiler.

Key Words: warm-up, incubation, egg storage, temperature
P146 Alternative molting programs using soy hulls. 1. Performance results. V. S. Avila1, H. Mazzuco*1, A. Coldebella1, and R. Morei2, 3. 1EMBRAPA Swine & Poultry, Concordia, SC, Brazil, 2Universidade do Contestado, Concordia, SC, Brazil, 3PBIIC-CNPq, Brasilia, DF, Brazil.

The effects of molting methods on egg production, egg quality and viability in Hy-Line W-36 hens in long-term postmolt production period were studied. The treatments consisted of a conventional molt (10 d fasting followed by cracked corn for 8 d and pullet developer diet for 10 d) and 4 alternative molting programs: soy hulls based diet (12% CP, 1455 ME kcal/kg, 1.38% Ca) offered for 14 d followed by cracked corn for 4 d and a pullet developer diet for 10 d and the other three molt regimens consisting of feeding soy hulls during 4, 8 or 12 d followed by 10, 6 or 2 d respectively, of feeding soy hulls based diet and 4 d of cracked corn plus 10 d pullet developer diet. A non-molted group of birds was fed a laying hen diet during the experimental period. Mortality and hen-day egg number were recorded daily for 56 wk (through 80 to 136 wks of age) from a total of 1152 birds housed two per cage (759 cm2/bird). The experimental design was a randomized complete block consisting of 12 replicates of 16 birds. Once collected, eggs were classified based on eggshell integrity in cracked, shell-less and intact eggs. Data were subjected to ANOVA considering the effect of treatment. Significant treatment effect (P < 0.01) for all variables was observed. The non-molted hens showed lower hen-day production and intact eggs (P < 0.01) and higher cracked and shell-less eggs (P < 0.0001) compared to the molted hens. Regardless molt regimen, at 136 wks of age, birds on the molting treatments showed greater viability (92% average, P < 0.05) compared to non-molted birds (85.4%). No differences (P > 0.05) were observed in the parameters evaluated among molt treatments. The molted layers outperformed the non-molted layers during the experimental period. Hen-day egg number was recorded daily for 56 wks from a total of 1152 birds housed two per cage (759 cm2/bird). The experimental design was a randomized complete block consisting of 12 replicates of 16 birds. Once collected, eggs were classified based on eggshell integrity in cracked, shell-less and intact eggs. Data were subjected to ANOVA considering the effect of treatment. Significant treatment effect (P < 0.01) for all variables was observed. The non-molted hens showed lower hen-day production and intact eggs (P < 0.01) and higher cracked and shell-less eggs (P < 0.0001) compared to the molted hens. Regardless molt regimen, at 136 wks of age, birds on the molting treatments showed greater viability (92% average, P < 0.05) compared to non-molted birds (85.4%). No differences (P > 0.05) were observed in the parameters evaluated among molt treatments. The molted layers outperformed the non-molted layers during the experimental period.

Key Words: alternative molting, eggshell integrity, hen-day production, soy hulls, viability

P147 Gastrointestinal tract development in chick progeny affected by broiler breeder genetics, nutrition, and feeding practices. V. Moraes1,2, E. O. Oviedo-Rondon1, N. M. Leandro1,3, P. E. Eusebio-Balcazar1, M. J. Wineland1, J. Brake1, R. D. Malheiro1,2, J. Whitley1, and J. Jornigan1, 1North Carolina State University, Raleigh, 2Universidade Estadual Paulista, UNESP, Jaboticabal, SP, Brazil, 3Universidade Federal de Goias, Goiania, GO, Brazil.

Two experiments were conducted with broiler breeders from two strains (A and B) at 45 and 49 wk of age to evaluate broiler breeder nutrition and management effects on gastrointestinal tract (GIT) during embryo development. Day-old breeders were housed in 16 pens and fed either corn (C) or wheat (W) based diets during rearing and production. Sigmoid late fast (LF) and sigmoid late slow (LS) feeding programs were used during rearing. At 23 wk, hens and roosters representing the BW distribution from each pen were moved to a cage breeder house at either 1 or 2 hens/cage (h/c). Hens were inseminated and eggs were collected over 8 d and identified to track hen effects. Eggs were incubated and placed in pedigree bags at 19 d. Embryo progeny were sampled from 18 to 21 d. Weights of chicks with and without yolk, whole GIT, gut, liver, gizzard, and proventriculus were recorded. Gut length was measured and residual yolk (RY) was calculated. Data was analyzed as a 2x2x2 factorial design considering strain, diet type, feeding program, and cage space as main effects. Egg weight and embryo age were used as covariants. In Exp. I, livers from progeny of LS breeders were heavier than progeny from LF when fed W. Guts from progeny of strain A were heavier when fed W as compared to C, or strain B when fed W. The gizzards from progeny of B fed W was the lightest. In Exp. II, embryos of A strain breeders were heavier than B strain embryos when fed W. However, these embryos had the largest RY. Progeny from 2 h/c had larger RY. Strain A embryos had larger gut and gizzard weights. Breeder feeding programs affected embryo weights with and without yolk as the LS program produced heavier embryos. W-fed breeder progeny had heavier gizzards than progeny of breeders fed C. Guts from progeny of A breeders placed in 1 h/c were longer than those placed with 2 h/c and 1 h/c B strain breeders. It was concluded that progeny may have different embryo intestinal development due to genetics, breeder feeding programs, diet, and feeder space and this may influence broiler progeny performance.

Key Words: gut development, maternal effects, nutrition

P148 Disinfection effectiveness in fertile eggs by aspersion and thermonebulization with a glutaraldehyde-ammonium quaternary combination. O. Urquiza-Bravo*1, S. Saldivar-Calderon2, I. Monroy-Becerra1, G. Ponce-P3, and J. A. Quintana-Lopez1, 1Universidad Nacional Autonoma de Mexico, Mexico, 2Anglo Corp, Mexico, 3Grupo Avicola El Peñon, Mexico.

The objective of the present work was to determine the effectiveness of a glutaraldehyde-ammonium quaternary combination for fertile eggs disinfection by aspersion and thermonebulisation. A combination of glutaraldehyde (400g) with ammonium quaternary (60g)/L of water was used in 50% solution for thermonebulisation and 100% concentration for aspersion. Three groups with 3661 hatched eggs each one were formed. Group A: Thermonebulisation disinfected eggs, which were introduced to a 6 cubic meters (m3) hermetic cabinet, using 2.5 ml/m3 as final volume during 20 min; Group B: the eggs were disinfected by aspersion, using 10 ml for each egg of the disinfectant in study with a concentration of 0.5 ml/L of water to 40°C, until they were completely dunktected. Group C: Egg without disinfecting (control group), these eggs did not receive any treatment. After 30 minutes of the time of disinfection, seven eggs of each group were collected in sterile plastic bags individually for their bacteriological processing for bacteria and fungi counting in shell and yolk. No bacterial neither fungi growth in shell and yolk in groups A and B was observed, nevertheless, in group A was used only 15 ml of the disinfectant without diluting in 3661 eggs, whereas for B group, 18.3 ml of disinfectant diluted in 3661.6 L of water were used for the same amount of eggs. The results in Group C were: General account from 4,400 to 190,000 cfu/g in 7/7 eggs, for gram (+) were from 7,600 to 180,000 cfu/g in 7/7 eggs, for Gram (-) did not
obtain growth as well as either fungi in any egg. Bacterial growth in yolk was not obtained either. Although by both methods the disinfectant effectiveness was observed, we have to take into account that the present time demands saving of material, human and natural resources as well as disinfection, manpower and water, reason why is necessary to think about other methods of disinfection where their costs could be lower as well as the water consumption for disinfection and then the use of the thermonebulisation like one of the better alternative for disinfection.

Key Words: disinfection, aspersion, thermonebulization

P149 Effect of early and late exposure to litter moisture on foot pad dermatitis in broiler chickens. O. Cengiz1, J. B. Hess2, and S. F. Bilgili2, 1Adnan Menderes University, Aydin, Turkey, 2Auburn University, Auburn, AL.

Food pad dermatitis (FPD) incidence and severity was assessed in broiler chickens following exposure to high moisture litter. In Experiment 1, a total of 150 d-old chicks were placed in 10 replicate pens (3x4 ft) with used litter (2-3 inches deep). One-half of the pens were wetted with a gallon of water on Days 0, 3, 4, 5, 7, and 9. FPD incidence and severity was determined on Days 14 and 46. In the second experiment, two hundred 46 d-old broilers with and without existing FPD were placed in 20 pens (3x4 ft) with used litter (2-3 inches). One-half of the pens were wetted with a gallon of water on Days 47, 48, 49, 50, 51, and 52. FPD incidence and severity were assessed on 62 d of age. In both experiments, common starter, grower and finisher feeds were used. Water was available and lighting was continuous throughout the study. In Experiment 1, wetting litter increased the incidence of FPD on 14 day of the trial (53 vs. 8%), but significantly reduced the FPD severity on Day 46 (3 vs. 43%) as compared to un-wetted litter. Live body weight and feed conversion rate were similar among treatment groups during the experiment. In Experiment 2, the FPD incidence was 8% on dry litter and 28% on wetted litter in birds without FPD at 46 d. On Day 62, the severity of FPD increased in birds with FPD at Day 46 when kept on wetted (63%) as compared to un-wetted litter (11%). FPD incidence remained high (94%) when birds were kept on wetted litter, whereas there was a reduction (56%) on un-wetted litter. The results indicate that FPD lesions as a result of exposure to litter moisture can be reversed. Late exposure to wet litter can increase FPD incidence and severity. Similarly, FPD lesions can be reversed if the litter conditions improve.

Key Words: broiler, foot pad dermatitis, litter moisture

P150 Maternal antibody transfer to broiler progeny varies among strains and it is affected by nutrition and management. N. M. Leandro1,2, R. Ali1, M. Koci1, V. Moraes1,2, E. O. Oviedo-Rondón1, R. Malheiros1,2, P. E. Eusebio-Balcazar1, M. J. Wineland1, J. Brake1, and J. Jornigan1, 1Adnan Menderes University, Aydın, Turkey, 2Universidade Estadual Paulista, Jaboticabal, SP, Brazil, 3Universidade Federal de Goiás, Goiânia, GO, Brazil.

Breeder management influences broiler performance. Two experiments were conducted to examine the effects of broiler breeder nutrition and feeding practices on maternal antibody transfer to progeny in 2 genetic strains (A and B) housed together. Broiler breeders were assigned to 16 pens and fed either corn (C) or wheat (W) based diets during rearing and production. At 23 wk, hens and roosters that represented the BW distribution from each treatment (Trt) were moved to a cage breeder house and placed at 1 or 2 hens/cage (b/h/c). Breeder vaccination included 2 live and 1 inactivated vaccines against Newcastle disease virus (NDV). Breeders were artificially inseminated at 44 and 48 wk, eggs were collected for 8 d, incubated, and placed in pedigree bags at 19 d of incubation. Pedigreed chicks were identified with neck tags at hatching. Blood samples from 5 chicks/Trt were collected at hatching in both experiments. In Exp. 2, 12 chicks/Trt were placed in battery cages, and blood samples were taken at 5, 9, and 14 d. Serum antibody levels against NDV were assessed by ELISA. Progeny were fed the same diet (C or W) as their parents were fed. Data were analyzed as a 2x2x2 factorial design considering strain, diet type, and cage space as main factors. In Exp. 1, strain B chicks had lower titers than A strain chicks (P ≤ 0.05) at hatching. Progeny at 1 h/c produced chicks with lower NDV titers as compared to 1 h/c breeders. Chicks from A strain breeders fed C had the highest NDV titers (P ≤ 0.05). In Exp. 2, chicks from W-fed breeders had higher titers at hatching, but no effects of Trts were observed at 5 d. Broilers from 2 h/c strain A breeders had lower (P ≤ 0.001) titers than 1 h/c A strain breeders at 9d, but 2 h/c W-fed breeder chicks at 14 d had the highest titers when compared to 1 h/c W-fed and 2 h/c C breeder chicks. It was concluded that genetics, nutrition, and management conditions may affect maternal antibody transfer to progeny.

Key Words: maternal antibodies, breeder effects, immunity, broilers

P151 Breeder feeding management practices affect eggs traits and leg health of broiler progeny. P. E. Eusebio-Balcazar*1, 1Adnan Menderes University, Aydin, Turkey, 2North Carolina State University, Raleigh, 3Universidade Estadual Paulista, Jaboticabal, SP, Brazil, 4Universidade Federal de Goiás, Goiânia, GO, Brazil.

This study evaluated the effects of breeder nutrition and feeding practices on leg health of broiler progeny. Cobb 500 breeders were housed in 16 pens with 81 females/pen and fed either corn (C) or wheat (W) based diets during rearing and production using either sigmoid late fast (LF) or sigmoid late slow (LS) feed allocation programs until peak egg production. At 23 wk, 69 females representing the BW distribution of each pen were placed in a 2/3 slat layer house where feeder space remained the same (S) or increased (M). Eggs were collected to obtain yolk, albumen, percentage shell, yolk/albumen (Y:A) ratio, haugh units, egg shape index, and egg surface area. Eggs produced at 45 wk of age were incubated. Progeny were placed in floor pens with 16 males and 16 females/pen and 4 replicates/breeder interaction cell for 32 experimental units total. Data were analyzed as a 2x2 factorial design considering main factors of diet type, feeding program, and feeder space. Broiler gait scores (GS) and prevalence of leg problems were evaluated at 28 and 46 d. Eggs laid by breeders fed C based diets had higher percentage albumen, greater albumen height, lighter yolks, and lower Y:A as compared to eggs laid by breeders fed W. Progeny of C-fed breeders had poorer locomotion than W-fed breeders while only C-fed females exhibited a higher prevalence of crooked toes. Breeders fed according to the LS program laid eggs with lower percentage shell and their progeny had better GS. Breeders from LS breeders maintained with S feeder space in production as during the rearing phase had a lower prevalence of twisted legs. Increasing feeder space in production lowered prevalence of varus deviation and reduced mildly impaired walking ability on male broiler progeny at 28 and 46 d, respectively. It
was concluded that breeder diet type, feeding programs, and change in feeder space from rearing to production may affect specific egg traits that could be important during embryo development and subsequently influence progeny leg problems and their ability to walk.

Key Words: broiler breeder, maternal nutrition, leg problem prevalence

P152  Evaluation of pellet quality in commercial broiler houses as influenced by feeder pan location.  R. N. Tidwell, III1,*, J. L. Purswell2, J. D. Davis3, and W. A. Dozier, III1, 1Auburn University, Auburn, AL, 2USDA, Agricultural Research Service, Mississippi State, MS, 3Mississippi State University, Mississippi State.

Broilers fed diets having superior pellet quality results in improved growth performance. Management factors such as feed delivery and feeder location may be factors that compromise integrity of pellets. This study evaluated percent pellets at various locations of feeder pans. One hundred and forty-four samples were obtained from 2 commercial broiler houses. Two samples (each 1 kg) were collected from 5 different locations on each feeder line. Both houses were equipped with 6 feeder lines. Treatments consisted of 5 locations from the middle of to the end of feeder space from rearing to production may affect specific egg traits in varying levels of used broiler litter: Top, middle and bottom. The regression equation to describe the quadratic response ($P \leq 0.001$) with percent pellets increasing from 27 to 40 m. These results indicated at locations at or further than 27 m from the middle of the house increased the proportion of percent pellets.

Key Words: pellet quality, feed form, broiler

P153  Concentrations of different types of pathogenic bacteria in varying levels of used broiler litter: Top, middle and bottom.  Z. Williams*, A. Segrest, M. Bailey, J. Krehling, and K. Macklin, Auburn University, Auburn, AL.

Little research has been performed investigating bacterial levels associated with the layers found within poultry litter. Typically litter samples are analyzed based on the top few inches of litter or are a homogenized mixture of the entire litter fraction. This would leave a large portion of the bacterial population either under reported or unreported. The goal of this project was to determine if differences existed in bacterial populations in the top, middle and bottom portions of used pine shaving broiler litter. Bacteria investigated were total aerobes, anaerobes, *Staphylococcus*, *E. coli*, *Clostridium perfringens* concentrations, as well as testing for the presence of *Salmonella* and *Campylobacter*. Litter samples were taken from the top 2 inches, the exact middle and the bottom 2 inches, which included the hard pan and dirt pad. Samples were taken every week from 1 week before bird placement until 1 week after bird removal. The data indicates a decline in the total numbers of bacteria for all types of bacteria as the samples approach the bottom of the litter. *Campylobacter*, *E. coli*, *Salmonella* or *Clostridium perfringens* was recovered until the broilers were 1 week old. At certain sampling times *Salmonella*, *E. coli*, *Campylobacter* and *Clostridium perfringens* were not even recoverable from the bottom depths. However, in this study *Staphylococcus* was found to be able to thrive throughout the litter regardless of depth much better than the other bacteria investigated, even though the preceding flock of broilers had been removed 3 weeks previously. Since litter management is crucial in maintaining good bird health these results can be used as an aide in the development of new or refinement of existing litter management techniques that will eliminate human pathogens from the litter, especially *Staphylococcus*.

Key Words: litter, pathogen, management, depth, total bacteria

P154  Eggshell hole diameter and disinfectant treatment used for air cell transponder implantation in broiler hatching eggs affects embryogenesis and hatchability.  A. O. Sokale*, E. D. Peebles, R. Pulikanti, W. Chai, and S. K. Womack, Mississippi State University, Mississippi State.

Temperature transponders have been used as a minimally invasive means to accurately determine the eggshell water vapor conductance of broiler hatching eggs. This study was conducted to determine the effects of 2 sizes of eggshell transponder implantation hole diameters and implantation site disinfectants on subsequent broiler embryogenesis. Seven embryonated eggs in each of 4 treatment groups (2 diameters × 2 disinfectants) on a single tray level in an NOM45 Natureform incubator were implanted on D10 of incubation with temperature transponders. Transponders were implanted in the air cell of embryonated eggs through either 3.0 or 4.5 mm diameter holes. Prior to perforation at a common site, eggshells were disinfected with 70% alcohol or 99% sodium Dichloro-s-Triazinetrione (SDT). All holes were subsequently covered with a common porous sealant. Treatment effects were tested on the following parameters: Percentage 10-19 d egg weight loss (PEWL) and relative weights of the embryo, yolk sac, liver, pipping muscle weight and carcass on D19 of incubation. An interaction between hole diameter size and disinfectant type on relative yolk sac weight was observed. Also, alcohol decreased relative embryo weight but increased pipping muscle weight. An effect opposite to that of alcohol was observed by SDT for both parameters. Egg contamination and PEWL were not affected by any treatment. Hatchability of embryonated eggs was 85.7% in the 4.5 mm and alcohol and 3.0 mm and SDT treatment combinations, but was 100% in all other treatment combinations. Broiler egg hatchability and embryogenesis may be affected by a particular combination of implantation hole diameter and disinfectant type.

Key Words: broiler hatching eggs, disinfectant, hole diameter, implantation, transponder

P155  The effect of litter type and stocking density on growth performance and immune responses of broilers chicks.  M. Toghyani*, E. Chitsaz1, A. A. Gheisari2, G.-H. Ghalamkari1, and M. Zamanizad3, 1Islamic Azad University-Khorasgan Branch, Esfahan, Iran, 2Esfahan Agricultural Research Center Esfahan, Iran.

This study examined the effect of two litter types and four stocking densities on growth performance and immunity of broiler chicks. A total of 504 Ross 308 chicks were placed into 32 floor pens. Broilers raised from hatch to 49 d of age on wood shavings or sand at four stocking densities (10, 13, 16 and 19 birds/m²). Body weight, feed intake and feed conversion ratio were measured at 21, 42 and 49 d. Antibody titer against Newcastle and Avian Influenza (H9N2) Viruses at 35 d (14 d post immunization) and SRBC (sheep red blood cell) at 40 d (6 d post immunization) were measured. Body weight and feed intake were similar among the treatments at 21 d. From 1 to 49 d body weight gain and feed intake were adversely affected by increasing stocking density but it was the same for 13 and 16 birds/m². Kg body weight/m² were significantly increased by increasing stocking density but it was the
same for 13 and 16 birds/m². Litter type had no significant effect on growth performance. Feed conversion ratio was not affected by the stocking density. Mortality significantly increased at stocking density of 16 and 19 birds/m² on both litters. Antibody titer against Newcastle and avian influenza viruses were not affected by treatments. In broilers reared on wood shavings, as stocking density increased, antibody titer against SRBC tended to decrease. The results indicate that body weight, feed intake and mortality adversely affected by increasing the stocking density on wood shavings or sand but kg body weight/m² increased and litter type had no effect.

Key Words: stocking density, litter, performance, immunity, broiler

**P156** Assessment of fertility levels and behavioral responses in broiler breeder males undergoing double interspiking in heat-stressed environments. K. M. Chung* and M. O. Smith, University of Tennessee, Knoxville.

Towards the end of a production cycle, fertility levels in broiler breeders naturally decline due to age. Male management techniques such as spiking are expected to increase fertility levels of a flock. It is important to identify the association between fertility levels and behavioral responses in order to recognize changes in male behaviors during fertility decline. The objective of this experiment was to investigate and analyze behavioral responses and fertility levels in flocks undergoing double interspiking in heat stressed environments. Two hundred and eighty-eight broiler breeder females and thirty-six broiler breeder males (Ross 708) were assigned to three groups at 21 weeks of age. All three groups were placed in separate rooms and experienced a simulated heat stress environment with temperatures cycling from 23.8-30 °C. At 42 and 52 weeks of age, the male management technique of double interspiking was applied to two rooms. Behavior was monitored with video cameras which recorded from 1900 to 2100 at specific time points in the experiment. Recordings were analyzed with the Noldus Observer analysis program, and frequency of specific behavioral responses of individual (preening, feather ruffling, and wing flapping), male to male (fighting, pecking, and retreating), and male to female (attempted and completed mating) behaviors were assessed. Eggs were set every two weeks, candled at day 12 of the incubation cycle, and percent fertility was calculated. The anticipation was that due to age, there would be a decline in percent fertility and frequency of all behavioral activities. However, due to the double interspiking, introduction of new males, and a decline in percent fertility of all behavioral activities. There were, however, some differences observed at some sampling times. At week 4 the floor pen birds had a significantly lower mean emergence time than the cage birds (P < 0.05). At weeks 2 and 12 there was a significant difference between pen and cage birds for tonic immobility time (P < 0.05), with the cage birds having a shorter time at 2 weeks and the pen birds having a shorter time at 12 weeks. Although there were significant differences in fear responses for laying hens housed in commercial cages versus floor pens at selected sampling times, the effect of housing was not consistent.

Key Words: tonic immobility, emergence test, laying hen behavior, fear response, laying hen welfare

**P158** Sensitivity and selectivity of cultivation methods to recover a specific *Salmonella* serogroup from hatchery plenum samples. N. A Cox*,1 L. J. Richardson1, P. J. Fedorka-Cray1, J. A. Cas9n1, J. M. Mauldin2, J. Guard-Bouldin1, J. G. Frye1, K. D. Ingram1, A. Hinton, Jr1, and R. J. Buhr1, 1USDA, ARS, Russell Research Center, Athens, GA, 2Department of Poultry Science, University of Georgia, Athens.

*Salmonella* serotypes exhibit different growth characteristics in the same enrichment and can cause certain serotypes like *S. Enteritidis* to go undetected in a sample. The objectives of this study were to evaluate the serogroup diversity recovered from a broiler hatchery plenum fluff sample using 41 cultivation method variations and to determine whether a particular method was more selective towards *S. Enteritidis* isolates. A 300g fluff sample was collected and transported back to the laboratory for analysis. Forty-one cultivation methods (combinations of: 3 primary enrichments, 3 plating media, and 2 incubation temperatures) were used to evaluate *Salmonella* status of a fluff sample. Five colonies per plate were picked and evaluated. Overall, 37/41 of the cultivation methods recovered *Salmonella*. From the fluff samples, 455 *Salmonella* isolates were evaluated. Three serogroups were recovered (B, C1, and C3) with 1 group B, 35 group C1, 416 group C3 and 3 ungroupable. All isolates evaluated from XLT4 plates were C3 except one isolate which grouped C1, while the other 34 C1 isolates came from BGS or HE plating media. The single group B isolate originated from BGS plating media. From M9RV, C1 and C3 were recovered from the inner and outer zones of growth. To determine S. Enteritidis presence in the fluff sample, PCR was conducted on primary enrichments. Even though no serogroup D isolate was recovered, using PCR, S. Enteritidis appeared to be present in the fluff sample. From this study, it is apparent that cultivation methods select for particular serogroups. Cultivation methods may be allowing for particular serotypes to outgrow other serotypes which would negatively influence the probability of recovering certain serotypes in lower numbers within the sample. This may explain why S. Enteritidis

**P157** Comparison of an enriched and barren rearing environment on the welfare related behavior of commercial layer type chicks and pullets. C. J. Davis*, H. Taira, and P. A. Skewes, Clemson University, Clemson, SC.

There is a continuing debate over laying hen welfare related to the type of housing system utilized. This study was conducted to determine the effects of rearing environment on the welfare related behaviors of commercial layer type chicks and pullets. Two behavioral assessments (emergence test and tonic immobility test) were used to determine the fearfulness of the birds. Nine hundred day-old Leghorn chicks were randomly assigned to either a floor pen environment or a commercial cage housing environment. The cage chicks were housed in a commercial battery brooder up until four weeks of age and moved to a battery grower for the remainder of the study. The floor pen chicks were continuously housed in an enriched environment which contained perches, a dust bath, and nest boxes. Behavioral assessments were conducted on 10 randomly selected birds from each environment during weeks 2, 4, 8 and 12. Ten chicks were tested for their latency to emerge from a box in an emergence test and an additional ten chicks were tested on their latency to recover from a tonic immobility test. There were no significant differences between emergence test times or tonic immobility test times between floor pen birds and cage birds over the entire course of the study. There were significant differences between emergence test times or tonic immobility test times between floor pen birds and cage birds over the entire course of the study. There were, however, some differences observed at some sampling times. At week 4 the floor pen birds had a significantly lower mean emergence time than the cage birds (P < 0.05). At weeks 2 and 12 there was a significant difference between pen and cage birds for tonic immobility time (P < 0.05), with the cage birds having a shorter time at 2 weeks and the pen birds having a shorter time at 12 weeks. Although there were significant differences in fear responses for laying hens housed in commercial cages versus floor pens at selected sampling times, the effect of housing was not consistent.

Key Words: tonic immobility, emergence test, laying hen behavior, fear response, laying hen welfare
was not detected from any of the 41 cultivation methods. Additional work evaluating culture method influences on serogroup and serotype recovery is underway evaluating the competition occurring between *Salmonella* during cultivation.

**Key Words**: *Salmonella*, cultivation methods, fluff

### P159 Growth performance of pearl grey guinea fowl subjected to varying floor densities from hatch to eight weeks of age

S. N. Nahashon*, N. Adefope, D. Wright, and A. Amenyenu, Tennessee State University, Nashville.

Little is known of the required floor density for optimum performance of the pearl grey guinea fowl. The objective of this study was to assess the effect of varying floor densities on growth performance of the pearl grey guinea fowl. In three replicates, 786 1-day-old French guinea keets were weighed individually and randomly assigned to floor pens covered with pine wood shavings at 80, 69, 60 and 53 birds/pen, equivalent to densities of 18, 15.6, 13.6, and 12 birds/m², respectively. Birds in these floor densities were allowed feeder space of 2.3, 2.7, 3.1, and 3.5 cm/bird, respectively, and water space of 1.2, 1.4, 1.6, and 1.8 cm/bird, respectively. All birds received 23 h lighting regime and were fed diets comprising 3,000 and 3,100 Kcal ME/kg of diet at 0-5 and 6-8 weeks of age (WOA), respectively, and 24% CP. Feed and water were provided ad libitum consumption. Body weight and feed consumption (FC) were measured weekly. Overall, FC and body weight gain (BWG) were significantly higher (P<0.05) in birds reared in floor densities of 12 and 13.6 birds/m² than those reared on 15.6 and 18 birds/m². Differences in average feed conversion ratios (FCR) of birds reared in floor densities of 12, 13.6 and 15.6 birds/m² were not significant, however these mean FCR were significantly higher (P<0.05) than those of birds reared on 18 birds/m². Therefore, pearl grey guinea fowl reared in floor density of 18 birds/m² exhibited superior performance when compared with birds reared in floor densities of 15.6, 13.6 and 12 birds/m² from hatch to 8 WOA.

**Key Words**: pearl grey guinea fowl, floor density, growth performance

### P160 Using thermal imaging for poultry house energy assessments

D. G. Overhults¹, A. Pescatore¹, I. Lopes¹, G. Morello¹, J. Earnest Jr.², M. Miller², J. P. Jacob², and R. S. Gates³, ¹University of Kentucky, Lexington, ²Kentucky Poultry Federation, Winchester, KY, ³University of Illinois, Urbana.

Infrared cameras are a powerful investigative tool with a multitude of uses. Infrared (IR) imaging in poultry houses is used to measure thermal energy emitted from objects (walls, ceilings, doors, curtains etc). Thermal or infrared energy is not visible because its wavelength is too long to be detected by the human eye. However, specialized sensors in the camera detect IR radiation emitted from objects in proportion to their temperature. In other words, the higher an object’s temperature, the greater the IR radiation emitted. A thermal camera detects and processes the IR radiation into a visible image with different colors representing the range of surface temperatures visible in the camera view. One very significant application of the IR camera is the thermal assessment of buildings, including poultry houses. While both quantitative and qualitative data can be obtained, the primary output from the project reported here is a qualitative assessment of various house components. Thermal images of the ceilings were used to detect areas of thin or missing insulation, roof leaks, rodent damage, and air leaks. Similarly, thermal imaging of the walls were used to detect beetle damaged insulation, settling of insulation in the wall cavity, air leaks over or under curtains, air leaks around end doors and air leaks at the wall and foundation joint. Ventilation problems that were detected include air leakage at tunnel inlets and tunnel fans. The effect of ceiling obstruction on air flow from air inlets was also observed. Additionally, thermal imaging was used to detect overheated electrical wires due to bad connections.

**Key Words**: poultry houses, thermal imaging, energy assessment

### P161 Effect of feeding poults naturally occurring mycotoxins to 21 days of age

J. Grimes¹, M. Koci¹, C. Stark¹, P. Nighot¹, D. Smith¹, and T. Middleton², ¹North Carolina State University, Raleigh, ²Ag ProVision, LLC, Kenansville, NC.

A trial was conducted to observe changes in poults (P) reared to 21 d feeding diets with naturally occurring mycotoxins. Two sources of corn, one with aflatoxin (AFL) or deoxynivalenol (DON), were used. Treatments (T) were: 1) clean corn (C), 2) AFL (A), 3) DON (D), and 4) ½A+½D (AD). Celite (1.5%) was added for 21 d AMEn. A basal with ingredients except corn was mixed. The basal and corn were mixed for T. Feed was pelleted and crumbled. Male P were placed into 24 pens in batteries (7 P/pen; 6 pens/T). Feed consumption, by pen, and BW were determined by wk. At 21 d, heart (H), spleen (S), gizzard (G), liver (L), and bursa of fabricios (B) were weighed and breast muscle (BM) collected for color analysis. Light microscopic analysis of H&E stained L, B, and S were performed to assess histopathology. One P/pen was injected with 7% SRBC on d 7 and 14. Serum albumin (SA) and antibodies (AB) were determined at 11, 14, 18, and 21 d (1 P/pen). Data were analyzed using GLM (P<0.05). The D feed had 1.7 ppm DON, A had 97 ppb AFL and AD had an even mixture. Poults fed D and AD gained less to 21 d than C or A (456, 454 v 486, 502±12 g). D fed P had the lowest feed consumption versus C, A, or AD (648 v 691, 701, 677±16 g). P fed AD had the highest feed:gain versus C, A, and D (1.50 v 1.42, 1.45, 1.44±0.02). AMEn (kcal/kg) at 21 d was increased for D (2894) fed P while for A (2696) fed P it was reduced versus C (2767; AD=2758±29). Relative (R) S wt of D (0.14) but not C or AD (0.12, 0.13±0.006 g). The RL wt A (2.26) and AD (2.52) were reduced versus C (2.68±0.079 g). A had reduced SA. Mortality, RH, RB, and RG wt, G score, and BM colors were not affected. There were no differences in AB. The L of A had hepatic parenchyma with diffuse degenerative changes. The hepaticocytic nuclei were swollen with condensed nucleoli. Some hepatic cords had hepatocyte necrosis. There was sinusoidal congestion with dilatation/congestion of few central veins. Feeding naturally occurring mycotoxins to poults can be used as a model to study interventions.

**Key Words**: turkey, mycotoxin, aflatoxin, deoxynivalenol, immunity

### P162 Pre-storage warming effects on hatchability of end-of-lay broiler breeder eggs

T. C. Gamble*, D. R. Ingram, and J. M. Dowden, Louisiana Agricultural Experiment Station Louisiana State University Agricultural Center, Baton Rouge, LA.

Three trials were conducted with eggs from 57-62 wk old Ross 708 breeders to determine if hatchability could be improved by pre-storage warming of the eggs. Each trial used 1,440 freshly laid eggs from 2 flocks. Eggs were transported for 4 h to the LSU farm where they were randomized and numbered. All treatments had 24 h of adjustment time...
at 15.5°C with a 60% RH to reduce the effect of prolonged transportation. Eggs were randomized into 6 treatment groups of 0, 12, 15, 18, 21, and 24 h of pre-storage warming. Each treatment was heated in a Natureform® Setter at 37.5°C with a 60% RH. The control group remained in the egg cooler. After each warming interval, the eggs were stored at 15.5°C with a 60% RH for 3 d. Following storage, the eggs were incubated for 18 d in a Natureform® Setter at 37.5°C with a 60% RH. On d 7, eggs were candled to determine fertile and early fertile dead. Inertfeite eggs were broken to determine true fertility. On d 18, eggs were transferred to a Natureform® Hatcher at 37°C with a 65% RH. On d 21 chicks, unhatched eggs, and pips were counted. Unhatched eggs were broken and the embryos classified as early (1-7 d), mid (8-14 d), or late (15-21 d) dead. A randomized block design was used for statistical analysis, with each level in the incubator serving as the block, and a group of 30 eggs was the experimental unit. All percentages underwent arcsine conversion before analysis. With no significant trial by treatment interaction, data from trials 1-3 were combined. In all trials, early, mid, late, pips, total dead, and percent fertile hatchability were measured. True fertility was not significantly different among treatments. Warming for 21 and 24 h increased \((P < 0.0001)\) early dead. Warming for 24 h increased \((P = 0.0085)\) mid-dead. All treatments except 15 h decreased \((P = 0.0003)\) late dead. Pips were not affected \((P = 0.52)\). Warming for 21 and 24 h increased \((P < 0.0001)\) total embryonic mortality when compared to the control (20.8% and 21.1% vs 15.7%). Warming for 12 h improved \((P = 0.0008)\) fertile hatchability when compared to the control (86.6% vs 81.8%).

**Key Words:** incubation, hatchability, pre-storage warming, embryonic mortality, broiler breeder

**P163 Inactivation of Salmonella Typhimurium for the production of immuno-modulators in commercial poultry using electron beam irradiation.** J. L. McReynolds*1, H. He1, K. J. Genovese1, M. H. Kogut1, P. R. Jesudhasan2, M. A. Davidson2, M. A. Cepeda2, S. E. Duke2, and S. D. Pillai2,1 USDA-ARS-SPARC, College Station, TX, 2Texas A&M University, College Station.

Food-borne diseases are a major cause of concern in both developed and developing countries. The worldwide incidences of food-borne diseases are difficult to estimate, but statistics show that in 2005 approximately 1.8 million people died due to diarrheal diseases. We are investigating the use of High Energy (10 MeV) Electron-Beam (E-beam) Irradiation to inactivate Salmonella Typhimurium (ST). Though the cells are inactivated, our studies suggest that the surface antigenic properties of ST are unaltered. The present investigations (3 replicates) evaluated the efficacy of the vaccine on heterophil function and Salmonella colonization in broilers. Broiler embryos on day 18 were divided into 5 trt. groups: pos/neg controls, E-beam ST, CPG-ODN dideoxynucleotide (CPG), E-beam ST/CPG, and injected with 100µl of saline, 100µl of 1X104 E-beam ST, 25µg of CPG, or 100µl of 1X104 E-beam ST/25µg of CPG respectively. Blood was collected from each trt. group on d 4 and functional assays were performed. On d 21 chicks were challenged orally with 1 X 106 ST, 4d post challenge the experiment was terminated to determine ST colonization. To evaluate the oxidative burst of heterophils, phorbol 12-myristate acetate was used to stimulate cells from each trt. group. The E-beam ST/CPG oxidative response was increased \((P < 0.05)\) compared to all other trt. groups. In the degranulation assay heterophils were stimulated with opsonized ST for one hour. Results showed E-beam ST/CPG degranulation response was increased \((P < 0.05)\) compared to all other trt. groups. ST colonization of the ceca was also reduced \((P < 0.05)\) in the E-beam ST, E-beam ST/CPG groups. The results show that the immunological effects of these intact ST immuno-modulators in broilers stimulates the immune system and provide protection against ST colonization.

**Key Words:** Salmonella, vaccination, chickens, irradiation, immunology

**P164 Development of fungal library collected from commercial poultry facilities.** J. A. Byrd*1, I. L. McReynolds1, and D. J. Caldwell2,1 USDA-ARS, Food and Feed Safety Research Unit, College Station, TX, 2Department of Poultry Science, Texas A&M University, College Station.

Fungi collected from six commercial broiler and layer houses without a history of mycotoxicosis were studied under normal production conditions. The goal of the present study was to identify fungi and yeast recovered from a commercial poultry houses during production using an automated repetitive extragenic palindromic (rep-PCR) technology. Environmental (litter, soil, insects, feed and water) and cecal samples from different age broiler or laying hens were evaluated for the presence of fungi and yeast. Fungi were isolated on Potato Dextrose and Dichloran-Rose Bengal-Chloram-phenicol Agar at 25°C for up to 12 days. Over 2000 fungal samples were isolated and ~690 samples have been further characterized using rep-PCR. The different fungal and yeast genera that were identified over 30 different genera which include: Penicillium spp., Aspergillus spp., Fusarium spp., and Candida spp. The relationship between these fungi and environmental parameters are presented for each sampling point throughout broiler grow-out and layer production. Generalized fungal growth patterns found in the litter and recovered from the birds are described and the relationship between environmental factors and foodborne pathogens on these patterns are described.

**Key Words:** fungal, yeast, poultry

**P165 Potential for land application of liquid from a broiler litter digester.** W. B. Evans*, Mississippi State University Truck Crops Branch, Crystal Springs.

Efforts are underway to commercialize digesters that produce marketable fuel gas from broiler litter. The process results in considerable amounts of residual liquid. This residual liquid digestate may be suitable for application as a fertilizer. Laboratory results from a digestate produced on a Mississippi broiler farm showed that the digestate tested contained 800 ppm N, 70 ppm P, 1490 ppm K, 130 ppm Ca, 11 ppm Fe, and less than 10 ppm of Al, Mn, Cu, Zn, and B. The sample, which contained less than 1% solids, also contained less than 0.5 ppm of Cr, Ni, Pb, and Cd. Initial studies of the digestate liquid on tomato growth in the greenhouse have shown a positive growth response to the product, with no significant negative effects on growth or appearance. In subsequent field and greenhouse tests of the product on ryegrass, up to four application rates of digestate were tested with or without the addition of standard commercial fertilizer. To date, the tests have shown no negative effects, with or without the simultaneous application of standard commercial fertilizer. Based on these results, additional testing of the product is warranted, including evaluation of variability the digestate within and among producing facilities, suitability of the digestate for various fertilizer uses, and appropriate management techniques.

**Key Words:** fertilizer, soil, nitrogen, phosphorus, nutrient management
Macroeconomic variables such as interest rate, exchange rate and inflation rate have played an important role in affecting the poultry industry in developing countries such as Nigeria. This work was done to determine the effects of these variables on poultry population output in Nigeria. Time series data covering three decades, 1978-2007 on poultry and macroeconomic variables were analyzed, using descriptive analysis and growth rate model (in graphs and tables). Forecast of poultry population and population growth rate was also determined for the next ten years (2008-2017).

Poultry population increased from an average of 89,821,000 in the first decade to 97,530,000 in the second decade and to 125,172,500 in the third decade. However, the growth rate decreased drastically from 4.1857% in the first decade to as low as 1.4071% in the second decade and a slight increase to 2.9986% in the third decade. The forecast showed a steady decline in the poultry population growth rate. Increase in macroeconomic variables has negatively affected the poultry population growth rate in Nigeria over the years. This study shows that policies that will decrease the macroeconomic variables will reduce the poultry population growth rate in Nigeria (1978-2007) and a ten-year forecast.

Forecast of poultry population and population growth rate have played an important role in affecting the poultry industry in developing countries such as Nigeria. This work was done to determine the effects of these variables on poultry population output in Nigeria. Time series data covering three decades, 1978-2007 on poultry and macroeconomic variables were analyzed, using descriptive analysis and growth rate model (in graphs and tables). Forecast of poultry population and population growth rate was also determined for the next ten years (2008-2017).

Poultry population increased from an average of 89,821,000 in the first decade to 97,530,000 in the second decade and to 125,172,500 in the third decade. However, the growth rate decreased drastically from 4.1857% in the first decade to as low as 1.4071% in the second decade and a slight increase to 2.9986% in the third decade. The forecast showed a steady decline in the poultry population growth rate. Increase in macroeconomic variables has negatively affected the poultry population growth rate in Nigeria over the years. This study shows that policies that will decrease the macroeconomic variables are essential for driving the poultry population growth rate in Nigeria and other developing countries.

Key Words: macroeconomic, variables, population, rate, poultry

Hatchery is the sector with great importance in the egg production. With the reduction of the computers costs, and increase of storages data for management of the productive process, becomes Data Mining, as a technique to identify a new and useful knowledge in data bases. In this way this paper has the aim to explore the Data Mining in hatchery’s database to identify the best standards of the incubation process, from which we can get better results of hatchery. The conclusion of this study is the technique and the attributes can be used to identify new, useful and applicable knowledge to increase the hatcheries productivity, attending the demand with less waste.

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Key Words: KDD, poultry science, artificial intelligence, hatcheries
P170  Genomic analysis of polymeric immunoglobulin receptor response to avian reovirus infection in broilers as influenced by dietary selenium. J. Read-Snyder1, F. W. Edens1, C. M. Ashwell1, A. Cantor2, and A. Pescatore2, 1North Carolina State University, Raleigh, 2University of Kentucky, Lexington.

Avian reovirus (ARV) is an economically important dsRNA virus, and secretory IgA (sIgA) is a major defense mechanism guarding against ARV invasion. This first line of defense is established through interaction between the mucosal B cell system and the polymeric immunoglobulin receptor (pIgR) protein that escorts sIgA transcellularly. A 1:1 relationship has been shown for sIgA and pIgR. At the apical surface of enterocytes, sIgA with its cleaved pIgR-secretory component are released into the intestinal lumen. Evidence shows that selenium has a negative influence on dsRNA viruses such as the avian reovirus. This work was conducted to examine, with the use of qRT-PCR, the influence of dietary selenium on tissue pIgR in broiler chickens challenged with an enteric avian reovirus (ARV-CU98 10^32 pfu/chick at day of hatch). Cobb 500 broilers were fed isocaloric Torula yeast diets with either no supplemental selenium (<0.02 ppm Se), Sel-Plex (0.3 ppm) or sodium selenite (0.3 ppm). Control and challenged birds were sampled at 14 and 21d posthatch to collect thymus, pancreas, bursa of Fabricius and liver tissues. All tissues were found to produce pIgR at 14 and 21d, but liver, pancreas, and bursa showed age related increases in pIgR expression while other tissues showed age-related decreases. ARV infection increased pIgR expression. Sel-Plex compared to selenite elevated pIgR expression in liver, a major site of IgA production. In the pancreas, selenite elevated pIgR over all other treatments. These data show that pIgR is produced in many tissues, but the results suggest that selenium induces greater pIgR expression in tissues with secretory capabilties. Induction of pIgR would facilitate transport and delivery of sIgA to combat viral and even bacterial invasion helping to explain the positive outcomes associated with selenium in disease-challenge studies.

Key Words: C. perfringens, essential oils, disc diffusion

P171  Decreased plasma ev21 virus envelop protein in Sel-Plex-fed broilers. R. F. Somody*,1, F. W. Edens1, and A. E. Sefton2, 1North Carolina State University, Raleigh, 2Alltech, Inc., Nicholasville, KY.

The sex-linked slow-feathering K allele (dominant to the fast feathering k allele) carries a DNA copy of the avian leukemia retrovirus RNA genome, which is expressed as endogenous virus 21 (ev21). Ev21 is transmitted congenitally from K+ hens but does not appear to affect progeny that inherit the K allele for slow-feathering. Fast-feathering (kk) progeny appear to be immunotolerant to the presence of ev21 but respond with poorer performance and increased mortality. An earlier study demonstrated increased rate of feathering due to Sel-Plex in both slow-feathering males and fast-feathering females. A comparison of broilers fed either supplemental selenium as Sel-Plex (Alltech, Inc., Nicholasville, KY) or sodium selenite at 0.2 ppm and reared from hatch to 6 weeks of age in either floor pens on old litter or Farmer Automatic cages revealed that selenite feeding resulted in higher plasma ev21 envelop protein levels as determined via the flow cytometry R2 plasma assay (Bacon, LD, 2000, Avian Pathol. 29:153-164). Selenite-fed males had higher plasma ev21 envelop protein levels than Sel-Plex-fed males, and caged-reared animals had lower ev21 envelop protein levels than floor-reared birds. Females in cages had lower plasma ev21 envelop protein levels regardless of selenium treatment than did males. However, in a floor environment, selenite-fed males and females had higher plasma ev21 envelop protein levels than Sel-Plex-fed birds. Selenite-fed females appeared to pick up ev21 virus from the floor pen environment, but floor-reared Sel-Plex-fed females did not increase plasma ev21 envelop protein levels. The data suggest that expression of ev21 might be suppressed by the organic selenium in Sel-Plex by yet to be determined mechanism. The suppression of ev21 by Sel-Plex might be responsible for increased rate of feathering.

Key Words: Sel-Plex, broiler, ev21 virus, avian leukosis, feathering


A challenge test was designed to study the virulence of Mexican Newcastle disease velogenic viruses named Chimalhuacan, Queretaro, Torreon and DPAA on lymphoid organs of non-immune reared mixed broiler chickens. Twenty one chickens were inoculated intranasally at 5-w-o with 10^2 ELDS_50/0.2 ml of NDV belonging to different genotypes and lineages, vaccine strain LaSota was used as lentogenic control. Chickens were observed for 4 days after challenge and humanely sacrificed in groups of 3 birds at 12 hours intervals from 24 to 96 hours post inoculation (hpi) and tissue sections from bursa of Fabricius, thymus, Harderian gland, cecal tonsil, spleen and bone marrow were processed for light microscopy. Different lesions scores were established for each organ and compared by Kruskal-Wallis and multiple comparison method of Dunn (P<0.05). The most severe lesions in thymus at 36 hpi were caused by Chimalhuacan strain; at 60 hpi by Chimalhuacan and DPAA; at 72 hpi by Chimalhuacan, DPAA and Torreon; at 84 hpi by DPAA and Torreon; and at 96 hpi by Chimalhuacan and Queretaro. In bursa of Fabricius, Chimalhuacan strain caused the highest lesion score at 48 hpi; at 96 hpi Chimalhuacan and Torreon caused complete follicular destruction of bursa. The spleen was severely damaged by DPAA strain
Poult. Sci. 89 (Suppl. 1)

**P173** CpG oligodeoxynucleotide and double-stranded RNA (poly I:C) synergistically stimulate inflammatory and Th1 cytokine expression in chicken peripheral blood monocytes. H. He*, K. Genovese, and M. Kogut, Southern Plains Agricultural Research Center, USDA-ARS, College Station, TX.

Toll-like receptors (TLRs) recognize microbial components and initiate the innate immune responses that control microbial infections. The interaction between ligands of TLR3 and TLR9, poly I:C (an analog of viral double-stranded RNA) and CpG-ODN (a CpG-motif containing oligodeoxynucleotide) on cytokine gene expressions, including interferons, IFN-γ, IFN-α and IFN-β, and proinflammatory cytokines interleukin (IL)-1β and IL-6, were investigated in chicken monocytes. CpG-ODN was found to up-regulate the expressions of INF-γ, IL-1β, IL-6, and IL-12, but not IFN-α and IFN-β; whereas poly I:C induced expressions of INF-α and IF-β, but not IL-1β, IL-6, and IL-12. However, stimulation with a combination of CpG-ODN and poly I:C synergistically up-regulated INF-γ, IFN-β, IL-1β, and IL-6 gene expression. Our results demonstrated that CpG-ODN synergizes with poly I:C to induce proinflammatory immune response in chicken monocytes.

**Key Words:** cytokine, CpG-ODN, Poly I:C, TH1 immune response, monocytes

**P174** Reproductive evaluation of heavy roosters fed different sources/levels of selenium. F. P. Gentilini, R. R. Silva, P. M. Nunes, F. M. Gonçalves, J. K. Nunes, M. A. Anciuti, and F. Rutz*, Universidade Federal de Pelotas, Rio Grande do Sul, Brazil.

An experiment was conducted to compare the effects of inorganic selenium (Se) (as sodium selenite) alone or in combination with added organic Se in the form of selenium yeast (Sel-Plex®, Alltech Inc.) on the reproductive performance and sperm quality of heavy roosters. Forty Cobb roosters (25 to 57 wk of age) were housed in individual cages (20 birds per treatment). Each rooster was fed 110 g of a corn-soybean meal diet per day. Roosters were ejaculated daily and sperm traits and fertility were examined monthly. Fertility was evaluated by artificially inseminating 30 hens per treatment, using 100 million sperm cells per insemination. Dietary treatments follow: T1 – Inorganic Se (0.3 ppm Se, as sodium selenite); T2 – T1 + organic Se (0.3 ppm Se, as Sel-Plex®). Reproductive measures included semen volume, spermatoctrit, number of sperm cells, sperm motility and sperm vigor and fertility (evaluated for 7 d after a single insemination). Data were subjected to ANOVA (P<0.05). Sperm traits were not significantly affected by dietary treatments, possibly because there was great variation in reproductive traits between roosters. However, there was a consistent numerical improvement in both quantitative (semen volume and number of sperm cells) and qualitative (motility and vigor) sperm characteristics with the feeding of Sel-Plex® throughout the study. Egg fertility rate in hens inseminated with sperm from roosters given additional selenium was unaffected. In conclusion, added Se in organic form provided mild quantitative and qualitative improvements in rooster sperm characteristics.

**Key Words:** selenium, reproduction, fertility, sperm, hatchability

**P175** Alternative molting programs using soy hulls. 2. Bone parameters response. H. Marzuoco*, A. Coldebellla, R. Moreira*, and V. S. Avila*, EMBRAPA Swine & Poultry, Concordia, SC, Brazil, Universidade do Contestado, Concordia, SC, Brazil, 3PIBIC-CNPq, Brasília, DF, Brazil.

This study evaluated the effects of alternative molting programs compared to conventional (feed removal) and nonmolted treatments on bone quality parameters of Hy-Line W-36 hens submitted to molt at 80 wks of age. Treatments consisted of a conventional molt (10 d fasting followed by cracked corn for 8 d and pullet developer diet for 10 d) and alternative molting programs: soy hulls based diet (12% CP, 1455 ME kcal/kg, 1.38% Ca) offered for 14 d followed by cracked corn for 4 d and a pullet developer diet for 10 d and the other three molt regimens consisting of feeding soy hulls during 4, 8 or 12 d followed by 10, 6 or 2 d respectively, of feeding soy hulls based diet and 4 d of cracked corn plus 10 d pullet developer diet. A nonmolted control group of birds was fed a laying hen diet during the experimental period. At 84, 92 and 105 wks of age, birds (n=216, 12 replicates/treatment) were euthanized. The left tibia and left femur were retrieved for bone measurements including ash wt (g), Ca (g), fat-free dry matter (FFDM, g) and ash/BW ratio. Data were subjected to ANOVA considering the effects of age, treatment and interactions. Significant treatment x age effects (P < 0.05) for both bones were observed on bone Ca and ash/BW ratio (P < 0.01). Treatment effects (P < 0.05) were observed for all variables except tibia ash/BW ratio. When compared to the molt treatments, control birds showed higher values for bone Ca in all ages and both bones except for tibia at 92 wks. For ash wt, higher values were observed for both bones in all ages on the control treatment except for tibia at 92 wks when no differences among treatments were found. Control birds had lower values of tibia ash/BW at 84 wks of age. FFDM values in all ages and both bones were observed to be higher on control birds than the other treatments with no difference at 92 wks for tibia. In conclusion, bone quality parameters decreased after molt on both alternative and conventional methods, when compared to nonmolted hens.

**Key Words:** alternative molting, ash weight, bone Ca, soy hulls

**P176** Gut microbiota in the avian embryo. D. V. Bohórquez*, N. E. Bohórquez², and P. R. Ferket*, North Carolina State University, Raleigh, ²Pan-American School of Agriculture Zamarano, Tegucigalpa, Honduras.

The gut of avian embryos is assumed to be sterile, and it is believed that microbial colonization begins soon after hatch; however, vertical transmission of bacteria during oviposition is known to occur in poultry. In several invertebrate species, including marine sponges, shrimp, earthworms and some insects, in-ovo transmission of bacteria is a common mechanism to ensure the inheritance of commensal microorganisms.
from one generation to the next. Likewise, microbial colonization of the avian gut may begin during the latter stages of embryonic development. This hypothesis was tested in three separate experiments using different incubation groups of Nicholas turkey embryos. In experiment 1, the distal ileum of 4 embryos was sampled at 22 days of embryo (E), 24E and 26E for scanning electron microscopic (SEM) analysis. In experiment 2, the ceca of 4 embryos were sampled at 15E, 17E, 19E, 21E, 23E, 25E and 27E for SEM analysis. In experiment 3, the contents of the distal intestine and ceca from 24 embryos were aseptically collected, and brain samples were taken as a negative control. DNA was extracted from intestinal and brain samples for microbial profiling using 16S rRNA gene amplification and Terminal Restriction Fragment Length Polymorphism (TRFLP) analysis. SEM micrographs of the distal ileum revealed distinctive colonies of microorganisms associated with the epithelium at 26E. SEM from ceca samples revealed micro-colonies of bacteria from at 17E through 27E. These appeared to be composed of at least 3 different shapes of bacteria-like microorganisms, and the complexity of these micro-colonies seemed to increase with age. Amplification of the 16S rRNA gene was accomplished using a set of universal primers only from intestinal samples. Evidence of 16S rRNA presence, a unique component of the small prokaryotic ribosomal subunit (30S), confirmed microbial colonization in the distal intestine of embryos. TRFLP analysis is in progress to characterize the microbial community present on these samples. This microscopic and molecular biological evidence confirms that microbial colonization of the gut, at least in turkeys, begins during embryonic development several days before hatch.

Key Words: embryonic bacteria, turkey embryo, gut microbiota

P178 Manure hygienisation development and application (MIDA) as biological technology for treatment of laying hen manure.

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Overall, the goal is to overcome the management of manure as waste and the agricultural lands need for its spreading through the direct production of quality hygienic fertilizer, that improves the soil structure, enhances its fertility and rehabilitates for predesertification. In details, the aim of the project was to verify laying hen manure (LHM) hygienisation by bio-treatment, according to Reg. (CE) 1774/2002 indications. The obtained product, should be transformed in a waste, but in an hygienic and marketable safe organic fertilizer. LHM dried at three different level of humidity by MDS (Manure Drying System) was treated inside big-bags and pile, by adding PAV (Vegetal Active Principles) a biocatalyst of plant origin, in a poultry farm in Italy. Manure sampling and analysis, taken at days -3 (before MDS), 0, 38, 81, 123, were carried out following Reg. (CE) 1774/2002 and taking into account also the chemical nutrients considered in D. Lgs. 217/06 Objectives for thermal and chemical process are: - absence of Salmonella spp. in 25 grams; - concentration of Escherichia coli in 1 gram lower than or equal to 1000 u.f.c.; - reduction 5 log 10 of Enterococcus faecalis in 1 gram; - reduction 5 log 10 of Parvovirus. In this early stage, due to the high environmental resistance of dispersal stages of parasites, we have added also the evaluation of PAV’s activity on coccidia and ascacid eggs. This justified the sampling at day -3 useful to assess the parasites burden in the fresh LHM. Also pathogen and saprophytic fungi were searched with the same timing. Due to the absence of Parvovirüs in poultry, to follow the reg. (CE) 1774/2002 we have developed a “daughter” trial in controlled conditions adding Parvovirus of swine origin to LHM. From a general point of view, the experimental activity of MIDA has shown good results in reducing biological parameters after 123 days and appears to be encouraging for the authors to go on, developing the project and searching for financial support.

Key Words: laying hen manure, organic fertilizer, hygienisation, PAV, soil fertility

P179 A visual time course of deep pectoral myopathy lesion development in broilers.

R. J. Lien, S. F. Bilgili, K. S. Joiner, and J. B. Hess*, Auburn University, Auburn, AL.

Deep Pectoral Myopathy (Green Muscle Disease, DPM or Oregon Disease) is a condition characterized by focal necrosis of the m. pectoralis minor muscles (tenders) of poultry. Lesions in broiler chickens often affect both tenders and vary in color, from fresh hemorrhages to green or tan discoloration. In this trial, DPM lesions were visually described and photographed at fixed times after the forced-wing induction method, which involves exercising broiler chickens by raising them into the air, encouraging wing flapping for 20 bouts of wing flapping in 32 seconds. Broiler chickens were raised to 47 d of age, then euthanized and dissected to examine m. pectoralis minor muscles for DPM after varying periods of time post exercise (1, 3, 5, 8, 11, 14 and 21 d prior to euthanasia). Mild redness and swelling of the p. minor muscles was noted at one day post exercise, while significant blood was noted covering much of the surface of the muscle at 3 d. At 5 d post exercise, blood breakdown was evident, with yellow and green pigmentation in addition to some

Key Words: breeder, male, maturation, testes, sertoli
remaining blood. At 8 and 11 d post exercise, hemoglobin breakdown to associated pigments appears complete, with a significant deterioration of muscle quality. Few lesions were noted when exercise was conducted 14 and 21 d prior to dissection, possibly because the birds were too small at that point to develop the condition. This information is intended for use to develop color posters or flash-cards which can be used by the live production or processing personnel to estimate the timing of DPM development in the field. Approximation of the time of flightiness would then help in the identification of contributory production/management factors.

Key Words: deep pectoral myopathy, green muscle disease, broiler chicken

P180  Measuring broiler breast fillet dimensions with digital image analysis.  J. L. Purswell*1, C. Igathinathane2, and W. A. Dozier III3, USDA-ARS Poultry Research Unit, Mississippi State, MS, Biological & Agricultural Engineering, Mississippi State University, Mississippi State, Department of Poultry Science, Auburn University, Auburn, AL.

Dimensions of breast fillets are an important consideration for poultry meat processors to ensure portion control for value added processing. Digital image analysis was employed as a non-contact means to acquire dimensions of breast fillets. A typical inexpensive flatbed document scanner was used to acquire images of breast fillets. Images were analyzed with ImageJ, a freeware image analysis software package available from the US National Institute of Health typically used for medical imaging applications. Results were compared to manual measurement with calipers and were within 0.8% for length and 3.8% for width. Dimensioning results were strongly correlated for length (R = 0.997) and width (R = 0.972).

Key Words: imaging, dimensions, breast fillet


The use of exogenous enzyme to improve performance of livestock is gaining prominence in the developing countries. However, little attention is paid to their effects on meat and product qualitative characteristics. An experiment was conducted to evaluate the effect of Roxazyme GR on meat and eating quality of broiler chicken. A total of one hundred and sixty unsexed three week-old Abor-Acre plus strain broiler chicken were randomly allocated to four dietary treatments in a completely randomized design. Each treatment was replicated four times with ten birds per replicate. The diets contained 0.00, 0.10, 0.20 and 0.30 % enzyme inclusion respectively. The birds were fed the experimented diets for a 35-day period. At the end of the feeding trial, six birds per replicate were sacrificed for evaluation of meat quality. The dressing percentage of birds fed the enzyme supplemented rations were superior to the control. The inclusion of the enzyme did not affect the primal cuts (P > 0.05). The water holding capacity (WHC) was least in the control [63.64%] and highest at 0.10% enzyme inclusion (76.71%). The Warner Brazzler shear force values were not significantly affected by the treatment effect. Cooking loss decreased as the enzyme supplementalations increased. The product qualitative characteristics of birds fed enzyme supplemented rations were higher (P < 0.05) than the control while there was no significant difference (P > 0.05) in the overall acceptability ratings.

The result showed that apart from increase in dressing out percentage, the use of Roxazyme GR improved the WHC, tenderness and product qualitative characteristics of broiler chicken meat.

Key Words: exogenous, enzyme,, meat-quality, chicken, carcass

P182  Phylogenetic analysis of Samonella Enteritidis isolates from poultry processing.  K. A. Lijiejhelke*1, R. Clinkscales III2, J. A. Cason1, K. D. Ingram1, and A. Hinton Jr.1, USDA-ARS-RRC-PPSP, Athens, GA, Tuskegee University, Tuskegee, AL.

Salmonella enterica serotype Enteritidis is a cause of food borne illness historically associated with consumption of contaminated table eggs. S. Enteritidis has recently become more frequently isolated from broiler poultry carcasses, raising concern that this serotype may also become a cause of food borne illness associated with consumption of chicken products. Understanding the origins and entry of this human pathogen into integrated poultry production is crucial to identifying control points in the farm-to-fork production continuum. We tested the hypothesis that we could identify an endemic strain of S. Enteritidis associated with the poultry company studied, with the goal being to identify potential sources of the contamination. We used two different molecular techniques; pulsed-field gel electrophoresis (PFGE), and repetitive extragenic palindromic sequence - polymerase chain reaction (REP-PCR), to generate genetic fingerprints of S. Enteritidis isolates from samples collected in a commercial broiler chicken processing plant, and from broiler carcasses processed at this plant over a period of four months. The PFGE and REP-PCR genetic fingerprints were used to create phylogenetic trees in order to determine the relatedness of the strains. Antibiotic resistance profiles generated using a microbroth diffusion method revealed that all isolates were pan-sensitive to the panel of antimicrobials tested. The phage types of the isolates were determined to be 8, 13, and 24, phage types commonly associated with food borne illness in the United States. Phylogenetic analysis revealed genetic diversity inconsistent with the hypothesis that these isolates originate from a single source within this poultry production system. This study provides data that contribute to understanding the epidemiology of S. Enteritidis in broiler poultry production.

Key Words: Salmonella, enteritidis, poultry, processing, phage type

P183  Qualitative attribute of pigeon meat as influenced by strain and sex.  A. B. Omojola1, O. O. Olusola*, A. M. Issa2, M. Jibir3, and O. A. Ogunwole1, University of Ibadan, Ibadan, Oyo State, Nigeria, Usman Danfodiyo University, Sokoto, Nigeria.

The consumption of pigeon meat if encouraged can be employed as a tool to alleviate poverty and ensure food security for economically disadvantaged peasant farmers. Pigeon meat is rarely consumed in most part of Nigeria. An experiment was carried out to evaluate carcass and meat quality of three strains of pigeon commonly found in the semi-arid region of Nigeria. A total of seventy-two matured pigeon with twenty-four from each strain were used for the study in a 3x2 (breed x sex) factorial arrangement in a completely randomized design. The strains evaluated are, Algardi, Jamul and Kura. The birds were slaughtered in batches of six, properly bled, defathered at 85 C and dressed. The carcasses were chilled at 2 C for 24 h prior to cutting up into primal cuts. Samples for cooking loss, water holding capacity and shear force were taken from the breast portion. The dressing out percent was highest in Kura (66.72 %) as against values of 66.18 and 65.15% for Jamul and Algardi.

Traditional plating methods are reliable, though time-consuming means for Campylobacter identification from poultry samples. However, automated gene-based detection systems now available can reduce assay time, data collection and analysis. Bio-Rad and DuPont Qualicon recently introduced Campylobacter assays for their real-time PCR instruments. We evaluated the utility of these assays compared to standard plating and enumeration methods routinely used in our laboratory. Two replicates of 40 broiler carcass rinses collected before and after defeathering at a commercial processing plant were tested. All samples were positive for Campylobacter by direct plating of rinses: log 10 values ranged from 0.24–4.61. In contrast, the Bio-Rad iQ-Check assay returned 60–72.5% positives on direct rinses; the Qualicon BAX Q7 test produced 60–85% positives with direct rinse samples. Using aliquots of 24 hr enrichment broth from rinses as samples in the real-time assays significantly improved detection: the Bio-Rad test had 95–100% positive while the Qualicon assay found 90–95% positive. We conclude that with minor modifications to reduce apparent PCR inhibition observed with direct rinses, these commercial tests would have greater utility and increased applications for field studies involving Campylobacter detection from complex sample material.

Key Words: campylobacter, real-time PCR, broiler carcass rinses, bacterial enumeration, PCR evaluation

P185 Use of tocopherol with polyunsaturated fatty acids in poultry feeds. R. Holser* and A. Hinton, Richard Russell Research Center, Athens, GA.

The ability of alpha-tocopherol to prevent the degradation the polyunsaturated fatty acids, docosahexaenoic acid (DHA) and linoleic acid (ALA) at elevated temperature was investigated in a series of laboratory experiments. DHA is known to promote nervous system function and health, however, DHA and other highly unsaturated fatty compounds are readily oxidized with structural degradation and loss of bioactivity. Mixtures of DHA or ALA and alpha-tocopherol were incubated at 70°C. Samples of these mixtures were analyzed by gas chromatography. After 72 hours mixtures with 0.25 mg tocopherol/mg retained 79.6% of the initial amount of DHA and 94.2% of the ALA. When tocopherol was present at 2.5 mg/mg the amount of DHA decreased to 62.5% and ALA decreased to 87.4%. Control samples that did not contain tocopherol retained 43% DHA and 52.6% ALA. These results indicate that tocopherol prevents degradation of these polyunsaturated fatty acids at elevated temperature. However, the greatest protective effect is not necessarily obtained with the highest level of tocopherol. This relationship needs to be considered when formulating feeds where elevated process temperatures are likely to occur such as during pelleting.

Key Words: docosahexaenoic acid, feed, linoleic acid, tocopherol, vitamin E


Synergistic effects of fumaric acid (FA) coupled with other organic acids were evaluated for the reduction of Salmonella spp. in vitro. Test tubes containing 0.5% FA alone or a combination 0.5% FA and 0.5% or 1.5% of various organic acids, including acetic, ascorbic, citric, lactic, malic, oxalic, propionic and tartaric acid, were inoculated with a four strain cocktail of Salmonella spp. After a contact time of 40 seconds at 22°C treatments were serially diluted in buffered peptone water and plated on XLD agar. Each acid combination was performed in triplicate and log reductions were determined by comparison to a control of sterile distilled water. Treatment with 0.5% FA alone showed 0.94 log reduction in recoverable cells. No significant differences were observed between control and FA coupled with 0.5% ascorbic, malic or tartaric acids. The synergistic effect of FA improved when concentration of the supplemented organic acid increased. The greatest synergistic effect was observed when 0.5% FA was coupled with 0.5% or 1.5% oxalic acid resulting in 2.09 log and ≥7 log reduction in recoverable cells, respectively. With the exception of oxalic acid, combining FA with 0.5% organic acids made FA less effective in reducing Salmonella than FA alone. FA effectiveness was only improved by the addition of 1.5% acetic and lactic acids.

Key Words: Salmonella, fumaric acid, synergistic effect, organic acid, vitro study

P187 Versatile, cost-effective automation of avian flu and Mycoplasma gallisepticum-synoviae ELISAs. W. Goodrich* and M. Durgin, 1BioTek Instruments, Winooski, VT, 2IDEXX Laboratories, Westbrook, ME.

Avian influenza (AI) is a highly pathogenic type A virus that, in addition to causing widespread loss of fowl stocks and production, can infect humans and has the potential of causing a global flu pandemic. Mycoplasma gallisepticum-synoviae (Mg/Ms) infections also spread rapidly in poultry populations, and although are easier to eliminate than AI due to the lack of a cell wall of the mycoplasma, still cause widespread loss of production and stock. Ensuring the health of the global agricultural economy and minimizing the probability of a worldwide flu pandemic is placing growing demands on laboratories that routinely test poultry and livestock samples. One of the biggest challenges to designing well planned throughput is managing the fluid overages that most automation consumes within the confines of the reagent volumes supplied by many standard ELISA screening kits. An experiment was designed using the BioTek EL406 Combination Microplate Washer/Dispenser to showcase workflow versatility and cost-effective reagent usage using two different throughput models, one using the IDEXX Mycoplasma
Galiseptium-Synoviae ELISA indirect format kit and the other using the IDEXX Avian Influenza Multi-Species ELISA blocking format kit. Data generated for both a small batch model composed of multiple runs of less than five plates, and a larger batch model integrating the BioStack robotic microplate handler for running single batches of five or more plates, demonstrated reliable, reproducible results with an expected level of inter and intra batch variability for both Mg/Ms and the AI Multi-Species while offering workflow versatility that optimized both throughput and reagent usage.

Key Words: avian, automation, EL406, IDEXX, microplate

P188  Pulsed field gel electrophoresis along with antimicrobial resistance pattern of Salmonella serotypes isolated from broiler external carcass rinses.  N. A. Cox1, P. J. Fedorka-Cray2, L. J. Richardson*1, R. J. Buhr1, B. McGlinchey2, C. Hall2, and J. Haro2, 1ARS, PMSRU, Russell Research Center, Athens, GA, 2Center for Food Safety and Department of Food Science and Technology, University of Georgia, Griffin, 3Poultry Science Department, Mississippi State University, Mississippi State, 4Poultry Science Department, North Carolina State University, Raleigh.

Pulsed field gel electrophoresis (PFGE) and antibiogram patterns have been used to evaluate the diversity within and between individual Salmonella serotypes. The objectives of the study were to evaluate the PFGE and antimicrobial resistance patterns of Salmonella broiler carcass rinse isolates and compare pattern similarity to 4,620 XbaI patterns originating from testing 17,597 isolates in USDA-VetNet. The Salmonella isolates (n=176) originated from 49 post-pick carcass external rinse samples. Overall, the antimicrobial resistance diversity as well as the PFGE diversity within eight different S. enterica serotypes [Agona (n=7); Berta (n=32); Heidelberg (n=8); 4,5,12:i:- (n=1); Kentucky (n=57); Kiambu (n=28); Mbandaka (n=27); Senftenberg (n=16)] was studied. For genetic fingerprinting, PFGE was used and to determine antibiogram patterns, isolate potential resistance to 15 different antibiotics was evaluated using a Sensititre®. Overall, 8 different antibiogram patterns were observed across all isolates. S. Kentucky isolates (n=57) exhibited the greatest heterogeneity with 6 different antimicrobial resistance patterns within 13 different PFGE patterns. S. Berta (n=32) isolates exhibited 3 different PFGE patterns while S. Agona exhibited 2 different patterns. Isolates from both S. enterica serotypes were pan-susceptible. Compared to patterns within the USDA-VetNet database, a total of 10 new Salmonella PFGE XbaI patterns were identified with 6 new patterns originating from S. Kentucky isolates. The S. Kiambu isolates all had a unique XbaI pattern (TEN01.0013 ARS) that has a slight band shift difference from a S. Kiambu pattern only seen twice before in diagnostic cattle samples. The identification of new patterns suggests that further work needs to be conducted on cultural influences that select certain Salmonella serotypes along with diversity within serotypes. The isolates from this study originated from cultivation method combinations that are not commonly used by regulatory agencies to recover Salmonella from poultry carcasses.

Key Words: PFGE, Salmonella, antimicrobial resistance, poultry, carcass rinse

P189  Feasibility of zero tolerance for Salmonella on raw poultry.  N. A. Cox*1, P. J. Fedorka-Cray2, L. J. Richardson1, J. A. Cason1, Y. Vizzieri-Thaxton3, P. J. Fedorka-Cray1, D. P. Smith1, and R. J. Buhr1, 1USDA, ARS, Russell Research Center, Athens, GA, 2Center for Food Safety and Department of Food Science and Technology, University of Georgia, Griffin, 3Poultry Science Department, Mississippi State University, Mississippi State, 4Poultry Science Department, North Carolina State University, Raleigh.

It is difficult to compare prevalence data from country-to-country when sample plan, sample type, sample frequency and laboratory media along with methods differ. The European Union (E.U.) and the United States (U.S.) have different Salmonella sampling methods for broiler carcasses. The E.U. uses a 3 carcass composite of neck skin totaling 25g and stomachs this in 225ml buffered peptone water (BPW). In the U.S., the whole carcass is rinsed with 400 ml BPW but only 30 ml (7.5%) is analyzed. When a side-by-side comparison was done, the external carcass rinse, the neck skin (NS) and a composite of both methods detected Salmonella on 71/357 (20%), 61/357 (17.1%) and 110/357 (30.8%) of the broiler carcasses, respectively. Given the insensitivity of both methods, it is not surprising that both methods produced false negatives. In addition to sampling and laboratory methods, other fundamental differences exist between E.U. and U.S. The E.U. uses air chill and no chemicals in the processing plant, while the U.S. uses immersion chill with a variety of chemicals. E.U. applies pressure in live production while the U.S. applies pressure during processing to lower Salmonella prevalence. E.U. considers Salmonella presence on a processed carcass to be a sanitation indicator while in the U.S. it is a food safety issue. The E.U. (except Scandinavia) is concerned primarily about 5 serotypes (S. Enteritidis, S. Typhimurium, S. Hadar, S. Infantis and S. Virchow) while the U.S. is concerned about all serotypes. Monitoring and surveillance programs are used internationally. The term zero tolerance was created by Bureaucrats to assure food safety, but gives consumers a false sense of security and can be misleading. A guarantee that all raw poultry meat will be Salmonella free is impractical. Absence in a sample(s) does not mean zero tolerance and zero tolerance does not mean eradication. Countries should try to use internationally standardized methods for sampling and participate in harmonizing international standards along with terminology for Salmonella prevalence on poultry.

Key Words: Salmonella, zero tolerance, raw poultry, US sampling, EU sampling

P190  Salmonella serotype diversity from broiler carcass rinsates evaluated by two secondary enrichments along with two plating media.  N. A. Cox*1, P. J. Fedorka-Cray2, L. J. Richardson1, R. J. Buhr1, and S. L. House2, 1USDA, ARS, PMSRU, Russell Research Center, Athens, GA, 2Center for Food Safety and Department of Food Science and Technology, University of Georgia, Griffin.

Salmonella diversity on broiler carcasses has received significant attention in recent years, due to emphasis being placed on recovery of certain...
serotypes associated to human attribution studies. The objective of this study was to evaluate Salmonella diversity from broiler carcass rinsates by two cultivation methods. Twenty-six broiler carcasses were removed immediately after defeathering on two separate occasions and a external carcass rinse procedure performed. The rinsate was evaluated using a pre-enrichment (1% buffered peptone water) followed by transfer into either Gram negative (GN) or tetrathionate (TET) broth then from each plating onto BGS and XLT4 plates. When available, 3 typical colonies were picked per plate for identification and serotyping. A total of 236 isolates were identified as Salmonella and serotyping was performed by the National Veterinary Services Laboratories. Overall, eight different serotypes were recovered (S. Kentucky (n=79), S. Berta (n=48), S. Kiambu (n=35), S. Mbandaka (n=33), S. Senftenburg (n=17), S. Heidelberg (n=14), S. Agona (n=8), and S. Enteritidis (n=1)) with four of the serotypes accounting for 83% of the isolates (S. Kentucky, 33.5%, S. Berta, 20.3%, S. Kiambu, 14.8%, and S. Mbandaka, 14.4%). One group B isolate was classified as 4, 5, 12.1. In both visits to the plant, S. Kentucky and S. Berta were the two prominent serotypes, however S. Kiambu was second most prevalent in visit 1, while S. Mbandaka was second most prevalent in visit 2. GN broth recovered significantly more S. Kentucky, while more S. Heidelberg and S. Senftenburg were isolated from TET. Significantly more S. Kentucky was recovered from XLT4 than BGS originating from TET broth. S. Kiamba was detected 15 times on XLT4, where it went undetected on BGS. Salmonella diversity on broiler carcasses was evident by examination of the carcass rinsate. The enrichment and plating media combinations along with number of colonies selected influenced the serotypes recovered and demonstrated the bias that may occur during cultivation of Salmonella.

Key Words: Salmonella, Salmonella serotype diversity, poultry, cultivation methods, broiler carcass

P191 Influence of feeding Mycofix® Select on table egg parameters and quality from hens fed mycotoxin-contaminated diets. K. Jessen1, J. Lee1, J. Coppedde1, L. Oden1, S. Pohl1, A. Klein1, V. Starkl2, R. Beltran2, and G. Schatzmayr2, 1Texas A & M University, College Station, 2Biomin GmbH, Herzogenburg, Austria.

An experiment was conducted to determine the effect of dietary inclusion of Mycofix® Select on discrete egg parameters and quality characteristics of hens fed mycotoxin-contaminated diets (aflatoxin (AFLA) and deoxynivalenol (DON)) during a 10 week trial. A 4 x 2 factorial design was utilized with 4 contamination levels: control, low (0.5 ppm AFLA + 1.0 ppm DON), medium (1.5 ppm AFLA + 1.5 ppm DON), and high (2.0 ppm AFLA + 2.0 ppm DON) with or without the inclusion of Mycofix® Select. Three hundred and eighty-four 25 week old laying hens were housed three per cage. Birds were fed contaminated diets for a six week phase of toxin administration followed by a four week recovery phase, when all birds were fed mycotoxin free diets. An interaction existed between Mycofix® Select inclusion and toxin level. An interaction existed between Mycofix® Select inclusion and level. An interaction existed between Mycofix® Select inclusion and toxin level with regard to specific gravity. Following the toxin phase, Mycofix® Select inclusion increased (P < 0.05) egg specific gravity in the control and low toxin groups while a decrease (P < 0.05) was observed at the high toxin level. These data indicate that mycotoxins present in feed can reduce egg quality, size, yolk weight and alter egg shape and that inclusion of a mycotoxin deactivating compound can ameliorate some of the negative effects of mycotoxin consumption.

Key Words: layer, mycotoxin, egg quality, aflatoxin, mycofix select

P192 Efficiency of xanthophyll and lutein deposition in the egg yolk from dietary pigments. S. E. Scheideler*1, P. Weber1, A. Yersin2, R. Snyder2, and T. Pham2, 1University of Nebraska, Dept. of Animal Science, Lincoln, 2Kemin AgriFoods, North America, West Des Moines, IA.

Four dietary sources of pigment (A, B, C, and D) were fed at 2 levels (3 or 6 lbs/ton to attain 40 or 80 mg/kg xanthophylls in the diet) in a 4 x 2 factorial arrangement of treatments. An additional negative control treatment with 0 added pigment was also included. Each treatment was fed to 5 replicate cages with young HyLine W-36 hens (4/cage) for 6 wks. Egg production and feed intake were measured daily, egg samples were collected weekly (1 day production) to determine egg wt and components (yolk, albumen and shell %). Two samples/pen were sent to Kemin labs for determination of egg yolk total xanthophylls, total lutein, trans-lutein and zeaxanthin (µg/g egg yolk) beginning at Wk 3-6. Two eggs/cage were also visually scored using the Roche and Kemin Color Fans Wk 3-6. Results of the study indicate no significant effects of dietary pigment on feed intake, egg production, egg wt or egg components. Roche and Kemin color scores indicated significant (P < 0.01) increases due to inclusion of pigments in the diet with Pigment A (80 mg/kg) and Pigment B (80 mg/kg) treatments having the highest scores. Total yolk xanthophyll, lutein and trans-lutein showed increases due to level of pigment supplementation, increasing with 80 mg/kg vs. 40 mg/kg. Contrasts comparisons showed Pigment A to be more efficient for total xanthophylls and lutein deposition compared to pigment C and D, Pigments A and B were not significantly different. Yolk trans-lutein levels were significantly greater in yolks from hens fed Pigment A vs. Pigment B, C and D in the diet. Zeaxanthin levels in the egg yolk were not significantly affected by the pigments tested. Analysis of conversion rate of feed xanthophylls to yolk xanthophylls show a conversion rate of 5.83, 5.84, 5.23 or 5.39 mg feed/mg in yolk for added pigments A, B, C or D; respectively at 40 mg/kg diet or 7.82, 8.63, 12.86 or 8.11 mg feed/mg in yolk for added pigments A, B, C, or D at 80 mg/kg diet. Efficiencies of deposition are better at the lower inclusion rates, but quantity of deposition increases at 80 mg/kg in the diet vs. 40 mg/kg in the diet.

Key Words: xanthophyll, lutein, pigments


Omega-3 fatty acids are essential nutrients for human health and the fortification of meat products with these fatty acids is an emerging practice to meet the demand for omega-3 enriched products. The partial replacement of animal fats with oils rich in omega-3 fatty acids would produce healthier meat products provided the color and textural properties are maintained. The present study was undertaken to evaluate the effect of incorporation of microencapsulated fish oil (MFO) and flax oil
on color and texture of chicken frankfurters. A total of 7 treatments on 4 storage days (0, 10, 20 and 30) were evaluated in this study. Chicken frankfurters for all the treatments were prepared with skin-on chicken thigh meat, mechanically separated chicken meat and chicken fat as the main ingredients. For test treatments, chicken fat was partially replaced with either flax oil or MFO at 1.2%, 2.4% and 3.6% of the batter. Three replicates of each batch were prepared in a pilot processing plant and the frankfurters were cooked to endpoint temperature of 74°C, vacuum packed and stored at 4°C for a month. Four samples from each treatment on each storage day were used to determine the textural profile and Warner Bratzler shear force using a texture analyzer. The color of these samples was measured using a Hunter colorimeter. Data was analyzed using the mixed model procedure with repeated measures for storage times. The results indicated that properties of the textural profile such as hardness, gumminess and chewiness were higher ($P \leq 0.05$) in chicken frankfurters formulated with 2.4% and 3.6% MFO compared to all levels of flax oil and the control for all storage days. The shear force (kg) was higher ($P > 0.05$) in frankfurters with 2.4% and 3.6% MFO (1.40±0.04, 1.37±0.04) than the control (1.10±0.04) for all storage times. The addition of oil to frankfurters did not affect ($P > 0.05$) lightness ($L^*$) whereas the redness ($a^*$) was higher ($P < 0.05$) in the treatment with 3.6% MFO (2.18±0.04) compared to control (1.90±0.04). This showed that the texture and color of chicken frankfurters can be influenced by the addition of microencapsulated fish oil.

Key Words: omega-3, chicken frankfurter, fish oil, texture, color

P195 Estimation of Allzyme® SSF metabolizable energy contribution to broiler diets. R. Tepper*, M. J. Schang2, R. Alvare2, V. de Basilio1, B. F. Iglesias4, and J. O. Azcona4, 1Alltech Venezuela SCS, Valencia, Venezuela, 2UCA, Ciudad Autónoma de Buenos Aires, Argentina, 3Universidade Central de Venezuela, Maracay, Venezuela, 4INTA, Pergamino, Buenos Aires, Argentina

A 42-day trial was designed to determine the energy yield from the solid state fermentation enzyme Allzyme® SSF (Alltech Inc.) in reformulated broiler diets that contained Allzyme® Vegpro (Alltech Inc.). A complete randomized experiment was conducted at the Poultry Research Lab at UCV Agronomic Faculty of Venezuela. A total of 800 Hubbard chickens (males and females) with 4 treatments and 8 replicates each (25 chickens/pen). Treatments 1 through 3 consisted of starter (1-28 d) and grower (29-42 d) corn-soy-based diets formulated to present increasing levels of metabolizable energy (ME) with the inclusion of Allzyme® Vegpro at 500 g/t. Starter and grower diets of Treatment 4 were similar to those of T2 with the addition of “on-top” Allzyme® SSF (200 g/t). Measurements included feed intake, final live weight and feed conversion ratio. Data were subject to ANOVA and regression analysis. Means were separated according to Tukey’s test. To estimate the energy yield of Allzyme® SSF, final weights corresponding to T1, T2 and T3 were plotted against ME intake data. There were no differences ($P > 0.05$) in feed intake between treatments. Differences ($P < 0.05$) were observed in final live weight and feed conversion. According to the estimated equation (ME = 702.72 + 0.1264 LW; $R^2=0.56$), the energy yield of SSF in T4 was 59 kcal/kg. In conclusion, increasing ME levels in the diets improved broiler performance. The estimated energy contribution of Allzyme® SSF when used in combination with Allzyme® Vegpro was 59 cal/g of ME.

Key Words: broiler, enzyme, metabolizable energy

P196 Effect of Allzyme® SSF on broiler performance: Variations in feed pelleting temperature. B. F. Iglesias*1, J. O. Azcona1, M. V. Carrièrem1, and M. J. Schang2, 1INTA, Pergamino, Buenos Aires, Argentina, 2UCA, Ciudad Autónoma de Buenos Aires, Argentina

An experiment was conducted to evaluate the effect of pelleting temperature on the efficacy of Allzyme® SSF (Alltech Inc.) in broiler diets. A total of 540 1-d-old male Cobb broiler chicks were allocated to 6 treatment groups with 6 replicates of 15 birds each per treatment. The experimental design was a factorial arrangement of 3 diets (control; basal + SSF; or basal without enzyme) and 2 pelleting temperatures (70 or 80°C). The treatments included corn-soy-based control diets formulated as per Cobb recommendations and basal diets that were isonutritive to the controls and reformulated based on 200 g/t Allzyme® SSF making a contribution of 75 kcal/kg ME, 0.2% CP, 0.029% lys, 0.011% met, 0.009% cystine, 0.004% trp, 0.014% thr, 0.024% iso, 0.022% arg, 0.1% Ca and 0.1% available P. Steam pressure and residence time of pelleting were 0.6 kg/cm2 and 30 sec, respectively. Pellet durability index (PDI) was determined as in Xing et al. (2004). The results were presented as

P194 Assessment of enzymes for use in poultry nutrition in the European Union. J. Galobart* and M. Anguita, European Food Safety Authority, Parma, Italy.

In the European Union (EU), feed additives need to undergo an authorization procedure as established in the Regulation (EC) No 1831/2003 in order to be placed on the market. The European Food Safety Authority (EFSA) is responsible of assessing the safety of feed additives for animals, humans and the environment as well as to evaluate its efficacy. Based on EFSA’s opinion, the European Commission will grant or deny the authorization of the product for its use in the EU market. Among the feed additives used in poultry nutrition, enzymes are of particular importance. While most of them are directed to improve the digestibility of non-starch polysaccharides, there is a growing interest for improving the nutritional value of the diet as well. Theftypeases (to increase the bioavailability of P and the reduction of P load on the environment). In the recent years, applications for the authorization of enzymes produced using genetically modified micro-organisms, have increased considerably. The assessment of an enzyme feed additive is based on the technical dossier prepared by applicants and focuses on: Identity and characterization of the additive. The product should be identified and characterized. If produced by a genetically modified micro-organism, the genetic modifications should be described to allow an assessment of the safety of the genetic modification. Possible risks associated to the production strains should be considered. Safety for: -the target animals, tolerance studies are required to demonstrate absence of adverse effects when fed to the target animals. -consumers of food derived from animals fed with the additive, is assessed by means of a set of genotoxicity studies and a subchronic repeated dose oral toxicity study. -users, it should be determined if the product is irritant to eyes/skin and whether it has a sensitization potential. -environment, normally no risk for the environment is envisaged, but attention should be paid to the presence of recombinant DNA in the final product. Efficacy, three trials should show that the product is effective according to the claim made.

Key Words: enzymes, poultry, safety, efficacy, assessment
a percentage of the initial sample retained by the screen. Because no interactions were observed, treatments were grouped by main effects (temperatures and diets). Irrespective of diet, broilers fed diets pelleted at 80 °C had lower feed intake \((P < 0.10)\), live weight \((P < 0.05)\) and live weight:conversion ratio \((P < 0.05)\). These results could be related to an increase in pellet hardness when processed at 80 °C compared with 70 °C (pellet durability index: 91 vs. 89, respectively) or to a decrease in starch and protein utilization. No differences in feed consumption were observed. Live weight of broilers fed SSF was similar to controls. Live weight of control broilers was higher \((P < 0.10)\) than that of birds fed diets without SSF. No differences in FCR were observed between control and SSF-containing diets; the basal diet without SSF had the worst ratio \((P < 0.05)\). No differences were observed between control and SSF diets for live weight:FCR, the basal diet without SSF had the worst FCR \((P < 0.05)\). In conclusion, broilers fed Allzyme® SSF at 200 g/t achieved performance levels similar to those fed the control. The pellet temperature of 80 °C negatively affected performance in all treatments.

**Key Words:** broiler, enzyme, pelleting, nutrition

**P197 Biometric analysis of small intestine of young pullets fed diets containing NuPro®**

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A two-week experiment was conducted to study the intestinal biometry of young table-egg Hixes Brown pullets fed diets formulated with NuPro® (Alltech Inc.), a yeast-derived source of protein, from 1 to 14 d of age. A total of 406 1-d-old pullets were allocated to two treatment groups: control or NuPro® (2% of diet). There were 203 birds per treatment. At 7 and 14 d of age, 16 birds per treatment were selected at random from the flock, euthanized by cervical dislocation and intestinal tract segments evaluated for weight and length. Data were analyzed using ANOVA \((P < 0.05)\). Formulation with NuPro® altered intestinal tract weight and length. Birds fed diets containing NuPro® had greater duodenum weight \((P = 0.04)\), duodenum length \((P = 0.029)\) and jejunum weight \((P = 0.002)\) at 7 d of age. Ileum weight and length were not affected at the end of the first week of life. At 14 d of age, the ileum weight \((P = 0.03)\), but not the remaining variables, was greater in the birds fed NuPro®. In conclusion, NuPro® in starter diets improved the intestinal development of young table-egg pullets.

**Key Words:** protein source, pullets

**P198 Effect of pelleting temperature and enzyme supplementation (Allzyme® SSF) on broiler performance.**

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A 28-day study was carried out in order to evaluate effects of pelleting temperature on the activity of an exogenous enzyme derived from solid state fermentation (Allzyme® SSF, Alltech Inc.). 900 Cobb male broilers were assigned to a factorial arrangement (5 diets and 2 pelleting temperatures) with 6 replicates of 15 birds each: T1- Control diet; T2- Basal diet + 200 g SSF/t of feed; T3- Basal diet + 250 g SSF/t; T4- Basal diet + 300g SSF/t and T5- Basal diet without SSF. Basal diets were isonitritive and formulations considered that 200 g SSF/t of feed provided 75 kcal/kg ME, 0.2% CP, 0.029% lys, 0.011% met, 0.009% cystine, 0.004% trp, 0.014% thr, 0.024% ile, 0.022% arg, 0.1% Ca and 0.1% available P. Corn-soy diets were pelleted at 75 and 90°C. Steam pressure and residence time of pelleting were 0.6 kg/cm2 and 30 sec, respectively. As no interactions were observed \((P > 0.05)\), only main effects were evaluated. The best performance was observed in birds fed diets pelleted at 75°C. The birds fed diets pelleted at 90°C had lower feed intake and live weight, regardless of SSF supplementation. No differences in intake were observed when 200 g SSF/t of feed was included. However, higher doses of SSF reduced feed intake. Body weight was similar in birds supplemented with SSF and controls. Increasing dosage of SSF reduced live weight, indicating that increasing enzyme inclusion does not necessarily improve performance. No differences were observed between treatments for feed conversion \((P > 0.05)\). It can be concluded that pelleting at 90°C negatively affected broiler performance. Also, SSF supplementation (200 g/t) resulted in similar performance compared to birds fed a control diet.

**Key Words:** broiler, enzyme, FCR

**P199 Effects of mannan oligosaccharide (Bio-Mos®) and chloro-hydroxyquinoline in diets fed to laying hens.**


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A total of 550 Bovans White pullets were allotted to 11 treatment groups in a 3 x 3 factorial structure: 3 levels of CHQ 98% (20 ppm, 30 ppm and 40 ppm), 3 levels of Bio-Mos® (BMOS, 0.5, 1.0 and 1.5 kg/t) and 2 negative controls (CHQ 30 ppm and BMOS 1.0 kg/t). There were 5 replicates of 10 hens per treatment. Hens were fed a corn/soy-based diet ad libitum formulated to meet genetic line requirements. The hens were evaluated from 17 to 46 wk of age. Egg production was measured daily; feed consumption was estimated every 14 d. Egg quality was evaluated every 4 wks once egg production reached 50% and was based on eggs laid on 3 consecutive days. Intestinal characteristics were determined at 36 and 46 wk of age. Data were subjected to ANOVA, contrast and polynomial regression. No effects \((P > 0.05)\) were observed on egg production, egg weight, FCR based on production, yolk, albumen and egg shell relative weight (%), or egg specific gravity. Feed consumption was highest for the BMOS negative control. Shell thickness improved when 40 ppm of CHQ was included with increasing levels of BMOS. Regression analysis indicated that 0.725 kg/t BMOS provided optimum conversion of feed to egg mass. No effects \((P > 0.05)\) were observed on egg quality, intestinal, gizzard, pancreas and liver weights or in the intestinal length at 36 and 46 wks. However, intestinal surface at 36 wks showed lower crypt depth and higher villi:crypt ratio in duodenum and ileum portions in birds given 1.5 kg/t BMOS and 40 ppm of CHQ. In conclusion, higher levels of CHQ and BMOS improved shell thickness and intestinal characteristics; while inclusion of BMOS at levels lower than 1.0 kg/t improved efficiency of feed conversion to egg mass.

**Key Words:** mannanoligosaccharide, chloro-hydroxyquinoline, layer, egg quality, villus

**P200 Effects of mannan oligosaccharide and/or an antibiotic growth promoter on performance, pathology, bacterial colonization, and histology in broilers challenged with Salmonella enteritidis.**

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Two hundred 1-d-old broilers were distributed into 5 treatments, with 3 replicates each. Birds were fed the treatment diets for 20 d (100 birds)

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or 40 d (100 birds). Treatments were as follows: T1: Positive control (birds challenged with Salmonella enteritidis (SE); T2: Challenged birds supplemented with Bio-Mos® (1 g/kg of feed); T3: Challenged birds with Bio-Mos® + AGP (Zn bacitracin, 2.2 mg of active component/kg of feed); T4: Challenged birds with AGP (Zn bacitracin, 2.2 mg of active component/kg of feed); T5: Negative control. Challenged birds were orally inoculated with 4 x 10^9 CFU/mL of SE at 5 and 14 d after hatching. Microbiologic, pathologic, and histologic parameters were evaluated. Cecal contents were sampled weekly for microbiologic analyses. Liver, spleen, bone, small intestine and bursa samples were collected for histologic determinations (1 bird/group/treatment/wk = 8 birds/wk). Feed conversion averaged 1.278, body weight averaged 762.5 g (after 20 d) in the birds from T3 with a production cost of USD 0.3676 per bird. Bio-Mos® promoted an increase in the concentrations of lactic acid bacteria. The presence of SE was evident in all treatments in the first day post-inoculation, except for T2 and T3, where a significant increase of SE and Escherichia coli isolated in culture was observed at d 10. Birds from T2 and T3 had fewer pathologic characteristics, including better integrity of intestinal mucous membrane and recovery of crypts (P < 0.05). Birds from T2 and T3 showed significantly better histologic characteristics (P < 0.05), including lower crypt depth at 20 and 40 days. In conclusion, the addition of Bio-Mos® to the diet, alone or with AGP, protects broiler intestinal integrity and speeds the recovery of intestinal crypts.

Key Words: Salmonella, broiler, histology, intestine

P201 Effects of exogenous enzymes (Allzyme® SSF and Allzyme Vegpro®TM) on performance of semi-heavy layers at peak production.

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A completely randomized experimental design with 5 treatments and 7 replicates (8 birds each) was used to evaluate response of layers to added enzymes. Treatments were: positive control (PC); negative control – reformulated (-50 kcal) (PC with 5% reduction in ME, CP and Met and Cys); 2 reformulated diets (R-50 and R-75, -50 kcal and -75 kcal, respectively) with Allzyme® (AZ) SSF at 150 g/t and Allzyme® Vegpro®TM at 400 g/t; and a PC with AZ VegproTM and AZ SSF added “on top” (OT). Performance and egg quality data were analyzed using covariance analysis with initial body weight as covariate. Adjusted means were compared using Tukey’s test. Gross margin of each treatment was calculated by the difference between gross income and cost of feed. The R-75 diet resulted in higher feed intake. The OT treatment resulted in an average increase in production of 13.8 percentage points compared with the other treatments. Birds fed positive control and OT treatments had better (P < 0.05) feed conversion by mass compared with the R-50 diet. The OT treatment promoted higher (P < 0.05) egg mass production compared with the negative control, R-50 and R-75 diets. FCR (per dozen eggs) for the OT treatment was similar to that observed in the positive control. Albumen and shell weights were lower (P < 0.05) for the OT treatment compared PC, however there were no differences between controls and reformulated diets. Yolk pigmentation was lower (P < 0.05) for the PC compared with R-50 and R-75 diets. The highest profit was obtained with the OT treatment, probably due to more efficient use of feed ingredients. A higher cost of feed per dozen eggs was observed in birds fed the PC, indicating lower nutrient availability. The R-75 diet resulted in higher cost per kg of eggs produced, similar to R-50, whereas the PC diet resulted in a lower cost. In conclusion, Allzyme® Vegpro and SSF on top of diets fed to semi-heavy layers at peak production promoted improved performance, egg quality similar to that from unsupplemented diets, and better gross margin.

Key Words: layers, enzymes, egg quality, feed efficiency

P202 High dietary inclusion of dried distillers grains with solubles in laying hen rations in combination with Alzyme®SSF enzyme (Phase II). M. K. Masa’deh* and S. E. Scheideler, University of Nebraska, Lincoln.

A study was conducted to test the effects of feeding high levels of Dried Distillers Grains with Solubles (DDGS) in combination with Alzyme®SSF enzyme on Phase II of egg production. Two hundred forty Hy-Line W-36 hens were fed from 44 to 64 weeks of age. Hens were fed diets containing 5 levels of DDGS (0, 10, 20, 30 or 40%) and two levels of Alzyme®SSF (0, 0.02%) having activities of Phytase, Protease, Pentosanase, Pectinase, Cellulase, Beta-Glucanase, and Amylase in a 5X2 factorial design. Diets were formulated to provide 2850 Kcal/kg ME, 16.75% protein, 0.88% lysine and 0.44% methionine; while diets containing 0.02% enzyme, were formulated to provide 2775 Kcal/kg ME, and the same level of protein and amino acids. The Alzyme®SSF enzyme treatments were substituted with 75 Kcal/kg ME, 0.1% calcium and 0.1% phosphorus for the enzyme value. Six replicate cages (4 hens/cage) were assigned per treatment in a randomized complete block design. DDGS by enzyme interactions were not significantly different (P > 0.05) for feed intake, hen weight and egg parameters. Average feed intake was similar (P > 0.05) between treatments with an average of 102 g/hen/d. Average hen weights were similar (P > 0.1) between dietary treatments. Average hen day egg production was not affected by dietary treatments (P > 0.05), as well as Egg wt. (P > 0.05). However, hens fed 40% DDGS had lower egg mass (P < 0.1) compared to 0, or 10% DDGS. There was no difference (P > 0.1) in egg Haugh unit, and specific gravity between treatments. Yolk color increased with increasing DDGS level with the highest Roche color fan score (P < 0.05) of 7.8 for hens fed 40% DDGS. In summary, feeding up to 30% DDGS with or without enzyme treatment during Phase II of production had no negative effects on feed intake, egg production, egg weight, haugh unit and specific gravity. Feeding Alzyme®SSF enzyme had an economical benefit of $14.5/ton and feeding 30% DDGS had a benefit of $59/ton of feed compared to the basal diet (0% DDGS) based on December, 2008 prices.

Key Words: dried distillers grains with solubles, DDGS, Hy-line W-36, Alzyme®SSF, laying hen

P203 Broiler breeder feeding programs and trace minerals on maternal antibody transfer and broiler humoral immune response.

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Specific feeding programs during breeder rearing and trace minerals (TM) in breeder production diets could affect broiler performance. This study evaluated the effects of breeder feeding programs and dietary TM sources on maternal antibody transfer, and humoral immune response to Newcastle disease virus (NDV) vaccine in progeny. Cobb 500 breeders were fed according to 2 feed allocation programs, sigmoid late fast (LF)
and sigmoid late slow (LS) until peak of production. From 56 to 62 wks of age, breeders were fed corn-soybean diets and 5% DDGS with either inorganic TM or an organic source (Mintrex® P) to replace 30% of Cu, Zn and Mn. Total dietary levels of the TM evaluated were 25, 125 and 255 ppm, respectively. Seven blood samples/treatment were collected from the progeny at hatching. Thirty six chicks/treatment were identified with neck tags to track hen effects, and placed in two isolation rooms, each with 6 floor pens. Three broilers/treatment were placed in each pen for 12 broilers/pen total. Broilers in one room were vaccinated by eye-drop with La Sota NDV vaccine at 8 d of age. Maternal antibody transfer data was analyzed as a 2x2 factorial design considering feeding programs and TM sources as main factors. At 14 d after vaccination (21 d of age) blood samples were collected and serum antibody levels against NDV were measured by ELISA. Post-vaccination data analyses included the vaccination factor in a 2x2x2 factorial design. At hatching, LS breeder progeny fed diets with 30% organic TM had higher (P<0.05) antibody titers as compared to progeny of breeders fed only inorganic TM. Similar results were observed 2 wks post vaccination; however, broilers from LF breeders fed diets with organic TM showed the lowest antibody titers (P<0.05). It was concluded that breeder feeding programs influence maternal antibody transfer, humoral immune response to NDV vaccine in the broiler progeny, and organic TM sources may influence these responses.

Key Words: organic trace minerals, maternal antibodies, immunity, broilers

P204  Broiler chick starter diets varying in amino acid density. L. C. G. S. Barbosa*, A. Corzo1, S. L. Branton2, and M. T. Kidd3
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This experiment assessed starter amino acid density from placement to d 14. Ross 308 male and female broilers were randomized in floor pens at 1 post hatch (15 pens each containing 50 birds). Three dietary treatments were implemented from 1 to 14 d of age (5 replicates of 250 total birds). Chicks fed treatment 1 received a common starter diet from d 1 to 14. The diet contained 1.18% digestible Lys and 22.2% CP. Chicks fed treatment 2 were fed decreasing graduations of amino acid density from d 1 to 7 and then the common starter (treatment 1) from d 8 to 14. The d 1 diet contained 1.40% digestible Lys and 28.5% CP. This diet was blended with a diet containing 1.24% digestible Lys and 23.5% CP to derive percentage CP levels of 28.5, 27.5, 26.5, 25.5, 24.5 and 23.5% from d 1 to 7, respectively. Chicks fed treatment 3 were also fed graduations but from d 1 to 14. Hence, the same decreasing graduations from treatment 2 were fed in treatment 3, but were allotted for 2 rather than d 1. Thus, treatment 3 finished at d 14 with the lowest titration level (23.5% CP) and birds did not receive the 22.2% CP control. Common feed was fed from d 15 to 30 and 31 to 40d of age. All diets contained 3,100 kcal/kg of ME. Live performance and processing measurements (3 birds per sex per pen at d 40) were obtained. Differences (P<0.05) in live performance and processing measurements among treatments did not occur. Future work of differing experimental designs is warranted to determine any potential benefits from feeding chicks high amino acid density diets on subsequent performance and carcass yields.

Key Words: chick, broiler, amino acid, crude protein


Studies showed that supplementing 250 mg/kg Cu as sulfate in broiler diets adversely affects retention of P when diets are supplemented with phytase. Two trials were designed to investigate the effects of supplementing 250 mg/kg Cu as sulfate or Cu proteinate (Bioplex® Cu, Alltech Inc.) on the efficacy of enzymatic feed supplements with phytase activity in chicks. In trial 1, chicks were fed a corn-soy low P diet with supplementation of Allzyme SSF® alone or with 250 mg/kg Cu as sulfate or Bioplex® Cu. Seven replicate pens of 22 chicks were randomly assigned to each of four dietary treatments. Chicks were raised in floor pens for 6 wks. Allzyme SSF® improved (P<0.01) performance of chicks. The growth rate of chicks given both Allzyme SSF® and 250 mg/kg Cu as sulfate was lower (P<0.01) than that of chicks given Allzyme SSF® alone. In trial 2, chicks were fed a corn-soy low P diet with pure phytase from fungal source added alone or with 125 or 250 mg/kg Cu as sulfate or 250 mg/kg Cu as Bioplex® Cu. Eight replicate cages of six chicks were randomly assigned to each of five dietary treatments. Chicks were housed in starter cages for 3 wks. At the end of trial, fecal samples were collected for the assay of P retention using Cr₂O₃ as a marker. Phytase improved (P<0.01) performance and P retention. Chicks fed diets with 250 mg/kg Cu in either form had lower (P<0.01) feed intake and weight gain compared with chicks fed phytase alone or plus 125 mg/kg Cu as sulfate. The P retention rate from chicks given 250 mg/kg Cu as sulfate was lower (P<0.01) than that from chicks supplemented with phytase plus125 mg/kg Cu as sulfate. The results from these trials suggest that supplementing high levels (250 mg/kg) of Cu as sulfate in broiler diets containing phytase had detrimental effect on the efficacy of phytase, which could be overcome by using Cu proteinate.

Key Words: Cu sulfate, Cu proteinate, broiler, phytase, P retention


Cobb 500 breeders received a control diet (containing poultry fat as oil source) or diets formulated with corn, soybean, or fish oil. Diets were formulated to be isocaloric. Ninety six breeders were housed in a floor pen facility with 32 pens (8 replications/treatment). Progeny were obtained from eggs set at 30 (study 1) and 38 wk (study 2). A total of 384 chicks were placed into 32 pens (4 treatments, 8 replications, and 12 birds/replication) of an open-sided floor pen facility. Chicks were placed as straight-run. Chicks had access to water ad libitum and to industry standard diets that were crumbled from 1 to 14 and pellets from 15 to 46 d. Thus, the dietary treatments of the broiler breeder flock represented the progeny treatments. Live performance parameters (BW gain and feed conversion ratio) were measured from 1 to 14 and 46 to 46 d. On d 46, 6 birds per pen (3 male and 3 female), were selected randomly and processed, and carcass characteristics were evaluated. Breeder pen was the experimental unit for the progeny design. All data were analyzed by the general linear models procedure of SAS software. In study 1, birds
from breeders fed fish oil showed lower weight at hatch ($P < 0.01$). Furthermore, birds from breeders fed soybean oil demonstrated higher BW at d 14 ($P < 0.01$) and d 46 ($P < 0.01$), and better feed conversion at d 14 than birds from breeders fed fish oil ($P = 0.005$). In contrast, soybean oil resulted in higher carcass yield than fish oil ($P < 0.02$). However, fish oil showed lower abdominal fat than corn oil ($P < 0.01$).

In study 2, BW was lower in chicks from breeders fed fish oil at hatch and d 46 ($P < 0.01$). At d 14, inclusion of soybean oil and corn oil had better effect on BW ($P = 0.014$) and feed conversion ($P = 0.024$) when compared to fish oil, respectively. Soybean oil and fish oil increased ($P < 0.01$) and decreased ($P < 0.02$) carcass yields and percentage fat, respectively. The use of different oil sources in broiler breeder diets can affect growth and carcass characteristics of progeny.

**Key Words:** corn oil, fish oil, poultry oil, soybean oil, progeny

**P207** Palm kernel cake and cassava grit supplemented with β-mannanase enzyme improved performance of broilers. O. A. Abu, O. A. Ogunwole, A. B. Omojola*, and O. O. Tewe, University of Ibadan, Ibadan, Oyo State, Nigeria.

 Provision of balanced and adequate feed at a reasonable cost is one of the major constraints to the expansion of the poultry industry in Nigeria. Apart from the high and fluctuating costs, some of the feed ingredients notably maize are in high demand for human consumption and this competition has exacerbated the food-feed situation. Palm kernel cake and cassava are likely feed ingredients that can replace maize in the diets of commercial broilers. A preliminary feeding investigation involving the replacement of maize with palm kernel cake and cassava grit was conducted for eight weeks at the Teaching and Research Farm, University of Ibadan, Nigeria. One hundred and forty-four day-old broiler chicks of Arbor acre strain were randomly allotted to four dietary treatments of 24 birds per treatment in a Completely Randomized Design. Each treatment had three replicates of eight birds per replicate. Diet I (Control) contained 50% maize and diet II contained 25% cassava grit + 25% palm kernel cake that were incorporated at the expense of maize in Diet I. Diet III and IV were similar to diets I and II respectively except that they were supplemented with 0.05% β-mannanase from a commercial origin. Other ingredients were common to all the four diets. Data were analyzed using ANOVA and Duncan Multiple Range Test where significant differences existed. Feed intake, feed conversion ratio and protein efficiency ratio were not significantly ($P > 0.05$) different among dietary treatments. Birds on diet IV had the highest average final body weight of 2.14 kg, daily weight (g/day) of 43.36 and Broiler Productive Index of 45.9. A complete replacement of maize with cassava grit and palm kernel cake each at 25% inclusion and supplemented with β-mannanase in broiler diets was achieved without compromising performance.

**Key Words:** palm kernel cake, cassava grit, body weight changes, productivity index, broiler

**P208** The effect of protease inclusion in corn-soy diets on performance and protein and amino acid digestibility in 7 to 22-Day-old broiler chicks. R. Angel*, W. Saylor, and N. Ward, University of Maryland, College Park, 2University of Delaware, Newark, 3DSM Nutritional Products, Inc., Parsippany, NJ.

A trial was done to determine the impact of a commercial protease (Ronozyme®R® ProAct, DSM) in corn-soy diets fed to Ross 708 broilers. Diets (corn-soy based) were fed from 7 to 22 d of age: a positive control (PC) diet containing 22.5% protein and meeting NRC (1994) recommendations; a low protein (NC) diet (20.5%) and with amino acids (AA) reduced to the same extent as the protein but formulated with only three synthetic AA (L-Lys, DL-Met, L-Thr); NC diet with protease added at 100, 200, 400, and 800 ppm (7,500, 15,000, 30,000, 60,000 units protease/kg, respectively), resulting in 6 diet treatments (Trt). Each Trt was fed to 7 pens of 5 birds each. At 22 d of age, BW and FC were determined and ileal contents removed for apparent protein and AA digestibility determination. Upon diet analysis, protein and AA were similar to formulated and protease levels were close to formulated except for the diet containing 60,000 units/kg that analyzed at 78,842 units protease/kg. BW (22 d) was similar for all Trt except for the NC that was lower ($P < 0.05$). Feed to gain (FE) was impaired ($P<0.05$) when the NC vs. PC diets was fed (1.58 and 1.48, respectively) but improved ($P < 0.05$) when 400 and 800 ppm (1.50 for both) were added to the NC diet. Ileal protein digestibility was lowest ($P < 0.05$) in the PC and NC (75.6 and 77.9%) and was improved ($P < 0.05$) in all diets containing the protease (82.6, 82.6, 82.7, 83.0 for the NC diet containing 100, 200, 400, and 800 ppm protease, respectively). Lys, Met, Arg, Iso, Cys, Val, Ser and Thr ileal digestibilities were improved ($P < 0.05$) when protease was added vs. both the PC and NC Trt. Thr digestibility was 74.2, 75.9, 82.2, 83.3, 83.9 and 83.7 in the PC, NC, and NC plus 100, 200, 400, and 800 PPM protease Trt, respectively. This was a 9.7% improvement when comparing the NC plus 200 ppm protease Trt with the NC Trt. Similarly, Lys and Met digestibilities were improved by 5.5 and 5.8% when the same two diets were compared. Use of a protease improved AA digestibility and would allow for diet protein and AA reductions.

**Key Words:** protease, broilers, amino acid, digestibility


Phytate phosphorus (PP) level and variance in feedstuffs is a concern as phytic acid (PA) has not been a routine quality control measurement in feed ingredient screening. In addition, literature values on PP or PA can reflect data that is 10 or more years old. Thus, this project collected harvest 2008 corn (n = 39), soybean meal (n = 19), corn DDGS (n = 39).
Limited information is available in the scientific literature on phosphorus (P), phytic acid (PA) and phytate phosphorus (PP) levels in corn sourced from two different countries within the same harvest year. The present work compared total P and PA levels in harvest 2008 corn sourced from the US (n = 39) and Brazil (n = 15 from the main harvest). Phytic acid was analyzed via the precipitation method of Ellis et al., 1977. Phosphorus was analyzed by ICP (AOAC 965.17/985.01 modified). Phytic acid was analyzed via the precipitation method of Ellis et al., 1977. Phosphorus and Ca were analyzed by ICP (AOAC 965.17/985.01). Phytic acid was analyzed via the precipitation method of Ellis et al., 1977.

In a tunnel ventilated poultry house, 1512 day-old broiler chickens were randomly assigned to 24 pens (n = 63 birds/pen). Commercial feed without antibiotics or coccidiostats meeting or exceeding the NRC requirements was used during the whole experimental period (35 days). Three groups were randomly assigned to the pens. Control group, plain feed; Zinc Bacitracin (ZB) group, feed plus ZB 125g/ton throughout the experiment; multi-species probiotic PoultryStar® sol (PS) 20 mg/bird in the drinking water on days 1, 2, 3, 7, 8, 9, 21, 22, and 23. Three diets were used during the whole period: mashed starter (from days 1 to 7), pelleted grower (from days 8 to 21) and pelleted finisher (from days 22 to 35). After each feeding period was concluded all remaining feed was removed from the trays and discarded to accentuate the intestinal stress of a feed change. One-way ANOVA was used to analyze the data. R = range

Key Words: phytic acid, phytate phosphorus, phosphorus, calcium, feedstuff

P211 Probiotics as an alternative to growth promoters in broiler diets. A. G. Lorenzoni1*, M. Mohnl1, T. Steiner1, R. Nichol1, and R. M. Gous2, 1Danisco Animal Nutrition, St. Louis, MO, 2Danisco Animal Nutrition, Cotia, Brazil.

In conclusion, the use of PoultryStar® sol is a good alternative to produce antibiotic-free birds in countries that pay premium prices for “green products” or in countries where the use of antibiotics as growth promoters is forbidden.
P212 Effect of enzyme supplementation (Avizyme® 1502) on nutrient digestibility in broiler chickens fed a low energy and low protein corn/soy diet. X. H. Hu1, K. Y. Zhang*1, A. Péron2, and Y. J. Ru3, 1Institute of Animal Nutrition, Sichuan Agricultural University, Sichuan, China, 2Danisco Animal Nutrition, Marlborough, United Kingdom, 3Danisco Animal Nutrition, Singapore.

An experiment was performed in order to determine the effects of Avizyme® 1502 and two competitor products (A and B), on the digestibility coefficients of 21 day-old broilers fed a low energy and low protein corn/soy diet. 192 day-old broiler chicks were randomly allocated to 4 dietary treatments, with 8 replicates pens (6 birds/pens) per treatment. The control treatment was a corn/soy-based diet containing low levels of rapeseed meal, cottonseed meal and wheat bran. It contained 2750 kcal ME/kg and 18.6% crude protein. This control was either supplemented with Avizyme® 1502 (500 g/tonne of feed), a combination of amylase, protease and xylanase, or with one of the two other competitor products (included according to the manufacturers recommendation). Avizyme® 1502 supplied a guaranteed minimum of 300 U xylanase, 400 U amylase and 4000 U protease/kg diet. Competitor A contained xylanase and beta-glucanase activities. Competitor B contained beta-mannanase activity. All diets were formulated using 0.4% chromic oxide as an indigestible marker, and were fed as mash. At 21 days, all birds were sacrificed by cervical dislocation. Contents of the distal ileum were collected, pooled per pen, and analyzed in order to determine apparent ileal digestibility coefficients of dry matter (DM), crude protein (CP) and fat, and to calculate ileal digestible energy (IDE). Results showed that, compared to the control treatment, Avizyme® 1502 improved (P < 0.05) the apparent digestibility of DM and CP by 1.7% and 4.4%, respectively. As a consequence, IDE was improved (P < 0.05) by 5.7% over the control diet. There was no significant difference (P > 0.05) in fat digestibility among treatments. In comparison with the control treatment, competitor enzymes A and B also improved (P < 0.05) DM and CP digestibility, as well as IDE. However, the magnitude of response was lower (P < 0.05) than when Avizyme® 1502 was added.

Key Words: enzyme, broiler, amylase, protease, xylanase

P213 Fiber composition and crude protein content in 20 corn-DDGS samples from China. X. X. Wen1, F. D. Li1, F. D. Li1, A. Péron2, and Y. J. Ru3, 1Gansu Agricultural University, Lanzhou, China, 2Danisco Animal Nutrition, Marlborough, United Kingdom, 3Danisco Animal Nutrition, Singapore.

It is well known that corn distiller’s dried grains with solubles (DDGS) from the United States is a highly variable ingredient in terms of crude protein, amino acid and metabolizable energy. However, few reports have described the variability of DDGS originating from China. To address this, the dry matter (DM), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF) and hemicellulose content of 20 corn-DDGS samples originating from China were analyzed. 200 g of each DDGS sample was milled through a 0.2 mm sieve. The DM content of samples was then determined by drying ground samples in an oven at 105°C for 12 hours. The fibre composition (NDF, ADF, and hemicellulose) was determined following the method described by Van Soest et al. (1991) and the crude protein (CP) content assayed according to Kjeldahl’s method. Like samples from the US, the 20 corn-DDGS from China exhibited a large range of variation in their composition (Table). CP and ADF contents were higher than the values generally reported for North American samples, whereas NDF contents were within the range of variation usually observed (Spiehs et al., 2002, J. Anim. Sci. 80:2639–2645; Stein, 2007, Swine Focus #001, University of Illinois; Widyaratne and Zijlstra, 2007, Can. J. Anim. Sci. 87:103–114).

Composition of 20 corn-DDGS samples from China (DM basis)

<table>
<thead>
<tr>
<th></th>
<th>CP (%)</th>
<th>ADF (%)</th>
<th>NDF (%)</th>
<th>Hemicellulose (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>33.9</td>
<td>19.8</td>
<td>31.8</td>
<td>12.0</td>
</tr>
<tr>
<td>CV</td>
<td>8.7</td>
<td>19.6</td>
<td>21.4</td>
<td>39.4</td>
</tr>
<tr>
<td>Range of variation</td>
<td>29.4 - 38.1</td>
<td>14.6 - 28.0</td>
<td>24.4 - 49.8</td>
<td>7.3 - 21.9</td>
</tr>
</tbody>
</table>

Key Words: corn, DDGS, NDF, ADF, hemicellulose

P214 Evaluation of different nutritional programs associated to exogenous enzyme supplementation on broiler diets. M. B. Cafa*1, J. H. Stringhini1, B. D. A. Fortes1, J. A. G. Brito2, P. L. P. Rezende1, and R. D. Silva1, 1Universidade Federal de Goias, Goiânia, GO, Brazil, 2Universidade Federal de Lavras, Lavras, MG, Brazil.

An experiment was conducted to evaluate the effect of different nutritional program associated to enzyme supplementation on performance and carcass characteristics. A total of 2,016 male broiler chicks of the Cobb-500 strain were allotted in third two pens of 2.10m X 2.50m. The experimental design used was a completely randomized with four treatments and eight replicates of sixty three birds each. The treatments were designed as follows: T1) nutritional program of Cobb-500 recommendations; T2) T1 nutritional program with reduction of 4% of metabolizable energy (AMEn) value, 3% of crude protein and 10% of all amino acids; T3) T1 nutritional program with 200g/T of carbohydrases and 50g/T of phytase and T4) T2 nutritional program with 200g/T of carbohydrases and 50g/T of phytase. All diets were based on corn and soybean meal. At 42 days, the performance characteristics (weight gain, feed consumption and feed conversion) were evaluated and two birds from each pen were slaughtered for determination of carcass yield, cuts and abdominal fat. The results showed no statistical (P > 0.05) difference in feed conversion ratio for all treatments in period of 1 to 42 days of age. Considering feed consumption and weight gain, treatments T3 and T4, in which enzyme supplementation was provided, showed better feed intake (increase of 5.4%) as compared with treatments T1 and T2, with no enzyme supplementation. The weight gain results followed the same pattern of feed consumption (increase of 6.7% on weight gain). There was no significant effect of the enzyme supplementation on characteristic carcass and cuts yield. In conclusion, the use of mix of carbohydrases and phytase enzymes was effective to increase the AMEn value of diets, as well as broilers performance.

Key Words: performance, enzymatic complex, carbohydrase, phytase, nutrition
P215 Effect of different supplementation levels of enzyme Alfa-amylose on broiler performance on 24 to 45 days of age. J. C. C. Carvalho2, B. D. A. Fortes4, A. G. Bertechini2, R. L. Rios2, M. B. Cae6, and J. H. Stringhini1, 1Universidade Federal de Goias, Goiania, GO, Brazil, 2Universidade Federal de Lavras, Lavras, MG, Brazil.

This work aimed to evaluate performance and carcass characteristics of broiler chickens from 24 to 45 days of age, fed with diets formulated with different levels of Alfa-amylose enzyme supplementation. A completely randomized experimental design was used. A total of 900 24 day-old male Cobb broiler chicks were distributed into the experimental pens. The diets were iso-nutrient, except for the levels of enzyme supplementation that was formulated with six different combination levels: T1) Diet without enzyme supplementation; T2) Diet formulated without supplementation and with a 6.78% decrease of Energy (AMEn) value; T3) Diet with supplementation of 250 g/T of Alfa-amylose; T4) Diet with supplementation of 500 g/T of Alfa-amylose; T5) Diet with supplementation of 750 g/T of Alfa-amylose and T6) Diet with supplementation of 1,000 g/T of Alfa-amylose. Each experimental diet was supplied to 30 birds in each one of the six replicates. At 45 days, performance characteristics (weight gain, feed consumption and feed conversion) were evaluated, and two birds from each pen were slaughtered for determination of carcass yield, cuts and abdominal fat. The performance results of the 45 day-old birds showed that the worst performance was observed in T1 without enzyme supplementation, results that were very similar to T2 with energy reduction. Treatment T6 with 1000g/T enzyme supplementation showed the best benefit to the birds with a 7.2% increase in weight gain. For carcass characteristics, treatment T6 showed more fat accumulation than the other treatments. In conclusion, the use of Alfa-amylose enzyme was effective to increase boilers performance.

Key Words: performance, enzymatic complex, α-amylose, nutrition, broiler

P216 Strain and lysine level I: Performance of 14 strains of brown and white egg layers as influenced by lysine. M. M. Bryant* and D. A. Roland, Auburn University, Auburn, AL.

This study was conducted to compare the performance of 14 strains of layers (7 strains of white egg layers and 7 strains of brown egg layers) fed three protein (lysine) levels. The trial utilized 2,520 laying hens with 180 hens from each strain. Each strain was divided into groups of 15 hens (6 replications) and fed one of three lysine levels (0.917%, 0.828% and 0.747%). The hens were 21 weeks old at the beginning of the study and the trial lasted 16 weeks. Criteria used to evaluate performance were egg production, egg weight, feed consumption, egg specific gravity, egg composition, egg solids, Haugh units and hen mortality. Data were also subjected to econometric analysis for profits. Without exception every strain fed the two lower lysine levels had reduced performance. The difference in production began to appear by week 23 and the average production of all strains on week 36 was 92.7%, 91.9% and 89.8% for hens fed the 0.917%, 0.828% and 0.747% lysine diets respectively. A highly significant difference in egg weight and feed consumption occurred within one week. As lysine levels increased egg weights increased and feed consumption decreased. The average egg weight of all strains at week 36 was 59.8g, 58.9g and 58.3g respectively and feed consumption was 119, 120 and 121 g/hen/day respectively. There were significant differences between strains in all criteria measured. Brown egg laying strains had higher egg production, feed consumption and egg weights than white egg laying strains. White eggs had higher percent yolk and more egg solids than brown eggs. Brown egg layer egg production was not affected by lysine until the last week of the trial when hens fed the 0.747% lysine feed produced fewer eggs than hens fed 0.917% or 0.828% lysine. At current egg and feed prices the hens fed the highest level of lysine yielded the highest profit and brown egg laying strains produced higher profits than white egg laying strains even though white egg layers had better feed efficiencies. Optimal lysine levels for maximum profits will change as feed and egg prices change.

Key Words: lysine, layer, strain

P217 Strain and lysine level II: Response time in performance of 14 strains of brown and white egg layers to changing levels of lysine. M. M. Bryant* and D. A. Roland, Auburn University, Auburn, AL.

Using lysine levels to control egg production could be an effective method of controlling egg supply. A study was conducted to compare the performance of 14 strains of layers (7 strains of white egg layers and 7 strains of brown egg layers) fed three protein (lysine) levels. The trial utilized 2,520 laying hens with 180 hens from each strain. Each strain was divided into groups of 15 hens (6 replications) and fed one of three lysine levels (0.917%, 0.828% and 0.747%). Diets were fed from the time hens were 21 weeks old until they were 36 weeks old. At the end of week 36 all hens were fed the middle lysine level (0.828%) diet for three weeks. During this three week period egg production and egg weights were recorded weekly. Feed consumption was measured the third week. At the end of three weeks the hens were fed the three original diets with increasing levels of lysine. Egg weights, egg production and feed consumption were measured weekly. Within one week of being fed different lysine levels performance was affected. Hens fed the lower lysine levels had reduced performance. When all of the hens were fed the same diet (0.828% lysine) for one week the differences in egg weights due to lysine disappeared and by two weeks there were no longer differences in egg production. There was no difference in feed consumption during the third week of being fed the same feed. After one week of being fed the original three diets again there was a linear increase in egg weights as lysine increased (62.61 g, 62.78 g and 63.37g respectively). There was a linear decrease in egg production of white egg layers as lysine decreased by the third week. The results indicate that hens respond to changes in lysine with egg weights and by two weeks there were no longer differences in egg production. There was no difference in feed consumption during the third week of being fed the same feed.

Key Words: lysine, layer, strain


A meta-analysis of results of broiler chicken pen trials plus a few commercial trials (2001-2009) from several countries was done to demonstrate effects of the dietary enzyme complex Allzyme® SSF (+SSF treatment, Alltech Inc.) vs. no supplement (negative control; nCON treatment) on live performance. According to the manufacturer, the SSF added to feed at the recommended dose (0.02% or 200 g/t) releases about 75 kcal ME/kg (34 kcal ME/lb), 0.1% calcium, and 0.1% available phosphorus, as well as 1% of the amino acids. Data from 31 references containing 60 comparisons of the 2 treatments for body weight or weight
gain and feed conversion ratio or feed/gain were used. Final ages or ages during the feeding trials in days were compiled. An estimate of average age was calculated using the final age for each trial. The amount of SSF added to the supplemented diets was recorded. A paired t-test was run on the 60 pairs of data points for body weight or feed conversion ratio to get overall averages and P values for statistical significance. The average age estimate was 32.1 days. Body weight (or gain) averaged 1.537 kg in the nCON group vs. 1.604 in the +SSF group (+0.067 kg; +4.36%; P < 0.001). Feed conversion ratio (feed:gain) averaged 1.647 in the nCON group vs. 1.599 in the +SSF group (-0.048; -2.91%; P < 0.001). It was concluded that supplementation of broiler diets with SSF enzyme complex significantly increased body weight and decreased feed conversion ratio. Therefore, it is concluded that Allzyme® SSF may be added to (on top of) broiler formulas with expectation of obtaining improvements in body weight and feed conversion ratio.

Key Words: Allzyme SSF, broiler, enzyme, meta-analysis


A meta-analysis of results of laying hen trials (1995-2008) from several countries was done to demonstrate effects of the dietary enzyme complex Allzyme® SSF (+SSF treatment, Alltech Inc.) vs. no supplement (negative control; nCON treatment) on layer performance. According to the manufacturer, the SSF added to feed at the recommended dose (0.015% or 150 g/t) releases about 75 kcal ME/kg (34 kcal ME/lb), 0.1% calcium, and 0.1% available phosphorus, as well as a portion of the amino acids. Data from 16 reports containing 26 comparisons of the 2 treatments for hen-day egg production, egg weight, daily egg mass, feed intake, feed/dozen eggs, and kg feed/kg eggs were used. A paired t-test was run on the 26 pairs of data points for the production parameters to get overall averages and P values for statistical significance. Hen-day egg production was numerically (P = 0.136) improved by +1.09% actual (+1.29% relative) for +SSF compared to nCON diets. Egg weight was significantly (P = 0.006) greater from hens fed +SSF rather than nCON diets (+0.89 g or +1.49%). Daily egg mass produced was significantly greater (P = 0.014) for +SSF than for nCON fed hens (+1.74 g/hen/d or +3.47%). Feed intake was numerically (P = 0.281) lower by -0.50 g/hen daily (-0.44%) for +SSF diets compared to nCON diets. Feed/dozen eggs was significantly (P = 0.028) lower by -0.027 kg/dozen eggs (-1.65%) for +SSF diets compared to nCON diets. Similarly, kg feed/kg eggs was significantly (P = 0.004) lower by -0.069 (-3.04%) for +SSF diets compared to nCON diets. It was concluded that supplementation of laying hen diets with SSF enzyme complex product significantly increased egg weight and daily egg mass, and decreased feed/dozen eggs and kg feed/kg eggs, compared to no supplement (nCON). Therefore, it is concluded that Allzyme® SSF may be added to (on top of) laying hen formulas with expectation of obtaining improvements in these performance parameters.

Key Words: Allzyme SSF, layer, enzyme, meta-analysis


A pioneer activity has been conducted for the last years by Biomin Holding in collaboration with Romer Labs Singapore Pte Ltd.. Results show the contamination of feedstuffs and feed not only qualitatively, but also quantitatively. From October 2007 until September 2008, a total of 5192 analyses were carried out for the most important mycotoxins in terms of agriculture and animal production – aflatoxin B1 (AFB1), zearalenone (ZON), deoxynivalenol (DON), fumonisin B1 (FUM) and ochratoxin A (OTA). In total, 1080 samples were analysed from North Asia, South East Asia and South Asia (89.4% of the samples), Oceania (8.5% of the samples) and America (North and South America) (2.1% of the samples). Samples tested were diverse, ranging from cereals such as corn, wheat and rice to processing by-products, namely soybean meal, corn gluten meal, DDGS and other fodder such as straw, silage and finished feed. HPLC was used for the analysis of all mycotoxins. For the purpose of data analysis, non-detection levels are based on the detection limits of the test method for each mycotoxin: Total aflatoxins ≤ 4 µg/kg (ppb); zearalenone ≤ 32 µg/kg (ppb); deoxynivalenol ≤ 50 µg/kg (ppb); fumonisin B1 ≤ 100 µg/kg (ppb) and ochratoxin A ≤ 2 µg/kg (ppb). Mycotoxin contamination varied amongst geographical regions and between commodities. From all survey samples 31%, 46%, 54%, 54% and 19% tested positive for contamination with AFB1, ZON, DON, FUM and OTA, respectively. Levels of contamination vary from below the limits of detection for each mycotoxin in the case of non-contaminated samples - to values as high as 32893 µg/kg, for example in the case of DON. With basis on these irrefutable results and on the known negative impacts mycotoxins cause in animals, these substances should be considered with precaution by professionals on the agricultural, animal production and feed sectors. Analyzing commodities and feed is crucial to monitor mycotoxins’ presence, as these substances are invisible, odourless and tasteless.

Key Words: occurrence, mycotoxins, aflatoxin, zearalenone, deoxynivalenol

P221 Active cells versus colony-forming units. S. Henikl*, R. Weiβ, M. Mohnl, and G. Schatzmayr, BIOMIN Research Center, Tulln, Austria.

Colony forming units are traditionally determined by plate counting, a simple but time consuming method. In recent years, the term ‘ABNC’ for active but non-culturable cells has appeared in literature. Plate counting does not detect these cells that are not able to build colonies any more but are still metabolically active. Therefore, a flow cytometry based method was established and validated that detects both colony forming units and ABNC cells. For validation, a probiotic multi-strain product with a colony count of 6E+10 cfu/g was used. The lyophilisate was resuspended in buffer and probiotics were stained with ChemChrome V26, a non fluorescent dye that is metabolized by active cells resulting in free fluorochromes. Dilution series were prepared (two fold) and fluorescent
activated units (FUa) were determined by a flow cytometer. The sample was analyzed in two independent experiments, in duplicate each time. Results were statistically evaluated for normal distribution according to Kolmogorov-Smirnov test and for homogeneity of variance according to Levene test. Cell numbers were determined to be 6.8 ± 4.8E+09 FUa/g. Results followed a normal distribution and homogeneity of variance was given. There was no significant difference between dilution series and dilution steps (Tukey-HSD P > 0.05). The flow cytometry based method turned out to be a suitable technique for the analysis of probiotic lyophilisates. Results were statistically reproducible and marginally higher than the colony count, which was expected. Further experiments will be carried out to improve the recovery of probiotic bacteria in different matrices.

**Key Words:** active cells, ABNC, colony-forming unit, flow cytometry, plate counting

P222 Chemical evaluation of co-products of cocoa, kola, coffee, cashew and tea as feed resource for poultry. R. A. Hamzat* and O. Adeola, Department of Animal Sciences, Purdue University, West Lafayette, IN.

Many by products that are considered as wastes in Nigeria have great potentials as animal feed ingredients if properly handled, processed and incorporated into rations. Some of such wastes are cocoa bean shell (CBS), cocoa pod husk (CPH), kola testa (KOT), kola pod husk (KPH) coffee husk (CFH), cashew apple waste (CAW), cashew nut shell (CNS) and spent tea leaf (STL). Nigeria is one of the world largest producers of cocoa, kola, coffee, cashew and tea and hence the by-products of these crops are abundantly wasted and constitute nuisance at farmstead and/or processing factory sites. Evaluating the chemical values of these by-products will offer possibility of effectively utilizing them as feed ingredients. The present study investigated the proximate contents, fibre fractions, mineral and amino acid profiles and energy values of CBS, CPH, KOT, KPH, CFH, CAW, CNS and STL in order to assess their various potentials as feed resources for poultry. The components that were analysed included the crude protein, ash, crude fat, crude fibre, acid detergent fibre, neutral detergent fibre, caffeine, calcium, phosphorus, magnesium, potassium, sodium, iron, zinc, copper, manganese, molybdenum, sulphur, chloride ion, cobalt, thiamine, proline, hydroxyproline, aspartic acid, threonine, serine, glutamic acid, lanthanum, glycine, alanine, cysteine, valine, methionine, isoleucine, leucine, tyrosine, phenylalanine, lysine, histidine, ornithine, arginine, tryptophan and energy. The results of the chemical determinations revealed that CBS, CPH, KOT, KPH, CFH, CAW, CNS and STL have a fairly good chemical composition suitable for use as animal feed ingredients. The fibre contents may however dictate the level of the co-products that can be incorporated in the rations, particularly for poultry.

**Key Words:** selected tree crops, co-products, chemical value, feed resource, poultry

P223 Skin pigmentation in broilers fed different levels of xanthophylls on the diet. J. I. Munoz-Díaz, B. Fuente-Martínez, X. Hernández-Velasco*, and E. Ávila-Gonzalez, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México, Mexico City, Mexico.

In Mexican poultry industry, one of the aspects of greatest economic importance is broiler carcass skin color. This determines the choice or rejection of the product by the consumers. Genetic selection of broilers has reduced the time of production and now are required higher levels of xanthophylls supplementation that represents between 8 and 10% of total cost diet. In order to study skin pigmentation in 320 Ross broilers chicks from 3 to 7 weeks of age, were randomly distributed in 4 treatments with four inclusion levels of yellow *Tagetes* xanthophylls in the diet, control with 75 ppm during 4 weeks and 108, 141, and 162 ppm during 2 weeks of administration. Body weight and feed consumption were not different (P > 0.05) among the treatments. The skin broiler color in the control group treated with 75 ppm of yellow xanthophylls showed an average daily increase of 0.59 yellowness units from 3 to 7 weeks. A daily decrease of 0.11 yellowness units was registered when the inclusion of pigment was stopped in the groups with 108, 141, and 162 ppm of xanthophylls. Chicks from treatments with 141 and 162 ppm had better (P ≤ 0.05) skin b values (yellowness) than the group with 108 ppm. Females gained an average of 1.73 b values more than males in all the groups. These results may allow reduction in pigmentation time just during 2 weeks to achieve good skin pigmentation in female and male broilers.

**Key Words:** skin pigmentation, broilers, xanthophylls, yellowness

P224 The nonphytate P requirement for 0 to 14-day old broilers. S. Powell*, T. D. Bidner, and L. L. Southern, Louisiana State University Agricultural Center, Baton Rouge.

Three experiments were conducted with Ross x Ross 708 broilers to estimate the nonphytate P (nPP) requirement from 0 to 14 d posthatching. Broilers were housed in 0.76 x 3.05 m floor pens in a tunnel ventilated room with cool cells and fans. Hours of light for a 24 h period consisted of 4 d of 24 h of light, followed by 5 d of 20 h of light, and 5 d of 18 h of light. Diets were corn soybean meal based and formulated to contain 3,025 kcal of ME/kg, 1.42% total Lys, and 1.07% total TSAA. All other nutrients met or exceeded the NRC (1994) recommendations except for nPP where appropriate. Treatments were replicated with 6 to 12 pens of 35 broilers per pen. At the end of each experiment, 6 broilers per pen were randomly selected, killed by CO2 asphyxiation, and the left tibia was removed, cleaned of tissue, and frozen for determination of bone breaking strength (BBS), ash, and weight. In experiment 1, the levels of nPP ranged from 0.30 to 0.50% with Ca:nPP of 2.22:1. Experiment 2 was similar to experiment 1 except the nPP levels ranged from 0.40 to 0.60%. Experiment 3 had nPP levels ranging from 0.35 to 0.60% in 0.05 increments with a Ca:nPP of 1.9:1. In experiment 1, ADG, ADFI, BBS, ASH, and ash weight increased (linear, P < 0.02) with increasing levels of nPP; however, BBS plateaued (quadratic, P < 0.03) at 0.45% nPP. In experiment 2, ADFI, BBS, ASH, and ash weight increased (linear, P < 0.06) with increasing levels of nPP; however, BBS, ASH, and ash weight plateaued (quadratic, P < 0.03) between 0.50 and 0.55% nPP. In experiment 3, ADG, BBS, ASH, and ash weight increased (linear, P < 0.01) with increasing levels of nPP; however, BBS and ASH plateaued (quadratic, P < 0.06) at 0.50% nPP. In experiments 1 and 3, the broken line and quadratic methods could not estimate an nPP requirement for any response variable. In experiment 2, one slope broken line analysis resulted in a requirement estimate of 0.52% nPP for BBS and ASH, while one slope quadratic analysis resulted in an estimate of 0.57% nPP for both BBS and ASH. The results of this research indicate that the nPP requirement for 0 to 14-d old broilers is at least 0.50%.

**Key Words:** broiler, phosphorus, requirement
P225 Effect of dietary levels of protein on growth performance, carcass characteristics and meat quality of Golden Montazah and Gimmizah chickens in Egypt. Y. E. Attia 1, S. I. El-Sharkawy 2, F. A. Mohamed 2, M. D. Sahledom 3, and S. E. Aggrey 4, 1 Alexandria University, Damanhour, Egypt, 2 Al-Azhar University, Cairo, Egypt, 3 Nasr Secondary School of Agriculture, Damanhour, Egypt, 4 University of Georgia, Athens.

The Golden Montazah (GM) and Gimmizah (Gim) are Egyptian native chickens used for meat production. Our objective was to establish their protein requirements for economic efficiency. We fed 3 protein levels: high (22-20-18%; 3000 kcal ME/kg diet), medium (20-18-16%; 3000 kcal ME/kg diet), and low (18-16-14%; 3100 kcal ME/kg diet) as starter (S) (1-28 d), grower (G) (29-70 d) and finisher (F) (71-91 d) diets, respectively. Each diet was fed to 25 male chicks in 3 replicates. The optimum protein level for GM was 22, 20 and 18% CP in S, G and F diets, respectively. The Gim males should be fed on diet containing 20, 18 and 16% CP in S, G and F diets, respectively. The GM and Gim males achieved the same BW gain, feed intake and feed efficiency. The inclusion of 7.5% canola meal in the diet of broilers negatively impacted the yield of the carcass, tenders and legs. There was no interaction of DDGS and canola meal on any of the carcass parameters respectively. Careful consideration should be given when DDGS and canola meal are fed because negative effects on performance and carcass yield may be observed.

Key Words: Golden Montazah, Gimmizah, crude protein level, growth.

P226 Evaluation of feeding distillers dried grains with solubles (DDGS) and canola meal on broiler performance and carcass characteristics. B. Jung 1, A. B. Batal 1, and R. Mitchell 2, 1 University of Georgia, Athens, 2 Perdue Farms, Inc., Salisbury, MD.

An experiment was conducted to evaluate the use of distillers dried grains plus solubles (DDGS) in combination with canola meal in broiler diets. In a 3 x 2 factorial design, 1,920 one-d-old male heritage broilers were randomly assigned to the 6 dietary treatments; control, 6% DDGS, 12% DDGS, 12% DDGS+7.5% canola meal, 12% DDGS+7.5% canola meal, and 7.5% canola meal. Eight replicate pens containing 40 chicks each were assigned to each treatment. The diets were formulated to be isocaloric and to meet the bird’s digestible amino acid requirements. Performance was evaluated at 14, 21, 35 and 48d of age and carcass characteristics were measured at 48d of age. Overall (0 to 48d of age) the inclusion of up to 12% DDGS in the diet did not significantly affect BW gain or feed intake but it did negatively affect feed efficiency. The inclusion of 7.5% canola meal did not significantly affect feed efficiency but, it did significantly reduce body weight gain and feed intake as compared to the controls. There was no interaction between DDGS and canola meal on BW gain, feed intake or feed efficiency. The inclusion of 7.5% canola meal in the diet of broilers negatively impacted the yield of the carcass, tenders and legs. There was no interaction of DDGS and canola meal on any of the carcass parameters measured. Although not statistically significant the inclusion of DDGS or canola meal in the diet did lead to a reduction in breast meat yield; from 23.4% for the birds fed the control diet to 22.5, 22.4, and 22.5% for the birds fed the 6 and 12% DDGS diets and the 7.5% canola meal diet respectively. Careful consideration should be given when DDGS and canola meal are fed because negative effects on performance and carcass yield may be observed.

Key Words: distillers dried grains with solubles (DDGS), canola meal, broilers, carcass characteristics.

P227 Evaluation of soybean meal with the genetically modified output trait DP-305423-1 when fed to laying hens. L. Mejia 1, C. M. Jacobs 2, P. L. Utterback 3, C. M. Parsons 1, D. Rice 2, C. Sanders 2, B. Smith 2, C. Liams 2 and T. Sauber 2, 1 University of Illinois, Urbana, 2 Pioneer Hi-Bred, Johnston, IA.

An experiment using 336 Hy-Line W-36 Single Comb White Leghorn hens was conducted to evaluate transgenic soybeans containing the gm-fad2-1 gene fragment and the gm-hra gene (event DP-305423-1). Expression of the gm-fad2-1 gene fragment suppresses the endogenous FAD2-1 gene and results in an increased level of oleic acid and decreased levels of linoleic acid, linolenic acid, and to a lesser extent, palmitic acid in the seed. The GM-HRA protein, encoded by the gm-hra gene, is a modified version of soybean acetyl-CoA synthase that is used as a selectable marker during transformation. Pullets (20 wk of age) were placed in cage lots (7 hens/cage; 2 cages/lot) and were randomly assigned to one of four corn-soybean meal dietary treatments (6 lots/treatment) formulated with the following soybean meals: non-transgenic near-isolate control (control), non-transgenic commercial reference soybean meal A (92M72), non-transgenic commercial reference soybean meal B (93B15) and transgenic soybean meal produced from soybeans containing event DP-305423-1 (305423). Weeks 20-24 were a preconditioning period and the four experimental diets were then fed from 25-36 wk of age. Differences between 305423 and control group means were evaluated with statistical significance at P < 0.05; data generated from hens fed the commercial soybean meal diets were used to only construct tolerance intervals for each trait evaluated. Body weight, hen-day egg production, egg mass, feed consumption and feed efficiency for hens fed 305423 soybean meal were not significantly different from the respective values for hens fed diets formulated with the near-isolate control soybean meal. Likewise, egg component weights, Haugh unit measures, and egg weights were similar regardless of the soybean meal source. This research indicates that performance of hens fed diets containing 305423 soybean meal, as measured by egg production and egg quality, was similar to that of hens fed diets formulated with near-isolate control and commercial soybean meals.

Key Words: gm-fad2-1, oleic acid, soybean meal, egg production, egg quality.

P228 Evaluation of energy enzymes in broiler diets varying in nutrient and energy levels as measured by live broiler performance and yield. J. R. Coppedge 1, L. A. Oden 1, J. Klein 1, S. Pohl 1, K. Jessen 1, A. Jordan 1, B. Ratliff 2, B. Brown 2, F. Ruch 2, and J. T. Lee 1, 1 Texas A&M University, College Station, 2 Enzyvia, LLC, Sheridan, IN.

An experiment was conducted to evaluate the effect of two energy enzymes on broiler performance when supplemented in corn/soy bean meal diets with varying nutrient profiles. The two energy enzymes were NSPase cocktails. The experimental design was a 3 x 3 factorial utilizing three nutrient profiles (control, negative 1, and negative 2) and three enzyme treatments (control, NSPase A, and NSPase B) with five replicates per treatment consisting of 45 chicks/replicate. The nutrient profile of the control diet met the dietary specifications of a commercial integrator. The negative 1 diet was achieved by a 4% reduction in total protein and energy levels from the control, and the negative 2 was achieved by a 4% reduction in energy level compared to the control. Broilers were fed the starter diet through 12 days of age, a grower diet through 26 days of age, and a finisher diet through 42 d. Body weights
were reduced \((P < 0.05)\) at day 12 and day 26 in the negative 1 diet as compared to the other two diets. Body weight of negative 2 fed broilers was reduced \((P < 0.05)\) compared to control fed broilers on day 26. An increase \((P < 0.05)\) in feed conversion was also observed through the starter period in the negative 1 diet. Improvements \((P < 0.05)\) were observed in feed conversion with inclusion of both NSPase enzymes through the starter and grower periods of the experiment. An interaction between diet and enzyme was observed on day 42 body weight with an increase \((P < 0.05)\) being observed with NSPase B inclusion to the negative 2 diet and NSPase B inclusion also increased \((P < 0.05)\) breast meat in the control diet. These data confirm that energy enzymes can improve growth performance in market broilers and allow for reduced nutrient inclusion rates as an effort to reduce costs.

**Key Words:** broiler, energy, performance, enzyme


An experiment was conducted with male Pekin ducks to determine the toxicity of melamine (M) in young ducks fed dietary treatments from hatch to 21 days of age. Two hundred day-old male ducks were purchased from a commercial hatchery and assigned to one of ten treatment groups. Each treatment group consisted of five replicates with four ducks per replicate group. The dietary treatments included 0, .25, .50, .75, 1.0, 1.25, 1.50, 1.75, 2.0, and 2.25% M. Compared to controls, feed intake and body weight gain were reduced \((P < 0.05)\) in ducks fed 1.0% M. Compared to controls, relative kidney weights were higher \((P < 0.05)\) in ducks fed diets containing 1% M. Relative liver weights were not affected by levels of M \((P > 0.05)\). Treatment related mortality was observed in 12 ducks fed 1.5% to 2.25% M. Ducks with mortality related to treatments had uniform gross lesions, and with one exception all had pale and enlarged kidneys. White crystal structures were found in the bile of four of the 12 birds, and 7 of the 12 were off feed. Renal histopathology of all ducks with treatment related mortality was uniform with moderate to severe multifocal accumulation of eosinophilic to basophilic mineralized casts within renal tubules and collecting tubules. These results indicate that melamine causes reduced growth performance in ducks fed \(\geq 1.0\%\) M, and severe renal pathology and mortality due to renal failure in ducks fed \(\geq 1.5\%\) M in the ration. The renal pathology observed in ducks is similar to what has been seen in other avian species fed toxic concentrations of M. However, the concentrations of M used in this study are well in excess of concentrations found in pet foods that were reported to cause kidney failure in dogs and cats.

**Key Words:** melamine, duck, kidney pathology


A series of in-vitro experiments was performed to determine the impact of zinc form and level on the activity of phytase from Alzyme® SSF. A complete randomized design was used with three zinc sources and 9 levels evaluated. The three zinc sources were zinc sulfate, Bioplex® Zn and zinc methioninehydroxyl analogue chelate (Zn chelate). The zinc levels were 0, 3, 6, 12, 23, 47, 94, 188 and 375 ppm. The response variable was the release of inorganic phosphate from phytic acid as micro moles phosphorus/ml of reaction. The results were analyzed by ANOVA and the means separated using LSD \((P < 0.05)\). As zinc levels increased the release of phosphate decreased for all zinc sources. The Bioplex®Zn had the highest P release across all zinc levels at 0.2354 ppm micro moles P/ml compared to 0.1824 ppm for Zn chelate and 0.1701 ppm for zinc sulfate \((P < 0.05)\). At each zinc level the Bioplex® Zn had significantly higher release of phosphate compared to the zinc sulfate and Zn chelate \((P < 0.05)\). At 3, 6, 47 and 375 ppm zinc the Zn chelate had a lower amount of phosphate released compared to the zinc sulfate \((P < 0.05)\) and at 12, 23, 94 and 188 ppm the levels were equivalent for the Zn chelate and zinc sulfate \((P < 0.05)\). These in-vitro studies demonstrate the negative impact that zinc sulfate and a Zn chelate have on the activity of phytase and the negative impact can be reduced with the use of Bioplex® Zn.

**Key Words:** phytase, zinc sulfate, bioplex Zn, zinc chelate, phosphate release


An experiment was conducted to determine the efficacy of different levels of two adsorbents, in ameliorating the toxic effects of aflatoxin (AF) in broiler chicks. Two hundred and fifty day-old male broiler chicks were assigned to a 2 X 4 factorial arrangement of dietary treatments plus a positive control (PC) treatment containing no AFB1, or adsorbent, and negative control (NC) treatment containing 3 mg AFB1/kg diet but no adsorbent. Factors were LEVEL of adsorbent (0.25, 0.50, 0.75 or 1.0%) and two adsorbents (ADSB-1 or ADSB-2). All 8 diets contained 3 mg AFB1/kg diet. Compared with chicks fed the PC diet, chicks fed the NC consumed 36% less feed (703 vs 1112 g; \(P < 0.05)\), gained 39% less weight (523 vs 868 g; \(P < 0.05)\), were less efficient (1.42 vs 1.31 g/g; \(P < 0.05)\), had heavier \((P < 0.05)\) relative liver (4.50 vs 2.90 g) and kidney weights (1.84 vs 0.86 g), lower \((P < 0.05)\) carcass pigmentation scores (1.80 vs 3.73), and more severe \((P < 0.05)\) liver lesions (3.2 vs 1.0). No ADSB by LEVEL interaction or main effects of adsorbent were observed for any of the response variables \((P > 0.05)\). There were, however, significant main effect differences for level of adsorbent. The addition of adsorbents to the AF diet increased feed intake from a low of 847g at 0.25% to a high of 979 g at 1.0%, and body weight gain from a low of 656 g at 0.25% to a high of 758 g at 1.0%. Liver lesion scores decreased from a high of 3.0 at 0.25% adsorbent to a low of 2.1 at 1.0%. In summary, both adsorbents were equally effective in reducing the toxic effects of AF; however both adsorbents were more effective at higher dietary concentrations.

**Key Words:** aflatoxin, adsorbent, broiler, liver lesions


The efficacy of exogenous feed enzymes on broiler performance is dependent upon a number of factors, including dietary minerals, since they can alter enzyme substrate availability. The objective of these experiments was to determine the effect of dietary copper sulfate...
(CuSO₄) levels on the efficacy of Allzyme SSF (SSF). In experiment one, hatchlings were randomly assigned to eight replicate pens and chicks were fed an experimental diet that contained either 0 or 0.1% CuSO₄ or 0 or 0.2% SSF. Total dietary copper was 20 ppm and 250 ppm in the 0 and 0.1% inclusion rations, respectively. Chicks fed SSF replete diets increased body weight by 2.5% and gain by 2.6% compared to chicks fed SSF deplete diets (P < 0.05). Addition of 0.1% CuSO₄ improved feed conversion compared to diets containing no CuSO₄ (P < 0.05). Feed intake increased in response to SSF, but only in the absence of excess CuSO₄ (P < 0.05). In experiment two, hatchlings were randomly assigned to six replicate pens and chicks were fed one of four experimental diets. The positive control (PC) diet was formulated to meet or exceed NRC requirements and contained 0.9% calcium (Ca), 0.45% available P (avP) and 0.1% CuSO₄. SSF was added to the NC diet at an inclusion rate of 0.2% and contained 0% or 0.1% CuSO₄. Chicks fed the NC+SSF diet increased body weight by 5.1%, gain by 5.7% and feed intake by 7.9% compared to chicks fed the PC+CuSO₄ diet (P < 0.05). Chicks fed NC+SSF+CuSO₄ had body weights, gain and feed intake intermediate to chicks fed NC+SSF and PC+CuSO₄ diets. Taken together, these data indicate that excess dietary CuSO₄ limits the efficacy of SSF function in diets low in Ca and avP, but has minimal impact on SSF function when included in nutritionally replete diets.

**Key Words:** calcium, copper, enzyme, phosphorous


The prevalence of mycotoxins in feedstuffs is impacted by weather conditions during the growing season and extended storage in bins and silos. The Customer Laboratory Services (CLS) department of Kemin AgriFoods North America provides analytical services to support customerneeds, including testing for mycotoxins. It is the objective of this study to compile information collected from customer samples, primarily from the Midwestern US, to provide an overview of mycotoxin prevalence. To date, over the period August 2008 to October 2009, a total of 346 feed and feed ingredient samples were screened for the presence of five common mycotoxins of agricultural significance: aflatoxin, zearalenone, T-2 toxin, deoxynivalenol and fumonisin. Mycotoxin analyses were conducted using a competitive direct ELISA kit (Veratox®, Neogen Corporation). Sample submissions included whole corn (83 samples), forages (11 samples, consisting of hay, corn silage and alfalfa haylage), DDGS (90 samples), wheat middlings (18 samples) and finished feed formulations (144 samples, consisting of mash, pellet and crumble diets). Of the 346 samples analyzed, 77 percent were positive for one or more of the target mycotoxins. For the samples tested, the order of prevalence was found to be zearalenone, deoxynivalenol, fumonisin, T-2 and aflatoxin, at occurrences of 63, 48, 42, 16 and 4 percent, respectively. Although only 40 percent of the whole corn samples were positive for the mycotoxins tested, all DDGS samples tested positive which may reflect the difficulty of obtaining representative samples of whole corn. Although representing small sample populations, wheat middlings and forage components also showed high percentages of positive samples (89 and 100, respectively). The prevalence of mycotoxins in the feed components is also confirmed by an 82 percent positive result for the analysis of complete feeds. Early indications are that the 2009 crop will offer continued challenges in dealing with elevated levels of mycotoxins.

**Key Words:** mycotoxin, corn, DDGS, ELISA, feed


Results from previous studies have shown that EconomasE®, a proprietary blend of ingredients that improves antioxidant status of the animal, significantly reduces the amount of vitamin E (VE) required in the diet and improves the meat quality of broilers. However, the molecular mechanism related to this VE sparing effect is not clear. The goal of this study is to use the microarray techniques to compare the effects of dietary VE and EconomasE® on broiler breast muscle gene expression profiles, to dissect the molecular mechanisms related to their biological functions and gain insight on this functional redundancy at the transcriptome level. Seven chicks fed with corn-soy based diet (Control), Control supplemented 50 IU/kg VE, 100 IU/kg VE, or 200 g/Ton EconomasE® diet were sacrificed at age of 42d, respectively. Breast muscle of each bird was used for gene expression analysis on an Affymetrix microarray system. Out of 32,773 transcripts corresponding to over 28,000 chicken genes represented on the genechip, 542 were found to be differentially expressed (P < 0.05, fold change (FC) > 1.2) by VE or EconomasE®, compared to Control. Gene ontology analysis revealed that genes differentially regulated by VE include muscle structure and extra cellular matrix genes, as well as anti-oxidative, lipid metabolism, inflammatory, and immune response genes. Compare to genes affected by VE, a significant part of those are also similarly modulated by EconomasE®, as visualized by hierarchical clustering calculations. Pathway analysis also showed common as well as distinct influences of EconomasE® and VE on gene signaling of breast muscle. Results of this experiment indicate that biological roles related to high level dietary VE can be greatly mimicked at the transcription level by EconomasE®; and it further suggest that gene expression profiles provide a good model for the study of the mechanisms linked to dietary factors.

**Key Words:** gene expression, vitamin E, EconomasE®, broiler chick


The benefits of antioxidant supplementation in broiler breeder diets have been well established for benefit to the developing embryo and chick. Few studies have examined how improvements in the antioxidant system affect broiler breeder body weight (BW) and flock uniformity. Therefore, a study was conducted to determine the effect of dietary supplementation of selenium (Se) and vitamin E (Vit. E) on BW and flock...
uniformity of developing broiler breeder pullets. In this experiment, 640 Cobb 500<sup>®</sup> broiler breeder pullets were allotted to 4 dietary treatments with 5 replicate floor pens of 32 birds/pen in a 2 x 2 factorial design. Dietary treatments consisted of a corn-soybean meal basal diet with no added Se or Vit. E, supplemented with 0.3 mg Se per kg diet as selenium yeast (Sel-Plex®, Alltech, Inc., Nicholasville, KY), supplemented with 30 IU Vit. E per kg as all-rac-α-tocopheryl acetate, or supplemented with both Se and Vit. E. Average pen weights were recorded weekly from 2 until 21 weeks of age and later compared to the recommended target weight defined in the Cobb Breeder Management Guide (2008). In addition, each week 10 pullets from each pen were randomly selected and weighed for determination of pen uniformity. Flock uniformity was reported as the percentage of pullets with a BW within ±15% of the mean BW for each pen. There was no effect of dietary treatment on pullet BW and pen uniformity over the 19 week period. When compared to the target BW, all treatment groups displayed mean BW above the target level. Through week 13, the values for pullets fed only Se yeast were numerically closer to the target BW than the control, displaying a significant effect in weeks 2, 6, 7 and 11 (P < 0.05). In addition, the pullets supplemented with both Se yeast and Vit. E were significantly closer to the target weight than the control group (P < 0.05) during weeks 6 and 7. The results indicate that dietary supplementation with Se yeast may be useful in achieving the ideal target BW of broiler breeder pullets throughout the early stages of development.

**Key Words:** selenium yeast, vitamin E, uniformity, broiler breeder

### P236

**Economasa<sup>®</sup> increases mRNA levels of vitamin E-responsive genes in breast muscle of 6-week old broilers.** K. M. Brennan*, T. Ao, and J. L. Pierce, Alltech-University of Kentucky Nutrition Research Alliance, Lexington.

Rising costs of vitamin E (VE) have stimulated interest in feeding regimes focusing on antioxidant status. Studies showed that Economasa<sup>®</sup>(Alltech Inc.), a proprietary blend of ingredients, can maximize antioxidant status of the animal and allow for a reduction in the dietary supplemental level of VE. The objective of this study was to compare the effects of Economasa<sup>®</sup> and VE on gene expression of VE-response genes from breast muscle of 6-wk old broilers. Dietary treatments included 1) corn-soy control diet containing 0.3 ppm Se as selenite, but no VE; 2) Diet 1 plus 50 IU VE /kg; 3) Diet 1 plus 100 IU/kg VE; 4) Diet 1 plus 200 g Economasa<sup>®</sup>/Ton. Seven chicks from each of four dietary treatments were randomly selected and euthanized at 42d. Breast muscle was snap frozen in liquid nitrogen immediately, then transferred to -80°C freezer until further analysis. Total RNA was isolated from frozen breast muscle, treated with DNase and reverse transcribed into cDNA. mRNA levels of target genes were measured using real-time PCR and normalized to the housekeeping gene translin-associated factor X (TSNAX). Target VE-responsive genes included: tropomyosin (TPM1), cytochrome P450 3A80 (CYP3A80), and connective tissue growth factor (CTGF). mRNA levels of TPM1 and CYP3A80 did not differ among dietary treatments. CTGF mRNA levels did not differ between the control and VE- supplemented birds, but birds fed Economase<sup>®</sup> had 1.46-fold higher (P < 0.05) CTGF mRNA levels than control birds. These data suggest that dietary supplementation of Economasa<sup>®</sup> resulted in the same or better mRNA levels of VE-responsive genes in breast muscle of broiler chicks.

**Key Words:** vitamin E, broiler, gene expression, real-time PCR

### P237

**Diet formulation based on digestible amino acids to Japanese quail for 1 to 21 days.** F. G. P. Costa*, V. P. Rodrigues, C. C. Goulart, R. B. Souza, J. H. V. Silva, I. S. Nobre, and C. F. S. Oliveira, Federal University of Paraiba, Areia, Paraiba, Brazil.

The aim was to evaluate diet formulation based on digestible amino acids in relation to the formulation based on total amino acids to Japanese quail from 1 to 21 days. Five hundred and seventy-six Japanese quail females with one day old were distributed in a completely randomized design, in a factorial scheme 2 x 3 (two basis for formulation x three ingredients), resulting in a total of six treatments with eight replications of 10 birds each. Treatments 1, 2 and 3 consisted of diets based on total amino acids (TAA), the first being formulated based on corn and soybean meal (CS); the second, in addition to corn and soybean received include meat and bone meal (CSMB) and the third in addition to the above ingredients, received in its composition feather meal (CSMBF). The other three treatments were the following sequence of ingredients of previous treatments, but the diets were formulated based on digestible amino acids (DAA). For the formulation of the diets were considered the nutritional requirements recommended by Silva and Costa (2009) and the values of TAA and DAA ingredients found in Rostagno et al. (2005). There was an interaction between the base formulation and ingredients used only for feed intake (FI), and where the diet formulation was based on CS the FI was higher with TAA. There was no significant effect on weight gain (WG) in the formulations based on TAA and DAA, however the feed conversion (FC) was better with DAA. Among the ingredients used, the use of complex diet with CSMBF resulted in higher FI and WG. Therefore, the performance of Japanese quails from 1 to 21 days of age can be improved when diets are formulated based on digestible amino acids.

**Key Words:** Coturnix coturnix japonica, ideal protein, initial phase

### P238

**Diet formulation based on digestible amino acids to Japanese quail for 22 to 42 days.** V. P. Rodrigues, F. G. P. Costa*, R. B. Souza, C. C. Goulart, G. M. Dantas, J. H. V. Silva, and G. S. Lima, Federal University of Paraiba, Areia, Paraiba, Brazil.

The experiment was conducted at the Agrarian Sciences Center of UFPB, Brazil. The aim was to evaluate diet formulation based on digestible amino acids in relation to the formulation based on total amino acids to Japanese quail from 22 to 42 days. Four hundred and eighty Japanese quails females with 22 days old were distributed in a completely randomized design, in a factorial scheme 2 x 3 (two basis for formulation x three ingredients), resulting in a total of six treatments with eight replications of 10 birds each. Treatments 1, 2 and 3 consisted of diets based on total amino acids (TAA), the first being formulated based on corn and soybean meal (CS), the second, in addition to corn and soybean received include meat and bone meal (CSMB) and the third in addition to the above ingredients, received in its composition feather meal (CSMBF). The other three treatments were the following sequence of ingredients of previous treatments, but the diets were formulated based on digestible amino acids (DAA). For the formulation of the diets were considered the nutritional requirements recommended by Silva and Costa (2009) and the values of TAA and DAA ingredients found in Rostagno et al. (2005). The variables evaluated were feed intake (FI), weight gain (WG) and feed conversion (FC). There was no interaction between the bases of the formulation and ingredients used. Similarly, no significant effect
was observed between the formulation based on TAA and DAA nor formulation with CS, CSMB and CSMBF for any of the variables. The FI, WG and FC of treatments TAA and DAA were 393.2 and 385.1 g/bird, 93.2 and 91.9 g/bird and 4.227 and 4.195 g/p, respectively, while treatments with CS, CSMB and CSMBF were 387.7, 389.8 and 389.9 g/bird, 93.7, 92.9 and 91.1 g/bird and 4.141, 4.284 and 4.207 g/p. Thus, the use of the diet formulation based on digestible amino acids did not affect the performance of Japanese quails in the growing phase.

Key Words: Coturnix coturnix japonica, growing phase, ideal protein

**P239 Digestible valine: Digestible lysine ratio for broilers in the initial phase.** S. A. N. Morais1, F. G. P. Costa*,1, E. T. Nogueira2, M. Kutschenko2, C. C. Goulart1, R. C. L. Neto1, C. F. S. Oliveira1, V. P. Rodrigues1, and M. R. Lima1, 1Federal University of Paraíba, Areia, Paraíba, Brazil, 2Ajinomoto Animal Nutrition, Sao Paulo, SP, Brazil.

Valine is likely the fourth limiting amino acid in most diets based of corn and soybean meal. However, its exact needs are not well known, and information regarding it is sparse. The study was carried through with the objective to estimate the digestible valine to digestible lysine ratio for broiler chickens in the initial phase (8 to 21 days). Seven hundred Cobb broilers were distributed in completely randomized experimental design, with five treatments and seven replicates of twenty birds each. The treatments were corn-soybean meal-gluten corn meald basal diet, supplemented with industrial amino acids L-lysine, DL-methionine, L-threonine, L-isoleucine, L-arginine and L-tryptophan in order to meet the nutritional requirements for broilers, except for valine. The basal diet was supplemented with L-valine to substitution in the glutamate in order to reach 0.745, 0.803, 0.860, 0.918 and 0.975% of digestible valine in diet, with digestible valine to digestible lysine ratio 65, 70, 75, 80 and 85%, respectively. The variables evaluated were feed intake (FI), weight gain (WG) and feed conversion (FC). The data were submitted to analysis of variance and regression using linear and quadratic effects to determine the best value for digestible valine to digestible lysine ratio. There was no significant effect of digestible valine: digestible lysine ratio on the FI, while the WG and FC improved linearly with the increase of digestible valine to digestible lysine ratio (22-35 weeks of age). There were twelve replicate pens with four hens per pen, thus 96 pens in total. The experiment consisted of eight dietary treatments arranged in a 2x2x2 factorial design, the factors were: diets (containing either DDGS or MBM), metabolizable energy (ME) levels (2930 Kcal/kg or 2860 Kcal/kg), and two enzyme levels(none or 0.0375% Avizyme® to provide protease at 8000U/g, amylase at 800U/g and xylanase at 600 U/g of product). All diets contained Phyzyme at 60 g MT (~300 FTU) and were formulated to contain 0.30% Avp and a calcium adjustment recommended by Phycheck software tool (10% decrease). Response variables measured were: egg weight (biweekly), feed intake (weekly). Data for the following were taken monthly: Haugh unit, yolk weight, albumen weight, shell weight, shell strength and specific gravity. There was a significant effect of feed intake across time as in the last three weeks (weeks 10, 11, 12) during which time there was a drop in feed intake of 4-8 g per bird per day in feed intake (P<0.05), most likely due to heat. However, there were no differences noted between treatments for feed intake, hen weight, egg production and egg quality parameters (P>0.05). Thus, reducing metabolizable energy, phosphorous and calcium with the addition of enzymes had no negative effect on egg production and quality. There was a savings of $4-6 per ton with the lower energy (ME 2860 Kcal/g) diets, looking at kg feed costs per dozen egg produced, the prices are shown in the following table:

<table>
<thead>
<tr>
<th></th>
<th>DDGS</th>
<th>MBM</th>
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<tbody>
<tr>
<td>ME- Avizyme</td>
<td>$0.237</td>
<td>$0.249</td>
</tr>
<tr>
<td>2930</td>
<td>$0.235</td>
<td>$0.256</td>
</tr>
<tr>
<td>2860</td>
<td>$0.238</td>
<td>$0.231</td>
</tr>
</tbody>
</table>

Key Words: Phyzyme®, Avizyme®, metabolizable energy, laying hen, microbial phytase

**P240 The effects of the addition of phytase and an enzyme cocktail on high and low nutrient density diets in laying hens.** D. Hahn1, S. Scheideler1, E. E. M. Pierson2, and C. L. Novak1, 1University of Nebraska, Department of Animal Science, Lincoln, 2Danisco Animal Nutrition, St. Louis, MO, 3Land O’ Lakes Purina Feed LLC, Kansas City, MO.

The objective was to test the addition of Avizyme® 1502 a blend of protease, amylase and xylanase (Danisco, UK Ltd.) in laying hens fed corn-soy diets containing Dried Distillers Grains (DDGS) or Meat and Bone Meal (MBM) during phase I of egg production. Three hundred eighty four Hy-Line W-36 laying hens were used in this study, from
76%. However, no significant effect was observed relations used on the F1 and WG. Therefore, it is recommended for broilers in the growing digestive valine: digestible lysine ratio of 76%.

**Key Words:** amino acid, ideal protein, performance

P242  Use of xylanase and phytase with fat (linoleic acid) levels different in broiler feeds from 1 to 21 days. F. G. P. Costa*1, T. T. Santos2, D. Suida2, S. A. N. Morais1, R. C. L. Neto1, C. F. S. Oliveira3, C. C. Goulart1, and M. R. Lima1, 1Federal University of Paraíba, Areia, Paraíba, Brazil, 2AB Vista Feed Ingredients, São Paulo, SP, Brazil.

The judicious use of exogenous feed enzymes allows increased inclusion levels of less digestible ingredients at the expense of more expensive, high nutrient density ingredient such as fat. The objective of this study was to evaluate how the removal of added fat (and with that some essential fatty acids such as linoleic acid) would affect bird performance. 700 male one-day-old Cobb 500 chicks were randomly allocated with five treatments of seven replicates per 20 birds each. The treatments were: (T1) Positive control (PC); (T2) Negative Control (NC) which was the same as the PC but formulated to contain 100kcal ME/kg less than the PC which had a minimum level of fat inclusion; (T3) (T2) with xylanase and xylanase added; (T4) - (T2) reformulated to maintain an intermediate level of fat inclusion with the remainder of the 100kcal reduction coming from incorporation of inert and with phytase and xylanase included; (T5) (T2) re-formulated with fat inclusion similar to the PC but with inert included to lower energy by 100kcal compared with the PC, with phytase and xylanase. The enzymes phytase and xylanase were added at the feed at 200 g/ton (500FTU/kg) and 100 g/ton (16,000 BXU/kg) respectively. The variables evaluated were: feed consumption (FC), body weight gain (BG) and feed conversion (FCR). The data was subjected to ANOVA and means separated using the Student Newman-Keuls test with the probability set at 5%. The use of the phytase and xylanase (T3) improved BG compared with the NC and gave similar results to PC. Results were further improved when the enzymes were used in the diet containing the highest level of fat inclusion (linoleic acid) (T5). Based on these results we can conclude that enzyme supplementation improved bird performance from 1-21 days but this improvement could be compromised if a low fat diet is used as is often the case with least cost formulation. These data suggest that the feed formulator should take care to ensure a minimum level of added fat is maintained in rations when energy sparing NSP enzymes are used in corn-soy diets.

**Key Words:** Azomite, broiler breeder, egg shell, laying hen, specific gravity


A hydrated sodium-calcium aluminosilicate (HSCAS; AZOMITE®, Azomite Mineral Products, Inc., Kansas City, MO) may provide benefits including mycotoxin binding and improved egg production, egg shell quality, and fertilizer value of manure. The HSCAS contains 75% of 92 naturally occurring elements, is OMRI® listed, and is an AAFCC approved (21 CFR 582.2729) anticaoking agent (up to 2% in feeds; practical levels 0.3-0.5%). Exp. 1 at Auburn University used 192 Hy-Line W-36 hens (6 pens of 16 hens each per treatment) for 8 1-wk periods to compare 0 (nCON) or 0.5% dietary HSCAS product. Paired t-test results (n = 8) for nCON and HSCAS treatments, respectively, were: hen-d egg production 76.92% vs. 79.17% (P = 0.025); feed intake 92.63 vs. 91.54 g/hen/d (P = 0.032); egg weight 61.21 vs. 60.10 g (P < 0.001); egg mass 47.07 vs. 47.58 g/hen/d (P = 0.328); and specific gravity 1.0792 vs. 1.0797 (P = 0.071). Exp. 2 was a broiler breeder field trial utilizing 0% pre-trial or 0.5% dietary HSCAS for 2 wk in 4 flocks ~45 wk of age. Paired t-test results (n = 4; 50 eggs per sample) for egg shell breaking strength pre-trial and after HSCAS feeding, respectively, were 3.24 vs. 3.49 kg (P = 0.075). Exp. 3 was a broiler breeder field trial during hot summer weather comparing egg specific gravity (ESG) in 28 flocks (26 to 49 wk of age; mean 36 wk) fed 0% HSCAS (nCON) pre-trial and after 2 wk or 19 flocks (52 to 63 wk of age; mean 57 wk) fed 0% pre-trial and 0.5% dietary HSCAS for 2 wk. The ESG results for nCON (n = 28) were 1.08179 pre-trial vs. 1.07899 after 2 wk (-0.0028; -0.26%) and for 0% pre-trial (n = 19) 1.07813 vs. 1.07750 for 0.5% HSCAS after 2 wk feeding in hot weather (-0.0006; -0.06%) (1-way ANOVA of ESG 28 differences vs. 19 differences, P < 0.001). In Exp. 4 (30-59 wk) broiler breeders fed 0.5% HSCAS had 69.45% of hen-d egg production compared to 66.16% for nCON sister flock (P < 0.001; paired t-test by wk). Dietary HSCAS (0.5%) significantly improved egg production or shell quality compared to 0% HSCAS.

**Key Words:** Azomite, broiler breeder, egg shell, laying hen, specific gravity


An experiment was conducted to evaluate the effects of diets containing 15 or 23% distillers dried grains with solubles (DDGS) with and without a naturally occurring enzyme complex (Allzyme SSF®, Alltech Inc., Nicholasville, KY) on egg quality and yolk color. A total of 420 hens Hy-Line W-36 egg layers were randomly assigned to five treatments with seven replicate groups of 12 hens each. Treatments consisted of the following diets: 1) positive control (corn-soybean meal) 2) 15% DDGS, 3) 23% DDGS, 4) 15% DDGS + enzymes, and 5) 23% DDGS + enzymes. The four diets with DDGS had reduced levels of ME (2800 vs. 2877 Kcal/kg), calcium (4.1 vs. 4.2 %) and available phosphorus (0.17% for diets 15% DDGS or 0.2% for diets 23% DDGS vs. 0.29% for the control diet). Egg production was monitored for 24 weeks. Six eggs were collected randomly from each replicate every 4 weeks to determine egg quality. Egg production, percent shell, shell breaking strength or Haugh units were not significantly affected by the addition of 15 or 23 % DDGS to the diet. Egg weights were significantly depressed with the addition of 23% DDGS to the diet. The addition of enzyme to the 15% DDGS diet significantly increased yolk weight at 12 and 16 weeks of production. Yolk color was impacted by the addition of DDGS to the diet. Hens fed 15 or 23% DDGS, with or without enzymes, had lower yolk lightness (L*) compared with eggs from hens fed the control diet. Eggs from hens fed the control diet had lowest yolk yellowness (b*) score compared with those from other treatments. Hens fed 23% DDGS had higher redness (a*) values compared with those fed 15% DDGS and control, indicating a darker yolk color. The current study suggests that DDGS is a useful feed ingredient for laying hens. It could be included to the diet up to 23% without negative effects on egg quality. The addition of DDGS to the diets impacted yolk color and may be
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ABSTRACTS OF PAPERS

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Useful in specialty markets. Addition of Allzyme SSF® in DDGS diets with lower nutrient density had no effect on egg quality, suggesting that higher DDGS inclusion levels or lower levels of ME, Ca and available P should be evaluated in the future.

Key Words: DDGS, egg quality, yolk color


An experiment was conducted to compare the effects of feeding graded levels of organic and inorganic sources of Cu, Mn, Fe and Zn (Bioplex®, Alltech, Inc.) and selenium yeast (Sel-Plex®, Alltech, Inc.). The seven treatments consisted of feeding corn-soybean meal diets alone (control) and supplemented with Cu, Mn, Fe and Zn at 25, 50 or 100 per cent of the NRC (1994) requirements provided by either inorganic salts or organic sources. Selenium was provided at 0.075, 0.15 and 0.3 mg/kg as either sodium selenite or selenium yeast in diets containing 25, 50 and 100 per cent of the NRC requirements, respectively. The level of other nutrients were adjusted to meet the requirements for each stage of growth or production. Eight replicate groups of 16 chicks, 1 day of age, were randomly assigned to each treatment. At 16 weeks of age pullets were transferred to laying cages using 12 pullets per replicate and the mineral treatments were continued for 28 weeks of production. Body weight, feed intake, egg production rate, eggshell breaking strength, specific gravity, and per cent shell were not affected by dietary treatments. Feeding both organic and inorganic Se sources increased egg Se concentration, compared with the control treatment. Egg Se concentration was significantly higher (P < 0.001) for hens fed selenium yeast compared with those fed inorganic sodium selenite (0.15 vs. 0.12 µg/g fresh weight). The results shows that use of organic Se is useful in enhancing the Se concentration of eggs.

Key Words: trace minerals, mineral proteinates, selenium, laying hen, egg production


There has been increased interest in improving antioxidant nutrients in target tissues. A study was conducted to determine the effect of dietary supplementation of selenium yeast (Sel-Plex®, Alltech, Inc., Nicholasville, KY) and vitamin E on Se concentration in lungs of Cobb 500® broiler breeder pullets. A corn-soybean meal basal diet with no added Se or vitamin E was fed alone, supplemented with 0.3 mg Se per kg diet as selenium yeast, supplemented with 30 IU vitamin E per kg as all-rac-α-tocopheryl acetate, or supplemented with both selenium yeast and vitamin E. At 21 weeks of age, lung tissue samples were collected from two randomly selected birds from each of four replicate pens of 24 pullets per treatment and stored at <20°C for subsequent analysis. Samples were pooled within replicate groups, homogenized and then analyzed in duplicate for Se using digestion with nitric and perchloric acids and fluorometric detection. The Se concentrations (µg/g, wet basis, mean ± SD) in lung tissue from pullets fed the basal diet alone and supplemented with vitamin E were 0.18 ± 0.027 and 0.19 ± 0.027, respectively, while the respective values for pullets supplemented with Se yeast alone and with vitamin E were 0.39 ± 0.023 and 0.34 ± 0.023. Selenium supplementation, either alone or in combination with vitamin E, significantly increased lung tissue Se concentration (P < 0.05). The results indicate that dietary supplementation with selenium yeast is an effective method of increasing Se levels in lung tissue of broiler breeders. Enhancing the concentration of this antioxidant nutrient in lungs may be beneficial in improving the ability of poultry to handle respiratory challenges.

Key Words: selenium, yeast, vitamin E, lung, broiler breeder


An experiment was conducted to evaluate the effects of diets containing 15 or 23% distillers dried grains with solubles (DDGS) with and without a naturally occurring enzyme complex (Allzyme SSF®, Alltech Inc., Nicholasville, KY) on quality and yolk color of brown shelled eggs. A total of 420 hens Hy-Line Brown egg layers were randomly assigned to five treatments with seven replicate groups of 12 hens each. Dietary treatments consisted of feeding the following diets: 1) positive control (corn-soybean meal) formulated to be adequate in all nutrients 2) 15% DDGS, 3) 23% DDGS, 4) 15% DDGS + enzymes, and 5) 23% DDGS + enzymes. The four diets with DDGS had reduced levels of ME (2800 vs. 2877 Kcal/kg), calcium (4.1 vs. 4.2%) and available phosphorus (0.17% for diets 15% DDGS or 0.2% for diets 23% DDGS vs. 0.29% for the control diet). Egg production was monitored for 24 weeks. Six eggs were collected randomly from each replicate every 4 weeks to determine egg quality. Egg production, percent shell or shell breaking strength were not significantly affected by the addition of 15 or 23 % DDGS to the diet. Egg weight, yolk weight and albumen weight were depressed by the inclusion of DDGS in the diet. At 20 weeks of production there was no difference in albumen weight between the control and the 15% DDGS diet with Allzyme SSF®. At 16 weeks of production Haugh units were lower for the control treatment compared to the DDGS treatments. Yolk color was impacted by the addition of DDGS to the diet. Hens fed 15 or 23% DDGS, with or without enzymes, had lower yolk lightness (L*) compared with eggs from hens fed the control diet. Eggs from hens fed the control diet had lowest yolk yellowness (b*) score compared with those from other treatments. Hens fed 23% DDGS had higher redness (a*) values compared with those fed 15% DDGS and control, indicating a darker yolk color. The depression of egg weight with the inclusion of DDGS suggests it may be a useful tool to control egg size in brown egg layers. The addition of DDGS to the diets impacted yolk color and may be useful in specialty markets.

Key Words: brown egg layers, DDGS, egg quality, yolk color
P248  Effects of a liquid source of mannanoligosaccharide plus a yeast culture in broiler chickens. S. Gomez1,2, M. L. Angeles*1, and M. A. Islas2, 1INIFAP, Ajuchitlan, Colon, Qro, Mexico, 2FESC-UNAM, Ajuchitlan, Colon, Qro. Mexico.

Two growth performance experiments were carried out to evaluate increasing doses of a liquid mixture of cell wall components (MOS) plus a culture of Saccharomyces cerevisiae (CSs) added into the drinking water of broiler chickens. In both experiments, mixed sexes Ross 308 chickens were raised in 2x2 m2 floor pens. In experiment 1, 420 chicks from 1 to 21 d of age were used. Four pens with 35 chicks each were randomly assigned to 3 increasing levels of liquid MOS+CSc to ensure a daily intake of 0, 12.5 and 25.0 mg/bird of the product. To achieve this, the doses of liquid MOS+CSc that were supplied through the drinking water were adjusted twice a week. In experiment 2, 504 chicks from 1 to 35 d of age were used. Four pens with 42 chicks each were randomly assigned to 3 increasing levels of liquid MOS+CSc to ensure a daily intake of 0, 9.4 and 18.8 mg/bird of the product. At the end of experiment 2, three birds from each pen were killed and small intestine samples were taken for villi morphology analysis, mucosa measurements and mucin production determinations. Results were subjected to analysis of variance. Growth performance of birds was similar among treatments in both experiments. From 1 to 21 d of age showed that chicks supplied with liquid MOS+CSc had a trend for greater feed conversion ratio. The length and weight of the small intestine as well as the weight and area of the mucosa were similar regardless of the level of liquid MOS+CSc. Height, width and area of the villi were similar among treatments. There was a trend for a linear increments of total acid mucines (mg of Alcian blue) on the mucosa as the level of liquid MOS+CSc increased ($P<0.10$). From the pooled data, it was observed that the actual consumption of liquid MOS+CSc ranged from 11.0 to 35.0 mg/bird/day and that the better responses on feed conversion ratio were observed for low and averaged values. In conclusion, it was observed that liquid MOS+CSc improved the feed conversion ratio of chicks from 1 to 21 d of age and that the optimum inclusion rate was 0.02% for chicks from 1 to 7 d and 0.01% afterwards.

Key Words: broiler chicken, mannanoligosaccharide, yeast culture, drinking water


Numerous studies have shown that the inclusion of Bio-Mos®, a proprietary mannan-oligosaccharide product derived from yeast, improved the growth performance of broilers. This beneficial effect is frequently explained by improved integrity and pathogen exclusion capability of the gut. However, its molecular mechanisms need to be elucidated. Actigen® is a newly developed yeast product based on Bio-Mos® technology and its benefit on anti-nutritive effects related with dietary stress has been well established. The goal of this study is to investigate the effects of dietary inclusion of Bio-Mos® or Actigen® on the gene expression profiles of broilers, and to gain insight on the associated mechanisms. Seven chicks from each of three dietary groups: wheat-soy based challenge diet (Control), Control diet plus 2kg/ton Bio-Mos® or 400g/ton Actigen® were sacrificed at age of 21d, respectively. Jejunum samples were used for gene expression analysis using an Affymetrix microarray system. Results indicated that ingestion of either Bio-Mos® or Actigen® lead to dramatic changes on gene expression profiles. Out of ~19,000 transcripts expressed in the gut, 1571 and 1516 genes were identified significantly changed ($P<0.01$, fold change (FC) $>1.2$) by Bio-Mos® or Actigen®, respectively. A comparison of these genes indicated that 40% of those are commonly affected by both products. Gene set enrichment analysis indicates that many of the genes differentially expressed are involved in protein translation and signaling processes, such as inflammatory suppression, oxidative reduction and ATP biosynthetic processes. Significant changes of multiple immune related genes may explain the role of immune modulation, which has long been credited to Bio-Mos®. Results of this study provide a novel view to understand the nutri-physiological aspects related to these two products at the gene expression level.

Key Words: gene expression, Bio-M®, Actigen®, broiler chick
SCAD Posters

P250  Effect of toltrazuril on the absorption of synthetic pigment, the number of oocysts excreted in faeces and the enteric lesions in broilers after being vaccinated against Eimeria spp. R. Tejeda-Gil1, X. Hernandez-Velasco1*, V. M. Petrone-Garcia1, and B. Fuente-Martinez2, 1Departamento de Produccion Animal, Aves, FMVZ, UNAM, Mexico City, Mexico, 2Centro de Enseñanza, Investigación y Extensión en Producción Avícola, FMVZ, UNAM, Mexico City, Mexico.

This study evaluates quantity of synthetic pigment in plasma, number of excreted Eimeria oocysts, and enteric lesions in broilers after vaccination against Eimeria spp and treatment with toltrazuril (Tlz). Broilers raised in battery were feed with grower diet containing 65 ppm of synthetic ester yellow pigment C30 (ethyl ester acid β-apo-8’-carotenoic). Chicks were Coccivac B® vaccinated oral route on 5th, 10th, 15th and 20th days old respectively, challenged at 25 days old, treated with Toltrazuril (Tlz) at dose 7mg/kg oral route at 32-33 days old and were challenged again at 39 days old. From chickens of each group at 24 days old, weekly we were obtained plasma samples and optical densities were determined at 478 nm. Faeces collected from chickens of each group at 25 days old and weekly were evaluated by modified Mc Master method. From each chicken a segment of duodenum, jejunum and caecum, was taken to calculate extraepithelial inflammatory cells percentage (EICP). Data were analysed by analysis of variance, and mean values were analysed by Tukey test (P < 0.05). Vaccine and Tlz combination avoids pigment concentration reduction and vaccinated chickens its immune system can control Eimeria infection and reestablish pigment absorption. Tlz didn’t interfere with chickens’ immunity when they faced coccidial challenge (CC). Tlz seems to regulate immune reaction against CC chickens, while vaccinated and non Tlz treated chickens, duodenal EICP increases with CC.

Key Words: toltrazuril, Eimeria, coccidiocide, immunity, skin pigmentation

P251  Acquisition of immunity to the protozoan parasite Eimeria adenooides in turkey poults and the peripheral blood leukocyte response to a primary infection. U. Gadde*, H. D. Chapman, T. Rathamam, and G. F. Erf, Department of Poultry Science, University of Arkansas, Fayetteville.

Coccidiosis is a widespread disease of the intestinal tract of turkeys. One of the most common species in the turkey is E. adenooides. The objective of this study was to investigate the acquisition of immunity to E. adenooides in turkey poults. A primary infection of 12.5 × 10^3 oocysts, given to 20 d old poult, resulted in depression of weight gain, and the production of large numbers of oocysts in the feces. Poult were raised under conditions to prevent re-infection to determine the ability of the primary infection to confer protective immunity against a challenge infection of 5 × 10^3 oocysts given at 34 d of age. Using weight gain and oocyst production following challenge as criteria for protection, the results indicated that immunity had developed. The concentration and proportions among white blood cell (WBC) in peripheral blood were determined at different times following the primary infection. The WBC concentration of infected poult was elevated on d 7 and 11, primarily due to elevated levels of lymphocytes and monocytes on d 7, and eosinophils on day 11. There were no differences in heterophil and basophil concentrations. With the exception of increased percentages of eosinophils on d 11, infection was not associated with alterations in the proportions among WBC populations. Comparison of CD4 and CD8 defined lymphocyte sub populations in the blood of infected revealed higher concentrations of CD4+ lymphocytes on d 11, lower concentrations of CD8+ cells on day 4, and higher concentrations of CD8+ cells on d 11, as well as elevated ratios of CD4+ and CD8+ lymphocytes in infected birds on d 4 and 11. These alterations in WBC profiles suggest initiation of both innate and adaptive cellular immune activities designed to effectively cope with a parasitic, intracellular pathogen.

Key Words: Eimeria, turkey, immunity, leukocyte, cell-population analysis

P252  Estimating dosage of spray applied Mycoplasma gallisepticum vaccine in layer pullets. J. L. Purswell1, J. J. Mayer*2, J. D. Evans3, and S. L. Branton1, 1USDA-ARS Poultry Research Unit, Mississippi State, MS, 2Biological & Agricultural Engineering, Mississippi State University, Mississippi State.

Spray application of Mycoplasma gallisepticum (MG) vaccines is a labor and time saving means of mass vaccination of layer chickens. Recent assessment of spray characteristics has shown that the amount of respirable (< 5 micron) droplets from commonly used nozzles is negligible, and that deposition (i.e. volume deposited per area) is likely more important than droplet size. Mucous membranes such as the eye are typically cited as avenues for vaccine delivery, hence dosage via spray application will be dependent upon projected eye surface area and orientation to the spray plume. Projected eye surface area was measured in 24 10-week old Hy-Line W36 pullets using digital photogrammetry. Mean projected eye surface area was 0.495 sq cm with a standard deviation of 0.065 sq cm; maximum and minimum area was 0.350 and 0.645 sq cm, respectively. Dosage rates in the field are nominally 0.46 mL/bird; given the average deposition from commonly used nozzles is 1 µl/sq cm, the maximum possible dose delivered to the eye is 0.495 µl.

Key Words: vaccination, spray application, layer chicken

P253  Evaluation of Vaxxitek for IBDV control in layers on a commercial set. F. Perez1*, F. Perez1, R. Fernandez2, F. Rojo2, and T. Barboza3, 1University of Zulia, Maracaibo, Zulia, Venezuela, 2Merial Select, Inc., Gainesville, GA, 3University of Georgia, Athens.

Early vaccination against infectious bursal disease virus (IBDV) is a common practice on commercial poultry operations. However, the use of live attenuated vaccines can compromise the bursal integrity in young birds leading to immunosuppression and failure of vaccination programs against respiratory antigens. As an alternative, the use of viral vectors for transgenic expression of immunogenic proteins provides adequate protection without the initial bursal damage. The objective of this work was to assess layers IBDV field vaccination using Vaxxitek, a recombinant turkey herpesvirus (HVT) expressing the viral protein 2 (VP2) from the IBDV. At 1-day of age, 7.575 ISA-Brown layers were vaccinated with the recombinant HVT-IBDV by the subcutaneous route and compared along rearing and production with the same amount of birds vaccinated with a traditional vaccination program (days 7 and 18 intermediate IBDV). The results showed significantly higher bursal indexes and lower bursal lesions (P < 0.05) at different time points in the Vaxxitek group, suggesting better bursal integrity when compared with the traditional vaccination program. Molecular analysis at 28 days of age detected field strains only in the traditional group, indicating
**P254** Resistance of field isolates of *Eimeria* to the anticoccidial drugs amprolium, clopidol, diclazuril and monensin in the Turkey. T. Rathnam* and H. D. Chapman, *University of Arkansas, Fayetteville.*

The sensitivity of field isolates of turkey coccidia from the United States to the anticoccidial drugs amprolium, clopidol, diclazuril, and monensin was investigated. Calculation of a growth and survival ratio and optimal anticoccidial activity index was used to investigate drug sensitivity. Thirty-one isolates were collected from commercial turkey farms in 11 states in the US. Clopidol and diclazuril were the most effective, followed by monensin and amprolium. Isolates from 10 states were classified as resistant, and 1 partially resistant to amprolium. Those from 5 states were sensitive, 5 partially resistant, and 1 resistant to clopidol. Isolates from 3 states were resistant, 7 partially resistant, and 1 sensitive to diclazuril. Isolates from nine states were resistant and two partially resistant to monensin. Resistance was widespread in States from different regions of USA.

**Key Words:** anticoccidial drug, resistance, growth and survival ratio, optimal anticoccidial activity, turkey *Eimeria*

**P255** The effect of diluent choice on immune response to *Mycoplasma gallisepticum* vaccination. S. A. Leigh*, S. L. Branton, S. D. Collier, and J. D. Evans, *USDA-ARS South Central Poultry Research Unit, Mississippi State, MS.*

Immune response to the live *Mycoplasma gallisepticum* vaccine Poultvac® Myco F (Fort Dodge Animal Health) rehydrated with three different diluents was measured to determine the potential effect of diluent on immune response to the vaccine. Treatment groups included uninoculated pullets and pullets eye-drop inoculated with the vaccine rehydrated using either Opti-Vac™ (Animal Science Products), Sterile Diluent 28 (Fort Dodge), or distilled water. Four replicates of each treatment were used with five pullets in each replicate which were bled on a rotating basis. Pullets were bled daily for the first week, and weekly for weeks two through six. The serum plate agglutination (SPA) score for each serum sample was determined. Vaccinated pullets from each group showed an immune response based on SPA testing starting on day 6 post vaccination. No significant differences in results were found between the different diluents tested for either the time post-vaccination at which the immune response was detected or the SPA score obtained. These results suggest that all three diluents perform equally well for eye-drop vaccination.

**Key Words:** *Mycoplasma gallisepticum*, immune response, vaccination, diluent
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**In vivo retention of Mycoplasma gallisepticum F strain in commercial layers previously vaccinated with live or killed Mycoplasma gallisepticum vaccines.**  R. Jacob*,1, J. D. Evans2, S. A. Leigh2, S. L. Branton3, and E. D. Peebles4, 1Mississippi State University, Mississippi State, 2Poultry Research Unit, Agricultural Research Service, USDA, Mississippi State, MS.

*Mycoplasma gallisepticum* (MG) is a major and economically significant pathogen of avian species. In the table egg sector, live and killed MG vaccines are commonly used to protect against MG-associated economic losses. In the present study, commercial Single Comb White Leghorn laying hens were vaccinated via eye-drop according to the following treatments: 1) sham vaccination at 10 weeks of age (woa); 2) Mycoplasma Gallisepticum Vaccine® (MG strain ts-11, Merial Select Gainesville, GA) at 10 woa; 3) MG Bac® (emulsified bacterin, Fort Dodge Animal Health, Overland Park, KS) at 10 woa; and 4) Mycoplasma Gallisepticum Vaccine®/MG Bac® combination at 10 woa. Throughout the study, the birds were maintained in negative pressure fiberglass biological isolation units. At 45 woa, the layers were challenged with a laboratory stock of the 99th passage of the F strain of MG (FMG). At 54 woa, the birds were sampled via swabbing of the choanal cleft and DNA from the resulting swabs was isolated and analyzed via a PCR reaction specific for FMG. Preliminary results indicate that the treatments/vaccinations at 10 woa had no effect on the survival of FMG, as FMG was detected in 100% of the clinical samples tested independent of the previous treatments.

**Key Words:** *Mycoplasma gallisepticum*, mycoplasmosis, PCR, table egg layer, vaccine

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**Detection of infectious laryngotracheitis virus by loop-mediated isothermal amplification (LAMP).**  S. C. Ou*, T. V. Dormitorio, and J. J. Giambrone, Department of Poultry Science, Auburn University, Auburn, AL.

Infectious laryngotracheitis virus (ILT) is an acute respiratory disease in chickens. ILTV belongs to the Herpesviridae family and Alphaherpesvirus subfamily. The ILT is characterized by various pathotypes, which can cause mild clinical signs such as labored breathing, dyspnea, nasal and ocular discharge, drops in egg production and shell quality, and more severe signs such as bloody mucus in the trachea and mortality. Clinical signs are similar to other respiratory diseases, such as infectious bronchitis (IB), Newcastle disease (ND), and mycoplasmosis. Therefore, a rapid, accurate, and economical method is necessary for ILTV detection. We developed a sensitive DNA detection method--loop-mediated isothermal amplification (LAMP) to identify ILTV DNA. The LAMP assay, which has been used to diagnose diseases in other animals, is a novel method for DNA amplification. Six pairs of specific primers of the ILTV ICP4 gene were designed. The reaction was performed at 63°C within 60 minutes and the amplified products were visualized as a ladder-like pattern on agarose gels. It detected as few as 60 viral template copies/μl. The LAMP assay is a sensitive and specific test, which can be used for rapid ILTV detection.

**Key Words:** infectious laryngotracheitis virus, ILTV, loop-mediated isothermal amplification, LAMP

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**Eimeria tenella lesion development and oocyst output in cecal or fecal material following challenge in broilers: Influence of ad libitum and restrict feeding.**  J. Klein*,1, D. Caldwell1, J. Coppedge1, A. Jordan1, S. Pohl1, K. Jessen1, S. Fitz-Coy2, and J. Lee1, 1Texas A&M University, College Station, 2Intervet/Schering-Plough Animal Health, Summit, NJ.

An experiment was conducted to evaluate the effect of *ad libitum* and restrict feeding on the development of *Eimeria tenella* lesions, oocyst output in cecal or fecal material, and performance characteristics following experimental challenge in brooder batteries. One hundred and forty-four Cobb 500 by-product males were placed in battery pens with six chicks per pen. On day 20, half of the battery pens were placed on feed restriction, and chicks were challenged with one of three challenge levels (0, 5,000, and 20,000 oocysts). Cecal and fecal material were collected separately beginning on day 4 post-challenge through day 10 post-challenge for oocysts per gram determination. Six days post-challenge, three broilers from each pen were removed and subjected to necropsy for lesion assessment. Body weight gain was not affected due to challenge dose in either the *ad libitum* or restrict-fed broilers. However, feed conversion ratio was increased in restrict-fed broilers with the highest challenge level compared to the control and low challenge level. Higher lesions developed in the high challenged broilers compared to the low challenged broilers in both restrict and *ad libitum*-fed broilers. Oocyst output peaked between days 7 and 9 post-challenge. Oocyst concentration was higher in cecal droppings as compared to fecal material throughout peak shedding in both *ad libitum* and restrict-fed broilers. These data indicate that oocyst concentration in fecal material may underestimate the level of *Eimeria tenella* present in field conditions when used as the sole indicator of *Eimeria tenella* presence.

**Key Words:** *Eimeria*, broiler, oocyst shedding, coccidiosis, lesion

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**Lesion development, weight gain, and oocyst cycling in a horizontal Eimeria challenge model in broilers.**  S. K. Pohl*,1, J. T. Lee1, S. M. Anderson1, K. Jessen1, J. R. Coppedge1, and S. Fitz-Coy2, 1Texas A&M University, College Station, 2Intervet/Schering-Plough Animal Health, Summit, NJ.

The objective of this study was to examine the effectiveness of using a horizontal Eimeria challenge model to induce clinical infection in broilers by inducing body weight gain depression, intestinal lesion development, and oocyst cycling. The employed challenge model consisted of orally challenging 20 percent of placed broiler chicks as seeders at day of hatch (d0). Seeder chicks were then reared with non-challenged broiler chicks, or contacts, to allow for transfer or challenge of *Eimeria* from seeders to contacts. Seeder chicks received 5000 sporulated oocysts of a mixed species inoculum of field strain Eimeria on d0. A negative control group reared in a separate floor pen was maintained for comparison throughout the trial. Broilers were grown to 26 days of age. At d16 and d23, seeders, contacts, and controls were subjected to necropsy and examined for gross and microscopic lesion development. Body weights were obtained weekly and at each necropsy date. Fecal samples from rearing pens were collected and analyzed for oocyst shedding beginning on d6 and continuing on an every other day basis until termination. Body weight depression was first observed on d14.
in both the seeders and contacts. Depression in weight gain compared to controls continued throughout the duration of the trial. Microscopic lesion development was observed in contact birds in all regions of the gut on d16, however on d23, lesion development was observed only in the mid and lower regions of the intestine. Peaks in oocyst shedding were first observed at d12 in both the seeder and contact birds, and a second peak of similar magnitude was observed in the contact birds at d22. By the termination of the trial, oocyst shedding in both seeders and contacts was minimal. These data suggest that a horizontal challenge method can be effectively utilized to produce clinical Eimeria infection in experimental broilers.

Key Words: *Eimeria*, coccidiosis, broiler, oocyst shedding, horizontal challenge

**P262** Comparative analysis of genes in the replication transcription complex of infectious bronchitis virus. J. E. Phillips*, D. A. Hilt, and M. W. Jackwood, Poultry Diagnostic and Research Center, University of Georgia, Athens.

Infectious Bronchitis Virus (IBV) causes an upper respiratory disease in chickens. The viral genome is approximately 27kb, which is one of the largest single stranded viral RNA genomes. The pathogenicity of IBV has yet to be determined, but polyproteins 1a and 1b have been implicated as determinants. These two polyproteins go through post-translational cleavage resulting in 15 nonstructural proteins (nsps) that make up the viral replication transcription complex. Based on predictions of the primary amino acid sequence in other coronaviruses, nsp 14, an exoribonuclease, is thought to have proofreading capabilities, which is important in maintaining the integrity of this extremely large viral genome. In this study, we examined nsp 14 from several IBV strains to determine if conserved sequences associated with proofreading capabilities were present in IBV. We identified conserved residues that if altered could potentially change the mutation rate in IBV.

Key Words: coronavirus, exoribonuclease, infectious bronchitis virus

**P263** Campylobacter effects on chicken heterophil innate immune function. K. J. Genovese*, H. He, J. L. McReynolds, C. L. Swaggerty, and M. H. Kogut, USDA ARS FFBSRU SPARC, College Station, TX.

Campylobacter infections in humans linked to uncooked or improperly handled poultry products are a major public health concern. The Centers for Disease Control (CDC) estimates that 2.4 million people have disease associated with Campylobacter each year and approximately 124 people die from the disease. Our laboratory has previously shown that Campylobacter causes an inflammatory cell influx and mortality in an intra-abdominal model of infection. The purpose of the present study was to determine the effects of a field isolate of Campylobacter jejuni (CJ) on heterophil oxidative burst production in vitro. Newly hatched leghorn chicks were bled and the heterophils from pooled samples of blood were isolated using established methods. Heterophils were then incubated for 1 hr at 39 C in groups: CJ alone; CJ for 30 mins, followed by addition of SE for 30 mins; SE for 30 mins, followed by the addition of CJ for 30 mins; and CJ and SE simultaneously. Oxidative burst activity was then determined by measuring fluorescence. The heterophils incubated with CJ alone showed very little oxidative burst response. The SE alone heterophils showed a high level of oxidative burst activity, as did the SE followed by CJ group and the CJ and SE simultaneously. However, heterophils that were incubated with CJ for 30 mins followed by SE for 30 mins showed a minimal response, only slightly more oxidative burst activity than the CJ alone group. The results indicate that CJ reduces or dampens the oxidative burst response of heterophils when incubated alone or pre-incubated prior to the addition of SE.

Key Words: chicken, heterophil, campylobacter, oxidative burst, innate immunity

**P264** Kinetics of ELISA antibodies raised by an HVT-IBD vector vaccine applied in broiler chickens and laying hens. R. Merino*1, L. A. Rojas2, and R. Ochoa2, 1Facultad de Medicina Veterinaria y Zootecnia, UNAM, Mexico, DF, Mexico, 2Merial Mexico, SA de CV, El Marques, Queretaro, Mexico.

Infectious bursal disease (IBD) is a very economically important disease that affects commercially produced chickens, is caused by the IBD virus which targets the bursa of Fabricius, causing damage by destroying developing B lymphocytes. This study describes the serological data obtained with an HVT vector vaccine expressing the protective IBDV VP2 gene (Vaxxitek®, Merial), applied to broiler chickens and laying hens immediately after hatching. One broiler chickens flock (Farm A) was divided in two groups, one vaccinated with Vaxxitek and the other with an intermediate IBD vaccine applied at 8 and 18 d-o via the drinking water. Serum samples were taken at 2, 4, 5 and 6 w-o and tested by ELISA (ProFLOCK ® IBD+, Synbiotics Corporation). HVT-IBD vector vaccinated group had antibody GMT at 2, 4, 5 and 6 w-o of 12,798, 10,151, 11,924 and 12,561, which were statistically higher (P < 0.05) than those from the intermediate IBD vaccinated group (8,542, 8,873, 11,008 and 12,807, respectively) when analyzed by two factor ANOVA. Two additional broiler farms vaccinated with HVT-IBD vector vaccine were also tested by ELISA (two houses from farm B and one house from farm C). MGT from Farm B, house 1 were 10,770, 8,431, 5,397, 5,850, 8,231, 9,711 at 1 d-o, 2, 3, 4, 5 and 6 w-o, respectively; MGT from Farm B, house 2 were 4,771, 6,268, 7,509, 6,224, 8,363, 8,319 at 2, 3, 4, 5, 6 and 7 w-o; MGT from Farm C were 13,165, 10,635, 4,282, 7,696, 8,952, 8,231 at 1, 2, 3, 4, 5, and 7 w-o. In the other hand, one laying hen flock was vaccinated with Vaxxitek and tested by ELISA at 1 d-o, 3, 5, 6, 7, 8, 9, 10, 17, 25, 35, 45, and 55 w-o which MGT were 10,670, 9,829, 9,192, 8,835, 9,340, 9,231, 11,459, 10,934, 12,833, 10,854, 15,772, 15,342, and 16,287, respectively. According to these results, the HVT-IBD vector vaccine allows the broiler chickens to reach higher antibody titers than those from two intermediate IBD vaccination program, as seen in flock A; besides, the antibodies last for all the lifespan of both, broiler chickens and laying hens. The ELISA test (IBD+) showed to be a very helpful tool to confirm the vaccination efficacy.

Key Words: IBD, Vaxxitek, ELISA, broiler chicken, laying hen

A healthy gastrointestinal tract is critical for optimum growth and productivity of layers, breeders, and broilers. A healthy gut allows maximum nutrient absorption and acts as the first line of defense against disease. The intestinal microflora maintains bird health via competitive exclusion, production of anti-microbial molecules, and by supporting development and maturation of the intestinal immune system (gut associated lymphoid tissue or GALT). Commercial stressors, such as feed disruptions, disease challenges and antibiotics destabilize the gut microenvironment and shift the microbial balance to an overgrowth of pathogenic bacteria. To support intestinal health during stressful periods, Avi-Lyte™, a unique water-soluble product containing electrolytes, vitamins and avian-derived beneficial bacteria, was developed. The purpose of this field investigation was to determine the effects of Avi-Lyte™ on livability of replacement pullets. This trial was conducted on day-old pullets by a US egg integrator in a midwest location during the winter of 2008. The test group (n=2,423) was given Avi-Lyte™ for days 1-5 post placement according to manufacturer’s instruction. The control group (n=10,260) received the farm’s usual water-based vitamin protocol for the same period. Both groups were in the same house. Results on day 14 showed that the control group had 4.59% mortality compared with 1.98% for the Avi-Lyte™ group (P < 0.001). Odds ratio analysis showed that the Avi-Lyte™-fed birds were 2.4 times more likely to survive than control birds (P < 0.05, 95% CI, 1.76 to 3.21). These results demonstrate that Avi-Lyte™ improved survival compared with the farm’s usual protocol. Actively managing gut health improved performance and profitability for this producer.

Key Words: gut health, electrolytes, vitamins, stress, direct fed microbial


The poultry industry is investigating natural compounds to improve broiler performance in the face of enteric challenges such as coccidiosis and Clostridium perfringens. Oregano essential oil (OEO) is a natural feed flavorant that has been shown to improve broiler performance on farms with enteric challenges. Seven field investigations reported here show the effects of OEO on performance of broilers on commercial farms in the US and Ecuador. Results consistently showed that birds fed OEO (Regano® 500, Ralco Nutrition) performed as well as birds receiving anti-coccidial - AGP protocols (Table 1). Average daily gain and survival of OEO-fed birds were equal to or better than conventional birds in all seven trials. Feed conversion was equal to or better than controls in 3/6 trials. In the three trials that measured breast meat yield, OEO increased yield by an average of 0.86% in two trials. Although these trials were conducted in different seasons, under diverse environmental conditions, and with birds of varied genetic backgrounds, OEO-fed birds consistently demonstrated high performance that compared favorably with birds fed commercial in-feed protocols.

Table 1. Seven field trials showing the effects of OEO on broiler performance. Results are given as OEO value minus control value.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Days to market</th>
<th>Location</th>
<th>N</th>
<th>Control protocol</th>
<th>ADG</th>
<th>F:G</th>
<th>Survival (%)</th>
<th>Breast meat yield (%)</th>
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<td>1</td>
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<td>USA</td>
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<td>nd</td>
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</table>

aControl protocol: C = chemical, I = ionophore, AGP = antibiotic growth promoter

Key Words: oregano essential oil, broiler health, coccidiosis, gut health, antibiotic-free