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POSTER PRESENTATIONS

*AuthorPresenting Paper

W1 Feeding laying hens low-tanning sorghum does not necessitate extra supplements (methionine, lysine, choline, or sulfur). H. İmik, A. Hayirli*, L. Turgut, E. Laçın, S. Çelebi, F. Koç, and L. Yildiz, *Atatürk University, Erzurum, Turkey.*

This experiment was conducted to determine the effects of supplemental methionine, lysine, choline, and sulfur on laying performance, metabolic parameters, and egg quality of hens fed diets containing sorghum (*Sorghum vulgare*) during the peak laying period. Lohman layers ($n = 144$), 30-wk of age as 6 replicate cages of 4 hens, were allocated randomly to receive basal diets containing either 22% corn (B) or 22% sorghum (BS) and diets BS plus 0.57% methionine, 0.66% lysine, 0.47% choline, or 0.05% sulfur for 98 d. Feed intake (FI) and egg production (EP) were recorded daily, egg weight (EW) was measured bi-weekly, and body weight (BW) was measured monthly. A sample of 12 eggs from each experimental group was collected every month to evaluate egg quality. At the end of the experiment, blood samples were collected for metabolite concentrations. Data were analyzed using one-way ANOVA as repeated measures and significant differences between the experimental groups were assessed using Duncan Multiple Range test. Partial replacement of corn with sorghum in the basal diet did not affect BW, EP, and FCR but increased FI by 5.7% and EW by 2.4%. The effects of additives on laying performance were variable. Except for serum total protein (STP) concentration, other metabolic parameters were not affected by partial replacement of corn with sorghum in the basal diet. Hens fed diet BS had lower SPT concentration than hens fed diet B. Except for methionine supplementation, other supplements ameliorated depression in STP concentration. The additives did not affect other metabolic parameters. Egg quality responses to the experimental diets were also variable. Partial replacement of corn with sorghum in the basal diet did not affect eggshell characteristics (both thickness and stiffness), whereas it had variable effects on inner egg quality parameters (increased yolk index, depressed yolk color, and unaltered albumen index and Haugh unit). In conclusion, laying hen diets could include low-tannin sorghum (0.26%) up to 22% without necessitating extra supplements to overcome compromised performance.

Key Words: sorghum, methionine, lysine

W2 Influence of soybean meal sources and total lysine concentration of the diet on performance of broilers. E. Jiménez-Moreno, A. de Coca, J. M. González-Alvarado, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid, Spain.*

We evaluated the influence of two soybean meal (SBM) sources and three levels of total lysine (LYS) in the diet on productive performance

of Ross 308 broilers from 1 to 36 d of age. There were six treatments arranged factorially with two SBM sources (regular meal with 47.4% CP, and high quality meal with 49.5% CP) and three levels of LYS (105%, 115%, and 125% of NRC requirements in the starter diets, and 100%, 108% and 116% of NRC requirements in the finisher diets). Within each LYS level the amount of CP supplied by the high quality SBM (SBM-O) and the regular SBM (SBM-A) was similar and therefore, the percentage of SBM was lower in the SBM-O than in the SBM-A containing diets. Each treatment was replicated ten times (a cage with 10 chicks). The SBM-A was collected from a commercial supplier and was of Argentina origin. The SBM-O is marketed under the Soymax trademark and was obtained from Owensboro (Ohio) soybean crushing plant. Both starter (1 to 21 d of age) and finisher diets (22 to 36 d of age) were based on corn, soybean meal, and soy oil and contained 3,050 and 3,200 kcal ME/kg for starter and finisher diets, respectively. Average daily feed intake (ADFI) and average daily gain (ADG) were recorded at 3, 10, 21, and 36 d of age. From 1 to 36 d of age, broilers fed SBM-O had better ADG (63.0 vs. 59.7 g/d; $P < 0.001$) and gain to feed ratio (G:F) (0.668 vs. 0.641 g/g; $P < 0.001$) than broilers fed SBM-A. ADG and G:F increased linearly as the lysine content of the diet increased (0.633, 0.660, and 0.671 g/g for G:F; $P < 0.001$). At 21 d of age broilers fed SBM-O grew faster than broilers fed SBM-A in diets supplying the lowest lysine level (105% of NRC) but no differences were detected for the higher lysine levels ($P < 0.05$). We conclude that SBM-O improves productive performance of broilers with respect to SBM-A indicating a better availability of the CP fraction. Also, lysine requirements of broilers from 1 to 21 are at least 25% higher than current NRC recommendations.

Key Words: soybean meal, total lysine concentration, broiler

W3 Inclusion levels of corn distillers grains with solubles and poultry byproduct meal in market turkey diets. S. L. Noll* and J. Brannon, *University of Minnesota, St. Paul.*

In the Midwestern U.S., animal protein and corn derived distillers grains with solubles (DDGS) are often priced favorably to enter diets at levels considered "excessive". A feeding trial was conducted to examine different inclusion levels of poultry byproduct meal (PBM) and DDGS and their combined effect on market tom performance during 5-19 wks of age. Large White male turkey poults (Nicholas strain) were randomly assigned to pens (10/pen) at 5 wks age and fed one of the following diet treatments (T): 1. Corn and soybean meal control; 2. As T1 with PBM (8%); 3. As T1 with PBM (12%); 4. As T1 with DDGS (10%); 5. As T1 with DDGS (20%); 6. As T2 and T4; 7. As T2 and T5; 8. As T3 and T4; and, 9. As T3 and T5. Diets were formulated using digestible amino acids. Diet protein level was

established by using intact protein to meet the digestible thr at 100% of the NRC recommendation. All diets were supplemented as needed with lys and met to meet the NRC recommendations. The ratio of calcium: phosphorus was maintained at 2:1 to accommodate higher levels of phosphorus. Each diet was fed to 10 replicate pens. The experimental design was a completely randomized block design with a factorial arrangement of PBM and DDGS inclusion levels. At 19 wks of age, dietary treatment affected 19-wk body weight and feed efficiency (5-19 wks) ($P < 0.001$). The BW of the corn-soy control diet (T1) averaged 20.18 kg. Diets containing PBM (8 or 12%) or DDGS (10 or 20%) were not significantly different from the control. BW of turkeys fed diets containing PBM (8 or 12%) in combination with 20% DDGS was less than that of the control by 3.3%. A significant interaction existed for inclusion of PBM and DDGS ($P < 0.02$) for feed efficiency. Feed/gain of turkeys fed diets containing PBM (8 or 12%) or DDGS (10 or 20%) were not different from the control. However, the feed/gain increased for turkeys fed diets containing PBM (8 or 12%) in combination with 20% DDGS and were different from the control by 5 to 6 points. In summary, performance of turkeys fed 20% DDGS diets was not different from the control except when used in combination with high levels of PBM.

Key Words: turkey, distillers grains, poultry byproduct

W4 Apparent metabolizable energy and ileal amino acid digestibility of fababeans, lupins and peas for broiler chickens. V. Ravindran*, C. L. Nalle, and G. Ravindran, *Institute of Food, Nutrition and Human Health, Palmerston North, New Zealand.*

The nitrogen-corrected apparent metabolizable energy (AMEn) and apparent ileal digestibility (AID) of amino acids in 3 cultivars of Australian sweet lupin (*Lupinus angustifolius*), 3 cultivars of white lupin (*L. albus*), 4 cultivars of peas (*Pisum sativum*) and 4 cultivars of fababeans (*Vicia faba*) for broiler chickens were determined. For the purpose of comparison, a sample of soybean meal was also assayed. The assay diets were formulated by substituting the soybean meal and legumes for 50 and 25% (w/w), respectively, of a maize-soy basal diet. Legume seeds, with hulls, were crushed to pass through a 3-mm sieve in a hammer mill prior to inclusion into diets. All diets contained titanium oxide as an indigestible marker. The basal diet and the 15 assay diets were each fed to four pens of five male broilers from day 28 to 35 post-hatching. Total collection of excreta was carried out during the last 4 days for the determination of AMEn. On day 35, digesta from the lower half of the ileum was collected and apparent amino acid digestibility coefficients were calculated using marker ratios in the diet and digesta. Calculations were based on the assumption of additivity between the basal diet and test ingredient. Significant ($P < 0.05$) cultivar effects on AMEn were observed only for fababeans. The average AMEn of sweet lupin, white lupin, peas, fababeans and soybean meal were determined to be 1610, 2170, 2470, 2430 and 2650 kcal/kg DM, respectively. The AMEn of the two lupins were lower ($P < 0.05$) than those of other ingredients. No cultivar effects ($P > 0.05$) were observed for the AID of amino acids in any of the legumes. In general, the AID of amino acids in two lupins were similar to those in soybean meal. The AID of threonine, cysteine, proline and tyrosine were lower ($P < 0.05$) in peas and fababeans compared to those in soybean meal. The mean AID coefficients of 17 amino acids in sweet lupin, white lupin, peas, fababeans and soybean meal were 0.84, 0.87, 0.85, 0.83 and 0.80, respectively.

Key Words: apparent metabolizable energy, amino acid digestibility, broilers

W5 Effects of the level of canola meal, lysine and energy in the rations of broiler chickens. S. Gomez* and M. L. Angeles, *National Center for Disciplinary Research in Animal Physiology, Ajuchitlan, Queretaro, Mexico.*

The objective was to evaluate productive responses, carcass yield, tissue composition and accretion rates and the efficiency of protein deposition in the meat of broiler chickens fed diets with soybean meal (SBM) or canola meal (CM). In experiment 1 (Exp 1), 36 male broiler chickens from 43 to 56 days of age were assigned to 3 diets with increasing amounts of CM (0, 10 and 20%) and 2 levels of digestible lysine (0.85 and 0.95%) for a total of 6 treatments. In experiment 2 (Exp. 2), 72 broiler chickens (half females and half males) from 28 to 42 days of age were assigned to 2 diets based on SBM or CM as the main proteic ingredient and 3 energy levels (3.0, 3.1 and 3.2 Mcal ME/kg) for a total of 6 treatments. In both experiments, birds were allocated individually and the slaughter methodology was used to estimate the tissue deposition rate and the efficiency of protein deposition in the breast (Exp. 1) or carcass (Exp. 2). In Exp. 1, no statistical differences were observed in any of the response variables evaluated. In Exp. 2, feed intake (129.9 vs 121.8 g/d, 2.326; $P < 0.05$), energy intake (0.403 vs 0.378 Mcal/d, SEM=0.0072; $P < 0.05$) and protein intake (22.47 vs 21.44 g/d, SEM=0.395; $P < 0.05$) were improved with SBM. Feed efficiency (0.467 vs 0.521, SEM=0.023; $P < 0.05$) was greater with CM. Fat content (2.75 vs 2.18 %, SEM=0.201; $P < 0.06$) and fat deposition (0.360 vs 0.265 g/d, SEM=0.0353; $P < 0.06$) in the meat of the carcass were increased with SBM. Energy intake (0.362, 0.401 and 0.408 Mcal/d, SEM=0.0085; $P < 0.01$) and body weight gain (56.24, 63.46 and 66.30 g/d, SEM=3.437; $P < 0.05$) were increased linearly as the level of dietary energy increased. In summary, the results indicate that is feasible to replace up to a 100% of SBM by CM in rations of broilers without any detrimental effect on growth, carcass yield and composition and the accretion rate and efficiency of protein deposition in the meat of the carcass.

Key Words: broiler chickens, canola meal, lysine-energy

W6 Effect of Betafin® and salinomycin on oocyst production of broilers exposed to either *Eimeria acervulina* or *E. tenella*. J. C. Remus*¹ and J. L. McNaughton², ¹Danisco Animal Nutrition, St. Louis, Missouri, ²Solution BioSciences, Inc., Salisbury, Maryland.

Previous trials have examined the impact of Betafin®, natural betaine, on intestinal integrity and bird performance. This 2 x 2 x 2 factorial design examined 0 or 0.15% Betafin (Bet), 0 or 60 g/t salinomycin (Sal) in the presence of either *Eimeria acervulina* (EA) or *E. tenella* (ET) challenge. Each treatment had 5 replicate battery pens containing 5 chicks per pen. Chicks were orally challenged at 12 days of age with 10,000 oocysts each of either EA or ET. From 18 to 21 days, daily collection of excreta was taken for oocyst measurement. Birds were weighed on day 21, lesion scores were measured on day 22. Probability was set at $P < 0.05$. At 21 days of age, birds supplemented with either Sal or Bet were heavier and shed less oocysts than control counterparts. Birds challenged with ET were lighter in weight and shed fewer oocysts than those given EA. Mortality-corrected FCR (mcFCR) and liveability were improved with the use of Sal. Challenge with ET worsened mcFCR compared to conversion of those birds given EA. Total intestinal lining (lesion) score was reduced (or improved) in birds given Bet or Sal. A significant interaction between Sal and coccidia type was due to a greater reduction in lesion score and oocyst output for EA-challenged broilers given salinomycin than for ET-challenged

birds. No other interactions were present. Treatwise, the combination of Bet and Sal had the greatest improvement in lesion score for either EA or ET challenge. Body weight of ET-challenged chicks was improved with Bet + Sal versus other ET treatments. Overall, these results indicate that Betafin and salinomycin in combination is likely to have the greatest impact on lesion scores and oocyst output.

Table 1.

Main effect	Additive	Weight (g)	Cumulative mcFCR	Total lesion score	Oocyst (#/day)	Mortality (%)
Bet	No	571 B	1.344	2.75 B	9133 B	7.0
	Yes	585 A	1.335	2.29 A	8381 A	8.0
Coccidia	EA	588 A	1.325 A	2.69 B	11,167 B	6.0
	ET	567 B	1.354 B	2.35 A	6347 A	9.0
Sal	No	564 B	1.363 B	3.45 B	10,188 B	12.0 B
	Yes	592 A	1.316 A	1.59 A	7326 A	3.0 A
Interaction	EA	No Sal		3.83	13,205	
	EA	Sal		1.55	9129	
	ET	No Sal		3.08	7170	
	ET	Sal		1.63	5523	

A,B: significant difference at $P < 0.05$ within that parameter

Key Words: betaine, coccidia, salinomycin

W7 Use of Bioplex/Sel-Plex trace minerals in commercial tom turkey diets from 0 to 19 weeks of age. C. Novak*¹, L. Lihong¹, A. P. McElroy¹, and A. Sefton², ¹Virginia Tech, Blacksburg, ²Alltech Inc., Nicholasville, Kentucky.

A study was conducted to test the effectiveness of low levels of organic minerals in place of a commercial trace mineral (TM) program on tom turkey performance from 0 to 19 wks of age. 1224 Hybrid poulters were received from a commercial hatchery and randomly assigned to one of four dietary trt (7 reps (pens)/trt). Experimental treatments consisted of: a positive control (PC), a negative control (trace minerals at 10% of PC - NC), and two regimens of Bioplex/Sel-Plex (1.5 lb/ton during starter and 1 lb/ton for grower and finisher - O1; 1.5 lb/ton for entire trial - O2). Bioplex/Sel-Plex treatments supplied TM at or below the level of NC. Commercial management practices were followed for the duration of the trial with poulters provided ad libitum access to feed and water (via Plassan drinkers). Body weight (BW), feed conversion (FCR), feed intake (FI) and fresh feces data was collected at feed changes (0, 49, 70, 84, 105 and 133 d of age), while bone breaking strengths (BBS) were collected at 49, 84 and 133 d of age. Litter TM concentration and breast yield were determined at 133 d. Overall, cumulative BW and gain, FCR and FI were not affected ($P > 0.05$) by dietary treatments with average BW and FCR of 16.72 kg and 2.41 g feed/g gain, respectively. Manure trace mineral content (manganese-Mn and zinc-Zn) was reduced ($P < 0.05$) feeding O1, O2 and NC compared to PC through out the trial. Copper excretion was significantly reduced similarly after 84 days of age. BBS of femur and tibia were only affected at 49 days of age with tibia and femurs from NC, O1 and O2 having reduced BBS compared to PC. Mn and Zn concentration in litter was reduced when feeding NC, O1 or O2. Breast yield at processing was improved ($P < 0.05$) feeding either O1 or O2 compared to PC. Overall, the data indicated the use of 10% commercial trace minerals or Bioplex/Sel-Plex in the diet of tom turkeys is adequate for

growth and performance and the use of organic minerals may increase breast yield at slaughter.

Key Words: organic trace minerals, nutrition, turkeys

W8 Impact of wheat middlings, citric acid, and phytase on phosphorus utilization and growth performance of broiler chicks in the starter phase. T. O'Connor-Dennie* and J. L. Emmert, University of Arkansas, Fayetteville.

An experiment was conducted to investigate interactions among citric acid (CA), wheat middlings (WM), and phytase in P-deficient corn soybean meal diets and its impact on growth and P utilization during the starter phase. Male broilers were raised in battery cages and fed experimental diets from day 7 to 21. Each dietary treatment was fed to 6 replicate pens containing 5 chicks. Diets 1 through 4 consisted of a P-deficient diet with graded levels of supplemental P (0, 0.04, 0.08, or 0.12 % P). Diets 5 through 15 were as diet 1 with phytase (300 or 600 FTU/kg), CA (3%) or WM (10%), alone or in combination. There was a linear response in growth and bone strength to supplemental P levels ($P < 0.05$), and adding phytase also improved growth and bone strength on low-P diets ($P < 0.05$). Adding CA increased gain and bone strength when compared to the negative control ($P < 0.05$); but did not restore it to the levels of the adequate diets. Combining phytase and CA improved growth and bone strength ($P < 0.05$). To assess bioavailable P release, standard curves were used with adjusted bone strength (ABS) (kg/mm²) and gain (g/c) as dependent variables and supplemental P consumption (g) as the independent variable. Phytase released at least 0.108 % P for ABS and gain. Citric acid released 0.056 % P and combining CA and phytase released at least 0.137 % P, which was higher than the amount released by phytase ($P < 0.001$). Combining all three supplements released 0.146 and 0.200 % P at 300 and 600 FTU/kg of phytase respectively, which was greater than P released by any supplement alone ($P < 0.001$). Furthermore, chicks fed diets containing 600 FTU/kg had a greater bioavailability of P compared to those fed 300 FTU/kg of phytase ($P < 0.0001$). These results suggest synergism between phytase, CA, and WM that can improve growth and bone strength, which is further enhanced by increasing phytase from 300 to 600 FTU/kg.

Key Words: citric acid, phytase, wheat middlings

W9 Effect of varying concentrations of dietary crude protein and metabolizable energy on laying performance of Pearl Grey guinea fowl hens. S. N. Nahashon*, N. Adefope, A. Amenyonu, and D. Wright, Institute of Agricultural and Environmental Research, Tennessee State University, Nashville, Tennessee.

This study was conducted to evaluate optimum dietary concentrations of metabolizable energy (ME) and crude protein (CP) for egg production performance of the pearl grey guinea fowl laying hens. In a 2 x 3 factorial arrangement, 360 Pearl Grey guinea fowl replacement pullets (22 wks of age) were randomly assigned to experimental diets with 2,800 and 2,900 kcal of ME /kg of diet each containing 14, 16 and 18% CP, respectively. Each dietary treatment was replicated 4 times, and feed and water were provided ad libitum. Experimental birds were raised in laying cages and received 16 hr light throughout the study period. The birds were observed for feed consumption (FC), hen-day egg production (HDEP), egg weight (EW), egg mass (EM), feed conversion ratio (FCR), internal egg quality (IEQ), shell thickness

(ST) and body weights at the end of each 28-day lay period for 6 consecutive periods (26-50 wk of age). Mortality was recorded as it occurred and the study was repeated two times. Mean HEP, EW, EM, and ST were higher ($P < 0.05$) in hens receiving diets with 2,800 kcal of ME/kg of feed than those fed diets containing 2,900 kcal of ME/kg of diet. Hens on 14% CP diets also exhibited higher ($P < 0.05$) HEP, EM and ST than those fed diets containing 16 and 18% CP diets. Mean FCR of birds on 2,800 kcal of ME/kg and 14% CP diets were significantly lower than those of hens on other dietary treatments. Differences in FC, EW, IEQ, BW and mortality among dietary ME and CP concentrations were not significant ($P > 0.05$). Overall, diets comprising 2,800 Kcal of ME/kg of diet and 14% CP were utilized more efficiently by the pearl gray guinea fowl laying hens at 26 to 50 wks of age.

Key Words: Pearl grey guinea fowl, metabolizable energy, crude protein

W10 Effect of drinking water nitrate on broiler performance. C. W. Ritz*, A. B. Batal, B. D. Fairchild, and P. Sedlacek, *University of Georgia, Athens.*

Standards for poultry drinking water state that there should be less than 10 ppm of nitrate. Two experiments were conducted to evaluate the effects of nitrate addition in the drinking water on broiler performance. Cobb 500 by-product male broiler chicks were housed in batteries equipped with a nipple water system. Chicks were fed a corn-soybean meal diet and were allowed ad libitum access to feed and water. Chick weight, feed intake, and water consumption were recorded weekly throughout the 35 d experiments. In Experiment 1, five replicate pens of ten birds were allotted to the water treatments which consisted of 0, 6.25, 25 and 100 ppm of nitrate. No performance parameters were significantly affected by the inclusion of nitrate. Therefore, in Experiment 2, five replicate pens of ten birds were allotted to the water treatments which consisted of 0, 200, 400 and 600 ppm of nitrate. Water treatments were mixed on a weekly basis. Water analysis for total nitrate was conducted on samples obtained each wk. Blood analysis was conducted on d 35 of Experiment 2 to determine blood nitrate levels. Water intake was not affected by the inclusion of nitrate in either experiment. The addition of 400 ppm of nitrate in the drinking water of broiler chickens significantly reduced chick weight gain during wk 4 and 5, respectively, and the gain:feed ratio during wk 5 in Experiment 2 compared to the chicks on the control city water. Nitrate levels of 600 ppm reduced all performance parameters evaluated compared to the control, although this effect was not significant. Blood nitrate levels at 35 days were significantly higher in the 400 and 600 ppm treatments over the control. Blood oxygen, total hemoglobin, CO hemoglobin, and methemoglobin levels were not significantly different between the treatments in Experiment 2. Based on these results, water nitrate levels up to 200 ppm did not impact broiler performance, however, levels greater than 200 ppm may reduce broiler performance. In contrast to published water quality standards, negative effects of water nitrate were only observed with levels that exceeded 200 ppm.

Key Words: broilers, water, nitrate

W11 Effect of feeding quinoa on the egg production performance of laying chickens. N. P. Johnston*¹, G. Aduviri², A. C. Christensen¹, and A. Parker¹, ¹*Brigham Young University, Provo, Utah*, ²*University of San Andres, La Paz, Bolivia.*

Quinoa is a high protein pseudo grain whose lysine content as a percent of protein is similar to soybean meal and it is produced in abundance in Bolivia and Peru. To date little is known of its feeding value for animals. It was hypothesized that quinoa could be substituted for corn on an isonitrogenous-isocaloric basis and support lay as well as corn-based diets. To test the hypothesis 15 twenty wk old SCWL were equally divided into three treatment groups according to the substitution of quinoa for corn in the grain fraction of the diet - 0, 50, 100%. The birds were maintained in individual cages and housed in environmentally controlled rooms with an ambient temperature of 18 C and a light dark cycle of 14L:10D. Egg production and egg weight were observed daily, feed consumption and shell thickness weekly and body weight every four weeks for 16 weeks. Though the feeds were similar in caloric content there was a noticeable decrease in feed consumption ($P < 0.05$) for the 100% quinoa (84.4 g/day) and 50% quinoa groups (89.g/day) as compared to the corn-based diet (98.7 g/day). The diminished feed intake did not affect egg numbers or egg weight but resulted in reduced final body weights ($P < 0.05$) for 100% quinoa (1348 g) compared to the corn control (1656 g). Though not significant the reduced feed intake appeared to affect shell thickness with reduced egg specific gravity for the 100% quinoa feeding (1.0995 vs. 1.0970). As hypothesized quinoa supported lay as well as corn substituting at either a 50% or 100% rate; however, it appears to be less palatable than corn as evidenced by lower feed intake which translated into reduced body weight and over a prolonged lay period may prove to have a negative impact on production.

Key Words: quinoa, production, egg

W12 The use of degermed-dehulled corn for rearing turkey toms to market age. J. L. Godwin and J. L. Grimes*, *North Carolina State University, Raleigh.*

Degermed-dehulled corn (DDC) is produced by dry milling and results in the removal of 80% of the corn phytate phosphorus (P). An experiment was conducted to determine if feeding DDC to male turkey poulters would support growth and performance as well as feeding normal corn (NC) for rearing turkeys to market age. Nicholas male turkey poulters (288) were reared in a curtain-sided house with 16 pens (18 birds per pen) until market age with 4 pens per treatment. Treatments were in a factorial arrangement with two types of corn (NC & DDC) and two Ca and available P levels; 15% above (CPA) and 15% below (CPB) recommended NRC (1994) levels. Toms were fed typical starter, grower and finisher rations. Feed and water were provided ad libitum. Individual BW, feed consumption and feed conversion (FC) were determined at 3, 6, 9, 12, and 18 wk. Percent toe ash, tibia breaking strength, AMEn, apparent nitrogen retention (ANR), and fecal P levels were measured at 3 and 6 wk. Data were analyzed using GLM and means were separated using LSMEANS of SAS ($P < 0.05$). Neither BW (18.3 + 0.2 kg) nor FC (2.66 + 0.04) were affected by corn type or Ca & P level at 18 wk. Poults fed CPA vs. CPB had higher toe ash (16.6 vs. 15.1 + 0.5 %), increased bone breaking strength (10.70 vs. 9.99 + 0.25 kg/mm²) and increased fecal P (2.4 vs. 1.4 + 0.1 %) at 3 wk regardless of corn type. At 6 wk, CPA

vs. CPB diets resulted in increased bone breaking strength (11.98 vs. 10.25 + 0.32 kg/mm²), fecal P (3.3 vs. 1.4 + 0.3 %), and AME (3058 vs. 2794 + 59 kcal/kg). ANR was not affected by corn type, Ca & P level or the interaction of the two at 3 or 6 wk. Using DDC resulted in turkey performance equal to using normal corn.

Key Words: degermed-dehulled corn, turkey, feed

W13 Relative biological availability of Ca and P in six sources of raw rock phosphates fed to broiler chickens. G. Diaz*¹, A. Cuesta², and G. Afanador³, ¹*University of Guelph, Guelph, ON, Canada*, ²*Universidad de Ciencias Agrarias, Bogota, Cundinamarca, Colombia*, ³*Universidad Nacional de Colombia, Bogota, Cundinamarca, Colombia*.

Two experiments were carried out to determine the relative biological availability (RBA) of Ca and P in 6 sources of raw rock phosphate (RRP). The effect of fluorine on the percentage of tibia ash and on BW gain was also determined in a third trial. Experimental diets were sorghum and soybean meal based with no supplementary Ca and P. One d old Starbro chickens were fed the experimental diets for 21 d. Tibia ash was determined by combustion in a muffle furnace at 600° C. In the first experiment, Ca was fed at 0.2, 0.25, 0.3, 0.35 and 0.4% Ca with a Ca: P ratio of 1: 2. In the second experiment, 0.1, 0.15, 0.2, 0.25 and 0.3% P was fed with 1% Ca. To assess the RBA of Ca, diets were supplemented with 0.25% and 0.35% of Ca from RRP. To assess the RBA of P, diets were supplemented with 0.1% and 0.2% of P from RRP. The mineral sources were calcium carbonate for Ca and monobasic sodium phosphate for P. To calculate the RBA, the percentage of tibia ash obtained from rock phosphate at any concentration of Ca or P were compared with the estimated concentration of the element in the equation to obtain an equal percentage of tibia ash from control sources. The ratios of the concentrations of the element in the rock to the element in the reference were then made to determine the RBA. The effect of F was determined by comparing the supplementation with 100, 300, 500, 700 and 900 ppm of F to a control fed 1% Ca and 0.4% P. The RBA of P was between 26 to 87%; the RRP from Pesca had the highest RBA at 84% when P addition was 0.1% and 87% when P addition was 0.2%. The Ca RBA was between 22 to 85%. The rock from Santander had the highest RBA of 85% when Ca addition was 0.35%. Other sources of RRP had RBA below 52% for both Ca and P. There was a negative linear response to increases of F on ash percentage ($P < 0.01$) and on BW gain ($P < 0.01$). Fluorine has a detrimental effect on bone-ash formation that may reduce the RBA of raw rock phosphates.

Key Words: calcium, fluorine

W14 The effect of calcium carbonate particle size and solubility on the utilization of phosphorus from phytase for broilers. M. K. Manangi* and C. N. Coon, *University of Arkansas, Fayetteville*.

A twenty-eight day floor pen experiment was carried out using 1680 Cobb 500 male day old chicks to evaluate the impact of feeding different particle sizes of calcium carbonate on broiler performance and tibia ash. The experiment consisted of 8 treatments with 6 replications per treatment to test 8 different CaCO₃ particle sizes. The eight treatments had 8 different CaCO₃ particle sizes. The corn soybean basal contained 21.5% CP, 3025 kcal ME/kg, 0.78% Ca, 0.20% NPP with 500 FTU/kg of Danisco Phyzyme XP added. The average particle

sizes of CaCO₃ (along with % solubility) tested were 28 (74.4), 137 (56.4), 299 (47.0), 388 (53.0), 519 (46.7), 760 (45.3), 796 (72.2), and 1306 (43.4) microns. Significantly ($P < 0.05$) increased weight gains were obtained in chicks fed CaCO₃ particle sizes between 137 and 388 microns compared to the gains obtained by feeding either the smallest (28) or largest particle (1306) sizes. An increased mg of ash per tibia was also obtained for the chicks fed CaCO₃ particle sizes ranging from 137-388 as compared to the smallest (28) or largest particle (1306) sizes. An in vitro phytate P hydrolysis by a 3-phytase at pH 2.5 and 6.5 using the same 8 different particles sizes of CaCO₃ at 9 g/kg diet was carried out to evaluate the effect of Ca particle size on phytate P hydrolysis at 15, 30, 60, and 120 min incubation at 37 C. The results indicate a significant ($P < 0.05$) interaction of Ca particle size and pH on phytate P hydrolysis with greater effect at pH 6.5. The main effect of particle size showed that the smallest particle size (28 microns) with more solubility (74.4%) had the lowest phytate P hydrolysis indicating the interference on the action of phytase on phytate hydrolysis due to Ca-phytate complex formation. In summary, both in vivo and in vitro studies indicate that a small calcium particle size (28 microns) limestone with a high solubility (>70.0%) limits phytase hydrolysis to provide available P for growth and bone ash formation.

Key Words: CaCO₃ particle size, phytate hydrolysis, broiler

W15 Methionine requirements of alternative slow-growing genotypes. A. Fanatico*, P. Pillai, T. O'Connor-Dennie, and J. Emmert, *University of Arkansas, Fayetteville*.

In the U.S. synthetic methionine (MET) will be banned from organic poultry diets in the future. Slower-growing alternative genotypes may be useful in organic production; they are less heavily muscled and may be expected to have lower MET requirements. Six trials were conducted to determine the MET and sulfur amino acid (SAA) requirements of alternative genotypes during the starter (7 to 21 d), grower (28-42 d), and finisher (49-63 d) phases. In each trial, five graded levels of DL-MET were added to corn-peanut meal basal diets that were deficient in MET (MET requirement trials) or MET and cysteine (CYS; SAA requirement trials). Experimental diets were fed to three genotypes: slow-growing (S), medium-growing (M) and fast-growing (F; starter and grower phase only). Each dietary treatment was fed to five replicate pens containing five male chicks (starter period) or thirteen male chicks (grower and finisher phases). Growth data were fitted to a broken line (when appropriate) such that an objective inflection point could be established. For each genotype (with the exception of the S birds in experiment 4), weight gain and feed efficiency increased ($P < 0.05$) with addition of DL-MET in experiments 1, 2, 3, and 4. Broken-line analysis with weight gain regressed against digestible MET or SAA intake revealed MET requirements (for S, M, and F genotypes, respectively) of 0.33, 0.30, and 0.33% for the starter phase and 0.28, 0.29, and 0.28% for the grower phase. In the finisher phase, the estimated MET requirement for the S genotype was 0.25%; no ($P > 0.05$) weight gain or feed efficiency response occurred in the M genotype in response to DL-MET addition, indicating that the basal diet contained adequate MET (0.22%). For the starter and grower periods estimates of SAA requirements ranged from 0.57 to 0.60%, regardless of genotype; extreme variability prevented the estimation of SAA requirements during the finisher phase. These data indicate that the MET and SAA requirements of the various genotypes are similar during the starter and grower phases.

Key Words: slow-growing, methionine, organic

W16 Influence of proteases on the apparent metabolizable energy (AME_n), ileal and total tract nitrogen digestibility and performance of broilers fed corn-soy diets. H. Schulze*¹, V. Ravindran², and P. J. Moughan³, ¹Danisco Animal Nutrition, Leiden, The Netherlands, ²Institute of Food, Nutrition and Human Health, Palmerston North, New Zealand, ³Riddet Centre, Massey University, Palmerston North, New Zealand.

The soybean meal has a lower energy value than would be predicted from its chemical composition. The energy and protein utilization in soybean meal may be improved by supplementation with exogenous proteases (PROT). The present study was conducted to evaluate the effects of 3 PROT on the performance, AME_n and ileal and total tract N digestibility of broilers fed corn-soy diets. Each of the 3 PROT was tested at 3 inclusion levels (PROT1, 50, 100 and 1000 mg/kg; PROT2, 75, 150 and 1500 mg/kg; PROT3, 75, 150 and 1500 mg/kg) and compared with the unsupplemented diet. Each of the 10 diets was randomly assigned to 15 individually-caged birds and fed from d 7 to 28. Total excreta collection was carried out from d 24 to 27. On day 28, all birds were euthanized and digesta contents from the lower half of the ileum collected and pooled to yield five replicates per treatment. PROT treatments had no effects on weight gain (P = 0.11) and feed intake (P = 0.20), but significantly (P < 0.05) influenced feed/gain of broilers. All 3 inclusion levels of PROT1 improved (P < 0.05) feed/gain over the unsupplemented control, but for the other PROT enzymes the differences were significant (P < 0.05) only with PROT2 at 75 mg/kg and PROT3 at 150 mg/kg. Enzyme treatments significantly increased (P < 0.001) the AME_n values. At all three inclusion levels of PROT1, PROT2 at 1500 mg/kg and PROT3 at 150 and 1500 mg/kg the AME_n was improved (P < 0.05) over the unsupplemented control diet. Total tract N digestibility was significantly (P < 0.001) influenced by protease treatments. N digestibility was improved by all 3 inclusion levels of PROT1 and PROT2. Ileal N digestibility, in general, followed the same pattern as the excreta N digestibility, but the differences between the enzyme treatments only tended to be significant (P = 0.09). These data are suggestive of the potential of supplemental proteases in corn-soy based poultry diets. In the present study, PROT1 was particularly effective in improving performance, and, energy and nitrogen utilization of broilers fed corn-soy diets.

Key Words: protease, metabolizable energy, broiler

W17 Investigation of relative bioavailability value and requirement of organic Zn for chicks. T. Ao*, J. L. Pierce, R. Power, K. A. Dawson, A. J. Pescatore, A. H. Cantor, and M. J. Ford, *Alltech-University of Kentucky Nutritional Research Alliance, Lexington.*

Two studies were conducted to investigate the relative bioavailability value (RBV) of Bioplex[®] Zn (a chelated Zn proteinate) comparing with ZnSO₄•7H₂O for chicks and to determine the requirement of organic Zn for broiler chicks. A practical corn soybean meal diet without Zn supplementation, containing 23 mg/kg Zn, was used as a basal diet. One-day-old male broiler chicks were used in both studies. Chicks were housed in starter cages with plastic-coated feeders in an environmentally controlled room. Regular tap water with no detectable Zn and feed were supplied on an ad libitum basis. In study 1, treatments consisted of feeding basal diet alone or with three supplemental levels of Zn (20, 40 and 80 mg/kg) either from Bioplex[®]

Zn or from analytical ZnSO₄•7H₂O. Six replicate cages of six chicks were randomly assigned to each of seven dietary treatments. Zinc supplementation increased (P < 0.01) weight gain. Total tibia Zn increased linearly when the first three levels of Zn were fed. There was no difference between two Zn sources. In study 2, treatments consisted of feeding basal diet alone or with four supplemental levels of Zn (5, 10, 20 and 40 mg/kg) either from Bioplex[®] Zn or from ZnSO₄•7H₂O. Eight replicate cages of six chicks were randomly assigned to each of the nine dietary treatments. Zinc supplementation significantly increased (P < 0.01) feed intake. Weight gain increased linearly (P < 0.01) with the first three levels of Zn from Bioplex[®] Zn and with the four levels of Zn from ZnSO₄•7H₂O. Broken-line analysis of the weight gain data indicated the inflection point occurred at 6.3 and 13.6 mg/kg of diet for Bioplex[®] Zn and ZnSO₄•7H₂O, respectively. The RBV of Bioplex[®] Zn was determined using slope ratios obtained from regressing weight gain and tibia Zn on supplemental Zn using data below the inflection points. The resulting RBV for Bioplex[®] Zn were 183% and 157% for weight gain and tibia Zn, respectively. Using the corn-soybean meal basal diet (23 mg Zn/kg) fed in these studies, chicks required 13.6 mg of Zn/kg as zinc sulfate and 6.3 mg Zn/kg as Bioplex[®] Zn to maximize weight gain.

Key Words: broiler, zinc proteinate, requirement

W18 The effect of dietary phytase on digestible energy and growth performance in young chickens. V. Pirgozliev*¹, P. Mares², T. Acamovic¹, and M. R. Bedford³, ¹ASRC, *Scottish Agricultural College, Edinburgh, Scotland, United Kingdom*, ²Mendel University of Agriculture and Forestry, Brno, Czech Republic, ³Syngenta Animal Nutrition Inc., Wiltshire, England, United Kingdom.

It has been suggested (Ravindran et al., 1999) that energy values based on digestible energy (DE) might more accurately predict the nutritive quality of poultry feeds compared to apparent metabolizable energy (AME) values. The aim of this experiment was to investigate the relationship between dietary DE, measured in the ileal digesta, dietary AME and growth performance of broiler chickens at 21 d age, when fed diets containing different activities of a phytase (Quantum 2500D: Syngenta Animal Nutrition Inc.). Four hundred and eighty female Ross 308 broilers were reared in 32 floor pens. The birds were fed a nutritionally complete (12.79 MJ/kg ME, 231 g/kg CP), low in P (28g/kg available P) maize-soy starter diets supplemented with 0, 250, 500 or 2500 IU phytase/kg. The AME and DE of the diets, and the growth performance of the birds were determined at 21 days of age. Each treatment was replicated eight times in a randomised block design. Dietary enzyme significantly increased (P<0.001) weight gain (WG) and feed intake (FI) of birds fed phytase-supplemented diets. Although diets supplemented with 2500 FTU tended to have higher AME (15.73 vs 15.35 MJ/kg DM) and DE (14.14 vs. 13.82 MJ/kg DM) compared to the negative control, no relationship (P>0.05) was detected between the energy and growth performance of birds. The lack of relationship between AME and DE, and performance suggest that neither of these methods is sensitive enough to predict the feeding quality of phytase supplemented diets.

Key Words: phytase, broilers performance, AME, DE

W19 Evaluation of an inherent thermo-tolerant phytase in diets of broilers. E. K. D Nyannor^{*1}, P. Williams², M. R. Bedford³, and O. Adeola¹, ¹*Purdue University, West Lafayette,* ²*Syngenta, North Carolina,* ³*Syngenta Animal Nutrition Inc., Marlborough, Wiltshire, United Kingdom.*

The efficacy of a microbial phytase (QuantumTM) in corn or sprayed directly on ground wheat (WP) was evaluated in a 14 d broiler study. The phytase activity of corn-based phytase (CBP) was determined to be 660 FTU/kg and incorporated into broiler diets. A total of 288 7-d old male broiler chickens were grouped by weight into 8 blocks of 6 cages. Six dietary treatments were randomly allotted to the cages within blocks. The corn-soybean meal-based diets consisted of a positive control (PC) adequate in P and Ca, low P and Ca (NC; no added inorganic phosphorus) NC supplemented with 0.55% CBP, NC + 5.5% CBP, NC + 55% CBP, and NC + WP, were formulated to contain 0, 0, 3630, 36300, and 3630 FTU/kg phytase activity respectively. Birds were fed the dietary treatments for 14 d. Excreta samples were collected between d 9 and 12, and on d 14 birds were weighed, euthanized and ileal digesta and left tibiae bones collected. Weight gain, feed efficiency tibia weight and percent tibia ash of birds fed 3630 FTU/kg of either CBP or WP were similar, and higher ($P < 0.05$) than birds fed low P and Ca diets. There was no difference in feed efficiency of birds fed the PC diet or phytase-supplemented NC diet, however, tibia ash of birds fed the PC diets was higher than birds fed supplemental phytase, whose performance surpassed the NC diets. Birds fed supplemental phytase had higher ($P < 0.01$) ileal and total tract P and Ca digestibility than birds fed NC diet. It could be concluded from the study that efficacy of CBP compared favorably with WP and would minimize the need for supplemental P in broiler diets.

Key Words: phytase, corn phytase, broiler chicks

W20 Effect of plant-based feed alternatives on the growth performance and carcass composition of heavy hen turkeys. J. L. MacIsaac^{*1}, S. MacPherson², D. M. Anderson², and B. Rathgeber³, ¹*Atlantic Poultry Research Institute, Truro, NS, Canada,* ²*Nova Scotia Agricultural College, Truro, NS, Canada,* ³*Agriculture & Agri-Food Canada, Truro, NS, Canada.*

To determine the effect of plant-based diets on growth performance and carcass composition, a one-way analysis was conducted with dietary protein/energy source (poultry by-product meal/poultry grease (P), roasted soybeans/soy oil (RS), extruded soybeans/soy oil (ES), full-fat canola/canola oil (C)) as the main factor. Birds fed RS gained more weight ($P \leq 0.05$) than those fed ES from 28-56 d (91, 98, 101, 65 g/bird/day; P, C, RS, ES). Birds fed RS and C had heavier ($P \leq 0.05$) 56-d weights than those fed P and ES and birds fed P were heavier ($P \leq 0.05$) than those fed ES (3474, 3691, 3791 2809 g/bird; P, C, RS, ES). From 28-56 d, birds fed RS and C ate more ($P \leq 0.05$) than the birds fed ES and birds fed P ate more ($P \leq 0.05$) than ES (4613, 4865, 5102, 3826 g/bird; P, C, RS, ES). At 69 d, birds fed C and RS had the heaviest ($P \leq 0.05$) weights and birds fed P were heavier ($P \leq 0.05$) than those fed ES (4978, 5329, 5327, 4138 g/bird; P, C, RS, ES). From 56-69 d, birds fed ES had the lowest ($P \leq 0.05$) daily weight gains (115, 126, 118, 102 RS g/bird/day; P, C, RS, ES) and birds fed ES ate the least ($P \leq 0.05$) amount of feed (3440, 3683, 3601, 2972 g/bird; P, C, RS, ES). Diet had no effect ($P \geq 0.05$) on feed conversion (1.76, 1.78, 1.81, 1.91 feed/gain/bird; P, C, RS, ES). Diet had no effect ($P \geq 0.05$) on carcass fat (30.4, 30.7, 25.5, 26.6%; P, C, RS, ES) or carcass

protein (60.4, 62.3, 64.5, 63.1%; P, C, RS, ES) percent at 69 d of age. Roasted soybeans and full-fat canola in combination with their respective oils were effective replacements for animal by-products in turkey diets.

Key Words: turkeys, growth, carcass

W21 Maternal dietary Sel-Plex[®] (selenium yeast) supplementation increases tissue and plasma glutathione peroxidase activity of broiler chicks. T. Ao^{*}, A. H. Cantor, R. Power, J. L. Pierce, A. J. Pescatore, and M. J. Ford, *Alltech-University of Kentucky Nutritional Research Alliance, Lexington.*

The objective of this study was to investigate the effect of maternal dietary selenium supplementation from Sel-Plex[®] (a selenium yeast product) or selenite on tissue and plasma Se-dependent glutathione peroxidase (GSH-Px) activities of newly hatched and 14-day-old chicks. Six replicate pens of 10 broiler breeder hens (Cobb x Cobb) plus one rooster were randomly assigned to each of three dietary treatments. A low-Se basal diet, containing corn, cornstarch, soybean meal and torula yeast as the main ingredients, was fed alone or supplemented with 0.3 mg Se per kg diet provided by sodium selenite or by Sel-Plex[®]. Fertile eggs were collected after 24 weeks of feeding the experimental diets and incubated for 21d. Upon hatching, 12 chicks per treatment were sacrificed to take liver, heart and brain samples. Another 90 chicks from each of the three treatments were grown in cages and were all fed a low-Se torula yeast diet. After 14d, 12 chicks per treatment were randomly selected for sampling. Blood samples were taken and plasma was obtained immediately by centrifugation. Chicks were then sacrificed to obtain brain, heart and liver samples. All samples were snap frozen in liquid nitrogen and stored at -80°C until assayed for GSH-Px activity. Compared with no supplementation, selenite supplementation of the breeder diet increased ($P < 0.01$) GSH-Px activity of brain, liver and heart from both day-old and 14-d old chicks, and Sel-Plex[®] supplementation of the hen diet further increased ($P < 0.01$) tissue GSH-Px activity. Sel-Plex[®] supplementation of the hen diet significantly ($P < 0.01$) increased plasma GSH-Px activity of the 14-d old chicks, compared with no supplementation or supplementing sodium selenite. The results indicate Sel-Plex[®] is more effective than sodium selenite as a supplement in the breeder hen diet for elevating tissue GSH-Px activity in chicks at hatching and for maintaining the enzyme activity when chicks are challenged with low-Se diet.

Key Words: chick, selenium yeast, glutathione peroxidase

W22 Dried porcine solubles (DPS) and coccidiosis vaccines on the performance of broilers. P. H. D. Tomasi and J. L. Andriguetto^{*}, *Universidade Federal do Paraná, Curitiba, Paraná, Brazil.*

The objectives of the present work were to compare the effect of two different vaccines against coccidiosis on the performance of broilers and to evaluate the interaction of dried porcine solubles, a source of peptides rich in glutamine, on the performance of the vaccinated broilers. Vaccines against coccidiosis tend to reduce performance due to the reaction on the mucosa of the lower digestive tract. A vaccine made of live attenuated oocysts (precocious strains - Paracox[®]-Schering Plough) was given to 1-day old chicks (active immunity), and a vaccine based on purified antigens, isolated from gametocytes of *Eimeria* (Coxabic[®]- Abic) was given to the breeders, and their chicks were used in the trials (passive immunity). DPS was supplied, for

the first 21 days, in an attempt to reduce the deleterious effects of the vaccines, as a source of highly available amino acids, in a 2 x 2 factorial design: T1(Paracox/DPS; n=420), T2 (Paracox only; n=420), T3 (Coxabic/DPS; n=420), T4 (Coxabic only; n=420). Animals received feed with equal levels of energy, protein, and aminoacids. Until 14 days of age, there was a significant ($P < 0.05$) reduction in weight gain of the birds receiving Paracox, if compared with birds receiving Coxabic. At 45 days, however, there was no significant difference in the final weight and feed conversion of the broilers receiving the two kinds of vaccine. The use of DPS increased ($P < 0.05$) the weight of chickens at 45 days of age. The feed conversion was improved by DPS ($P < 0.05$). Viability did not vary among treatments.

Key Words: broiler performance, DPS, coccidiosis vaccine

W23 Effects of reduced dietary phytate in phosphorus adequate practical-type diets fed to growing chicks. M. E. Persia*¹, R. Angel², and W. W. Saylor¹, ¹University of Delaware, Newark, ²University of Maryland, College Park.

In experiment 1, dehulled-degermed corn-by-product was mixed with cornstarch, corn oil, cellulose and synthetic amino acids to create a corn product similar in analyzed proximate composition to the control corn, but lacking phytate (DDC). Two diets were prepared utilizing either DDC or intact corn, and low ash meat meal and alfalfa meal. The DDC and corn diets were formulated to contain 0.43% nonphytate P and 0.00 or 0.13% phytate, respectively. Both diets were pelleted to account for physical consistency. Three dietary treatments consisted of the corn and DDC diets fed ad libitum and the DDC diet pair-fed to the feed intake of the corn diet. The treatments were fed to 15 replicate groups of 4 straight run Ross 308 chicks from 5 to 20 d of age. Feed intake (664 vs. 642 g) and weight gain (413 vs. 398 g) were not different between the ad libitum-fed corn and DDC diets respectively. Feed intake (607 g) and weight gain (377 g) were reduced in limit-fed chicks. The lack of performance differences between the diets could be attributed to the reduced phytate content of the control diet because soybean meal was removed to create a phytate-free diet. A second experiment utilized large amounts of phytase to reduce the exposure of chicks to dietary phytate in corn-soybean meal diets. Five dietary treatments were utilized: a control diet containing no phytase; diets containing *E. coli* phytase at 500, 7,500 and 15,000 U/kg and a diet containing 15,000 U/kg of a fungal phytase. All diets contained 0.45% nPP. Diets were fed to 9 replicate groups of 8 male Ross 708 chicks from 8 to 22 d of age. Feed intake increased 5 to 8% and weight gain increased 4 to 7% compared to control chicks ($P < 0.05$) when diets contained 7,500 and 15,000 U/kg of phytase activity, regardless of source. The addition of large amounts of phytase, presumably reducing dietary phytate content, resulted in increased feed intake and weight gain above the positive control diet.

Key Words: chick, phytase, phytate

W24 Study of effects saccharomyces cerevisiae on performance and biochemical parameters of broiler chicks during aflatoxicosis. A. Safamehr*¹ and M. Shivazad², ¹Maragheh Azad University, Maragheh, Iran, ²Tehran University, Karaj, Iran.

The amelioration of aflatoxicosis in broiler chicks was examined by the dietary addition of *Saccharomyces cerevisiae* (SCE). *Saccharomyces cerevisiae* incorporated into the diet at 1 g/Kg was evaluated for its

ability to reduce the deleterious effects of 1 and 2 mg total aflatoxin Kg-1 diet on growing broiler chicks from 1 day to 42 days of age. In this study 480 day-old male chicks (Ross 308) were assigned to a completely randomized design to six treatment (1:control without aflatoxin, 2:contain 1g/kg SCE, 3:contain 1 ppm aflatoxins(AFs), 4: 1 ppm AFs + SCE (1g/kg), 5: 2 ppm aflatoxins, 6: aflatoxins(2 ppm) plus SCE (1 g/kg)) with four replicate each with 20 chicks. The AF treatments (3 and 5) significantly decreased food consumption and body-weight gain and increased food conversion ratio ($p < 0.05$). Serum cholesterol, total protein and albumin decreased significantly ($p < 0.05$) in diets contaminated with aflatoxin. Compared to controls, the addition of SCE to an AF-containing diet significantly reduced the deleterious effects of AF on cholesterol, albumin and total protein. The toxin fed group had higher activities of the enzymes LDH and AST and decreased ALP. The addition of SCE to an AF-containing diet did not produce any significant changes in activities of enzymes compared with the control. These results suggest that SCE reduced the adverse effects of AF and should be helpful in a solution to the aflatoxicosis problem in poultry.

Key Words: *saccharomyces cerevisiae*, aflatoxicosis, chicken

W25 Reduction of *Campylobacter jejuni* colonization in four week old SPF leghorns using heat-resistant xylanase feed additive. R. A. Coleman*, R. N. Walton, M. Lamoureux, M. Wood, W. Sung, and C. M. Szymanski, NRC, Institute for Biological Sciences, Ottawa, ON, Canada.

Campylobacter jejuni is the leading cause of bacterial foodborne illness in North America. Contaminated poultry is the primary risk factor for *C. jejuni* infection in humans. Thus, reducing the levels of *C. jejuni* colonization in poultry is a priority in the area of risk management and control in order to increase food safety. The high-efficiency feed additive, xylanase, is currently being used in the poultry industry to supplement feed and was recently shown to cause reduction in *C. jejuni* colonization. NRC-IBS has engineered and patented a superior xylanase supplement that is able to resist extreme temperatures during the pelleting process and, therefore, remains active in the chicken gastrointestinal tract after pelleting. We have compared the effects of commercial and NRC-IBS modified xylanase on *C. jejuni* colonization with the intent of developing a cost-effective high efficiency animal feed supplement that will also improve food safety by reducing the levels of *C. jejuni* colonization in poultry. Specific pathogen-free (spf) leghorns (0-28 d) were fed either NRC modified or commercially available xylanase. A total of 72 birds were housed in medium animal bio-containment units (n=6/unit) produced on site and housed in a controlled environment. The birds were separated based on the following treatments: NRC modified and commercial xylanase (equal enzyme units/kg diet) (n=18 birds each), heat-inactivated (100°C, 20 min) NRC modified and commercial xylanase (n=12 birds each), positive and negative controls (n=6 birds each). On day 6, all but the negative control birds were inoculated with 300 µl of 109 cfu/mL *C. jejuni* 11168CJ1. On day 28, cecal contents were removed and serially diluted to determine colonization levels. Preliminary results indicate *C. jejuni* colonization in the cecum was reduced by approximately 1 log with either active xylanase treatment. NRC-IBS modified xylanase offers an added advantage over the commercially available xylanase because it can be added to feed during the pelleting process.

Key Words: xylanase, *Campylobacter jejuni*, colonization

W26 *C. jejuni* as a secondary colonizer of poultry biofilms. I. Hanning*, A. O'Leary, and M. Slavik, *University of Arkansas, Fayetteville.*

Previous research in our lab has shown *C. jejuni* has poor attachment to processing materials and fails to form biofilms in monoculture. We concluded *C. jejuni* may be a secondary colonizer rather than primary. Therefore, we decided to investigate the ability of *C. jejuni* to incorporate into an established biofilm. The objectives of the research were to determine if *C. jejuni* biofilm formation is influenced by intraspecies and interspecies cell signals and assess the physical interactions between *C. jejuni* and resident biofilms. Bacteria were isolated from chicken carcass rinses and identified using Gram-staining, biochemical testing, and sequencing of the 16s rDNA gene. Interspecies cell signal influence on *C. jejuni* was done by culturing *C. jejuni* in supernatants from each isolate and assessing subsequent biofilm formation in a 96-well plate assay. The *V. harveyi* AI-2 assay was used to determine the level of interspecies cell signals in the supernatant and this was compared to level of biofilm formation by *C. jejuni*. Intraspecies cell signaling levels of *C. jejuni* were manipulated by adding antagonists and promoters of the LuxS cell cycle. To view physical interactions of *C. jejuni* with a resident biofilm, biofilms grown on glass coverslips were inoculated with GFP *campylobacter* isolates, counterstained with DAPI, and viewed periodically using confocal microscopy. Interspecies cell signaling had no influence on *C. jejuni* biofilm formation regardless of the level of AI-2 production. Similarly, manipulating LuxS signals did not influence biofilm formation. Reconstruction of confocal images showed an influence on *C. jejuni* attachment by specific bacterial populations. In monoculture, *C. jejuni* attached sparsely. However, with species such as *Enterococcus*, finding any *C. jejuni* attached was difficult. Given the prevalence of campylobacteriosis, yet the lack of genetic survival abilities, the formation of a biofilm seems a plausible explanation for *Campylobacter* survival. However, our current research indicates *C. jejuni* may prefer to remain motile, which may be advantageous in terms of colonization and virulence.

Key Words: campylobacter, biofilm, poultry

W27 Molecular analysis of *Salmonella* serotypes at different stages of commercial turkey processing. P. N. Anderson¹, M. E. Hume^{*1,2}, J. A. Byrd^{1,2}, S. M. Stevens¹, and D. J. Caldwell¹, ¹*Texas A & M University, College Station*, ²*USDA/ARS, Food and Feed Safety Research Unit, College Station, Texas.*

Salmonella is one of the predominant human foodborne pathogens affecting the poultry industry. A study was conducted to determine the homo- or heterogeneity of individual *Salmonella* isolates recovered at various stages of processing in a commercial turkey processing facility. The sampling sites were: 1) Pre-IOBW (IOBW; inside and outside bird wash), 2) Post-IOBW, 3) Post-chill, 4) Pre-scald, and 5) Post-scald, with n=23, 46, 24, 17, 54 samples evaluated per site, respectively. The 164 *Salmonella* isolates collected were stored on trypticase soy agar slants and were streaked onto BGA (novobiocin) plates and grown overnight at 37 C. A *Salmonella* colony from each plate was boiled for 15 min in TE buffer, chilled, and centrifuged for 1 min at 8,000 x g. The PCR primers used for amplification of RNA spacer region were conserved regions located between the 16S and 23S rRNA genes: Forward G1 (5'-GAA GTC GTA ACA AGG-3') and reverse L1 (5'-CAA GGC ATC CAC AGT-3'). Polyacrylamide gel electrophoresis (PAGE) was carried out using a 5% polyacrylamide run for 180 min

at 250 volts. Ethidium bromide was used to visualize the banding patterns. The analysis of the *Salmonella* serotypes genotype was expressed as a dendrogram with comparisons expressed as percentage similarity coefficients. Based on the different clusters, ten major banding patterns were observed and designated as genotypes A through J with the corresponding number of isolates ranging 3 to 60 and with percentage similarity coefficients ranging from 83.8 to 95.8 respectively. Genotypes, and corresponding serotypes, were distributed among treatments and results suggested that several *Salmonella* serotypes may be present at the different sampling sites in the turkey processing plant.

Key Words: *Salmonella* serotype, genotype, PCR

W28 Identification and Serotyping of *Escherichia coli* strains isolated from poultry carcasses in a public market in Mexico City. E. Fite¹, C. Eslava³, and C. Rosario^{*2}, ¹*Texas A&M University, College Station*, ²*Facultad de Medicina Veterinaria y Zootecnia, UNAM, Mexico, D.F. Mexico*, ³*Facultad de Medicina, Mexico, D.F. Mexico.*

Escherichia coli is one of the most common pathogens involved in gastrointestinal disorders in developing countries. Additionally it has been described that poultry meat is one of the most important sources of pathogens for human being. The aim of the present study was to analyze the predominant *E. coli* serotypes in poultry carcasses. Ten samples from broiler skin and 10 from gut were obtained from a public market in Mexico City. All samples were seed onto MacConkey-Lactose agar, and Blood agar and incubated at 18 hours at 37°C. Two lactose positive colonies were selected from each initial sample. Biochemical testing, and serotyping of *E. coli* were performed. Seventy *E. coli* strains from the 100 original colonies chosen were identified, 49 from gut and 21 from skin. There were 26 O groups found among the strains; the most common were O25 (10), OR (10) and O? (7); on the other hand, 10 different H antigens were detected and the most common were H? (24), NM (23) and H4 (12). The most frequent serotype was O25:H4. Serogroups from skin and gut were different, except O3 and O25. Results suggest that contamination of the skin does not comes from gut, however, it could be important to look for virulence factors in these *E. coli* strains since they could represent a threat for consumers.

Key Words: *Escherichia coli*, poultry meat, serotyping

W29 The sensory acceptance of table eggs from quinoa-based diets under red and normal lighting. N. P. Johnston^{*1}, G. Aduviri², L. Jefferies¹, A. Parker¹, and B. T. Slauch³, ¹*Brigham Young University, Provo, Utah*, ²*University of San Andres, La Paz, Bolivia*, ³*Eggland's Best, King of Prussia, Pennsylvania.*

Quinoa is a pseudo grain noted for its protein quantity and quality that is grown extensively on small-scale, self-sufficient farms in Bolivia and Peru. When quinoa, which is absent of xanthophyll, is fed to farmstead flocks the resulting egg yolks are a creamy white color. It was hypothesized that consumers in the USA would look unfavorably on the quinoa eggs because of unfamiliarity with white yolks. However, if they were unable to distinguish the yolk color, as is the case under sensory red light illumination, no detectable differences would be observed. To test these hypotheses two sensory panels were conducted to evaluate table eggs from hens whose dietary grain portion contained

0, 50 or 100% quinoa producing yolks with a strong yellow, pale yellow or cream-white color respectively. In the first panel the sensory testing area was illuminated with red light and yolk color was indistinguishable and based on a nine point Hedonic scale the 50 panelist found no differences in appearance (6.7, 6.9, 7.2), overall acceptance (7.3, 7.2, 7.0), aroma (6.3, 6.0, 6.2), flavor (7.1, 7.0, 7.0), texture (7.1, 6.8, 7.1) and aftertaste (6.6, 6.4, 6.5). Because the second panel was conducted under normal light the 50 panelists were able to observe yolk color differences and as one might expect egg appearance was downgraded ($P<0.05$) (7.3, 6.3, 3.1), and the eggs were now perceived to have an objectionable aroma ($P<0.05$) (6.7, 6.5, 5.8), a less favorable flavor ($P<0.05$) (7.4, 6.8, 5.5), a poorer texture (7.3, 7.0, 6.1), a noticeable aftertaste ($P<0.05$) (6.8, 6.2, 5.4) and an overall reduction in acceptance ($P<0.05$) (6.8, 6.2, 5.4). As hypothesized, if panelists were unable to distinguish yolk color no differences existed in the sensory acceptance of quinoa-based eggs as compared to corn-based egg; however, when yolk color was distinguishable not only did appearance drop but also, aroma, smell, texture and aftertaste.

Key Words: quinoa, yolk, sensory

W30 Dietary lipid source and vitamin E effect on lipid oxidation stability of raw chicken parts. C. Narciso-Gaytán*, C. A. Bailey, A. R. Sams, and M. X. Sánchez-Plata, *Texas A&M University, College Station.*

The lipid nutritional effect on the fatty acid composition and the lipid oxidation stability of chicken meat was evaluated. Six hundred Cobb x Ross broilers were raised under commercial-like conditions, randomly assigned into 8 treatments with 3 repetitions. A 4x2 factorial arrangement was used, supplementing a basal corn-soybean meal diet with 5% animal/vegetable fat (AV), lard (LA), palm kernel oil (PK), or soybean oil (SB), and 33 or 400 mg/Kg of dl- α -tocopheryl acetate. Skinless breast and thigh muscle pieces and harvested skin were packaged, refrigerated (4.4°C), and challenged with ~1100 luxes of fluorescent light, in retail display-like condition during 15 days. TBARS (thiobarbituric reactant substances) and Gas Chromatography analysis were performed to determine the lipid oxidation stability (malonaldehyde mg/Kg) and fatty acid methyl esters of the meat, respectively. The results showed that the dietary lipid source significantly influence the amount and type of fatty acids deposited into the breast and thigh muscle tissues, as well as the percent of fat in breast muscle, $1.9 \pm .07$, $1.7 \pm .05$, $1.7 \pm .06$, and $1.5 \pm .04\%$ for SB, AV, LA, and PK, respectively ($P<0.01$). Regarding lipid oxidation, no interaction between dietary oil/fat and level of vitamin E was observed. Breast muscle did not show significant lipid oxidation over the entire storage time due to dietary fat. However, thigh muscle and skin had significant treatment differences starting at the 10 day of storage, for which SB and PK had the highest and lowest lipid oxidation rate, respectively ($P<0.05$). Supra-nutritional supplementation of vitamin E proved to be significantly effective at inhibiting the lipid oxidation development in all the raw products including breast, thigh muscle, and skin. In conclusion, the fatty acid source and level of vitamin E supplemented in the broilers' diet influence the lipid oxidation stability of raw chicken meat and skin.

Key Words: dietary lipid, vitamin E, chicken meat

W31 Dietary lipid source and vitamin E effect on lipid oxidation stability of cooked chicken patties. C. Narciso-Gaytán*, C. A. Bailey, A. R. Sams, and M. X. Sánchez-Plata, *Texas A&M University, College Station.*

The dietary effect of oils and fats and supra-nutritional levels of vitamin E on the lipid oxidation stability of cooked chicken patties was analyzed. Six hundred Cobb x Ross broilers were raised under commercial-like conditions, randomly assigned into 8 treatments with 3 repetitions. A 4x2 factorial arrangement was used, supplementing a basal corn-soybean meal diet with 5% animal/vegetable fat (AV), lard (LA), palm kernel (PK), or soybean oil (SB), and 33 or 400 mg/Kg of dl- α -tocopheryl acetate. Broilers were fed ad libitum during a 6-week period. Skinless breast and thigh muscle pieces were blast frozen and stored for ~6 months at -20°C. Muscle pieces were thawed out for 24 h under refrigeration, deboned, and trimmed of connective and fat tissue. Meat was ground twice using a 1/2" and 1/16" plate and manually formed into patties of 150 g each. Patties were cooked in a convection oven to an internal temperature of 74°C, cooled, placed on trays, wrapped with film and stored in boxes at 4.4°C for 0, 1, 3, and 6 days before analysis. TBARS (thiobarbituric reactant substances) analysis was performed to determine the lipid oxidation. The results showed no significant interaction between dietary oil/fat and level of vitamin E. However, significant differences were observed between dietary lipid treatments ($P<0.05$). SB showed the highest lipid oxidation in all of the sampling days for both breast and thigh meat patties. In breast meat patties, PK showed lower lipid oxidation at 0 and 6 days of storage when compared to the other treatments. For thigh meat patties, PK showed significantly lower lipid oxidation only at day 0. For all the treatments in both breast and thigh meat patties, 400 mg/Kg of vitamin E was significantly more effective at reducing the lipid oxidation of cooked chicken patties. In conclusion, dietary oil/fat and supra-nutritional levels of vitamin E directly influence the lipid oxidation stability of cooked chicken meat.

Key Words: dietary lipid, vitamin E, chicken meat lipid oxidation

W32 Tenderness, juiciness and flavor of pre- and post-rigor marinated broiler breast fillets evaluated by consumer sensory panel. A. Saha*, A. V. S. Perumalla, Y. Lee, J. F. Meullenet, and C. M. Owens, *University of Arkansas, Fayetteville.*

Pre-rigor deboning and marination of broiler breast fillets are growing trends in the poultry industry. Marination can often enhance product attributes such as flavor, juiciness and texture. The purpose of this study was to evaluate the effectiveness of marination in improving meat quality attributes and uniformity of pre- and post-rigor deboned broiler breast fillets. A total of 400 broiler carcasses were processed using an in-line system and deboned at various times: 0.25, 1.25, 2.0, 2.5, 3.0, 3.5, 4.0, 6.0 and 24.0 h post-mortem (PM). A two stage chilling system was used for all treatments with exception of the 0.25 h which was deboned prior to chilling. Following chilling, carcasses and/or fillets were aged on ice. Breast fillets were marinated with 1% salt and 0.45% phosphate concentration. Consumer sensory evaluations for juiciness, tenderness, salt intensity, flavor intensity, and overall impression were obtained on all treatments using hedonic and just about right scales. Although there were slight differences in hedonic ratings for overall impression, texture and flavor of marinated breast fillets, all treatments could be categorized as 'like slightly to like moderately.' Using a JAR scale, only a small percentage of consumers

(<20%) considered any of the treatments as too tough. The scores for overall flavor or juiciness were not affected by the deboning times as the majority of the people considered them to be just about right. A majority of the consumers reported the potential for purchase of the product as 'probably would buy' to 'maybe/maybe not.' The results of this study indicate that marination of pre-rigor deboned meat (with 1% salt) is effective in producing product similar to marinated post-rigor deboned meat suggesting its effectiveness in improving meat quality attributes of early deboned meat.

Key Words: salt, consumer sensory analysis, marination

W33 Conjugated linoleic acid and fish oil in laying hen diets: Effects on egg tocopherols, total fat and fatty acids upon storage. G. Cherian^{*1}, M. G. Traber², K. S. Ryu¹, M. P. Goeger¹, and S. Leonard², ¹Oregon State University, Corvallis, ²Linus Pauling Institute, Oregon State University, Corvallis.

Omega-3 and conjugated linoleic (CLA) fatty acids have received considerable attention for their health-enhancing properties. Increasing omega-3 fatty acid intakes have been recommended by nutritionists, but cost, consumer preference and seasonal availability limit the consumption of fish. Consuming low-fat ruminant foods also limit the intake of CLA. We sought to improve the omega-3 and CLA fatty acid pattern in eggs and simultaneously maintain egg vitamin E concentrations to prevent lipid peroxidation during storage. Therefore, the effects of incorporating CLA and fish oil in laying hen diets on chicken egg, CLA, omega-3 fatty acid and tocopherol contents during sixty-days storage were investigated. Hens were fed corn-soybean meal-based diet containing, 3% yellow grease (control), 2.75% yellow grease + 0.25% CLA (CLA), 2.5% yellow grease + 0.25% CLA + 0.25% fish oil (CLA-FO), or 2.75% yellow grease + 0.25% fish oil (FO), eggs were collected and stored at 4°C up to sixty days. On storage day 0, 20, 40 and 60, eggs (n=8) from each treatment were selected randomly, then tocopherol and total lipid concentrations, and fatty acid composition were measured. CLA and CLA-FO diets reduced α and γ -tocopherol contents at all days of storage compared with control eggs (P<0.05). Regardless of diet, egg storage for 40 days or longer depleted egg tocopherol contents (P<0.05). Feeding CLA-FO reduced egg total lipids (P<0.05); CLA diet increased egg saturated, omega-6 and CLA contents and decreased monounsaturated fatty acids. Egg omega-3 was highest in eggs from FO-fed hens and lowest in control hens (P<0.05). Storage for sixty days decreased omega-3 and CLA in eggs from CLA, CLA-FO and FO fed hens (P<0.05). No effect of dietary oils on egg cholesterol was observed (P>0.05). These data demonstrate that "healthy" eggs with increased omega-3 fatty acids and CLA can be generated by minor diet modifications and added tocopherol supplementation may be needed when omega-3 or CLA is included in the hen diet.

Key Words: eggs, tocopherol, conjugated linoleic/Omega-3 fatty Acid

W34 Effect of drinking water iron, nitrate, and manganese on broiler performance. B. D. Fairchild^{*}, A. B. Batal, and C. W. Ritz, University of Georgia, Athens.

Many producers have problems with drinking water quality and are uncertain of the effect this will have on broiler performance and health. The maximum acceptable concentrations for Fe, NO₃, and Mn

for poultry drinking water are reported to be 0.3, 25, and 0.3 mg/L respectively. Previous work indicates that these contaminants alone do not have a significant impact on broiler performance at 600, 600 and 20 mg/L for Fe, NO₃ and Mn, respectively. Two trials were conducted to examine the effects of combining these contaminants on broiler performance using the highest concentrations utilized in previous studies. Cobb 500 by-product male broiler chicks were housed in batteries equipped with a nipple water system. Chick weight, feed intake, and water consumption were recorded weekly throughout the 35 day trials. Water treatments were mixed and analyzed weekly. In Trial 1 water treatments consisted of Control (C), 600 mg/L Fe + 600 mg/L NO₃ (FN), 600 mg/L Fe + 20 mg/L Mn (FM), and 20 mg/L Mn + 600 mg/L NO₃ (MN). Water treatments in Trial 2 were identical to Trial 1 with the exception of treatment 4, 600 mg/L Fe + 600 mg/L NO₃ + 20 mg/L Mn (FMN). Five replicate pens with 10 birds were used in for FN and FM, while 4 replicate pens were used for C, MN and FMN. In Trial 1, FN and FM birds consumed less water than C and MN birds. Birds in FN and FM had less weight gain in weeks 1 and 2 but experienced better weight gain in weeks 3 and 4. In Trial 2, FN and FM birds experienced less weight gain in weeks 3 and 4 respectively, but cumulative weight gain was not affected. Less water was consumed by FM birds as compared to other treatments. Less feed was consumed by FN and FM birds in weeks 2 and 3 but no differences were noted in final body weights. No differences in feed:gain ratio were noted in either trial. Combining Fe and Mn had negative effects on performance parameters measured while mixing Fe and NO₃ were more variable. Previous work suggests that these single contaminants do not affect performance; the current study indicates certain combinations may yield negative effects.

Key Words: water quality, broilers, performance

W35 Prevalence and antibiotic resistance profile of *Campylobacter jejuni* from turkey house litter in commercial North Carolina farms. W. Willis^{*}, M. Worku, and C. Murray, North Carolina A&T State University, Greensboro.

An experiment was conducted to assess the prevalence and antibiotic resistance of *Campylobacter jejuni* (*C. jejuni*) in turkey house litter and transportation crates from commercial farms in North Carolina. A total of 76 farms from two turkey integrated companies were monitored utilizing samples collected at wk 1, 4, and 14 from farm house litter and transportation crates at the processing plant. *C. jejuni* was isolated and antimicrobial susceptibility was determined using Sensi-Disc™ discs. *C. jejuni* was isolated at a low rate in the litter for both companies at 1, 4, and 14 wks (company A 12.5%, 7.5%, 7.7% and company B 8.3%, 2.8%, 11.1%, respectively). Isolation rates from crates at the processing plant were higher (company A 45.0, 47.5%, 33.3%, and company B 38.9%, 48.6%, 25.7%, respectively). Isolates from house litter and transportation crates at all three sampling times and from both companies were resistant to enrofloxacin (15.0%, 100%, 100%), erythromycin (85.0%, 61.8%, 58.6%), gentamicin (55.0%, 26.5%, 13.8%), naladixic acid (37.5%, 26.5% 13.8%) and tetracycline (47.5%, 29.4%, 31.0%). No clear patterns were observed in relation to age of the bird or source of sample (litter/crates) and presence of *Campylobacter*. This study showed that *C. jejuni* is prevalent on turkey farms in house litter and transportation crates. Multiple drug resistant *C. jejuni* was prevalent in turkey flock at various stages of maturity. Both house litter and transportation crates may serve as reservoirs for infection of flocks. Thus, events which occur prior to slaughter, such as loading, transport, and holding in transportation crates may contribute to the

prevalence of *C. jejuni*. Further, multiple resistance may complicate approaches to control.

Key Words: *Campylobacter jejuni*, turkey farms, drug resistance litter

W36 Impact of poultry litter on surface and groundwater in areas of hydric and non-hydric soil types: stable ^{15}N isotopes of nitrate assessment. C. M. Williams*, W. J. Showers, and G. D. Jennings, *North Carolina State University, Raleigh.*

Land application of poultry litter and resulting surface and groundwater impacts due to nitrate nitrogen are a concern in many areas of dense poultry production agriculture. This study investigated such impacts in a watershed located in North Carolina where poultry production is prevalent. The stable ^{15}N isotopes of nitrate procedure was utilized. Results showed that ^{15}N of groundwater nitrate was controlled by the types of soils in the poultry litter application fields. Hydric soils had enriched ^{15}N nitrate compositions and reduced nitrate concentrations associated with denitrification. Partially hydric and non-hydric soils did not show elevated groundwater ^{15}N nitrate compositions. The ^{15}N composition of groundwater nitrate in litter application fields with non-hydric soils indicate the source of nitrate were a mixture of litter and fertilizer N. On a watershed scale, the ^{15}N composition of stream water nitrate was not related to the distribution of poultry operations, but was related to the distribution of hydric soils in the basin. Nitrate concentrations in stream waters remained low throughout the sub-basin studied. The ^{15}N composition of stream nitrate decreased downstream suggesting minimal impact on surface water quality from the surrounding poultry operations. The practice of placing poultry operations proximate to swampy land also places them in areas of abundant hydric soils. Denitrification proceeds quickly in such areas, which minimizes offsite nitrate transport and mitigates surface water quality impacts in these areas. This data suggest that water quality impacts from poultry production agriculture can be predicted from the distribution of hydric soils in a watershed.

Key Words: poultry litter, ^{15}N natural abundance, watershed water quality

W37 The use of a urease inhibitor on broiler litter. W. D. King*¹, A. J. Pescatore¹, A. Singh², R. S. Gates², K. D. Casey³, M. J. Ford¹, and A. H. Cantor¹, ¹*University of Kentucky, Lexington*, ²*Department of Biosystems and Agricultural Engineering, Lexington, Kentucky*, ³*Texas Agricultural Experiment Station, Amarillo.*

To determine the effect of a urease inhibitor on ammonia release from broiler litter, two experiments were conducted using an equilibrium chamber gas sampling technique. In both experiments, 22 male broilers were placed in each of 48 floor pens (10.28 birds / m²). All pens had built up litter and were in one climate controlled room with uniform airflow to each pen. The urease inhibitor used for these experiments was N-(n-butyl) thiophosphoric triamide (NBPT). Four treatments were used for these experiments: control (no urease inhibitor); 50 ml/pen of urease inhibitor solution applied at day 0; 50 ml/pen urease inhibitor solution applied at day 21; 50 ml/pen of urease inhibitor solution applied at day 0 and again at day 21. An equal volume of water was applied to the control pens. In experiment one three gas samples were taken on day 0, 21, and 42. No reduction in equilibrium ammonia concentration was observed from use of the urease inhibitor,

perhaps due to the infrequent sampling. In experiment two, samples were taken 10 times (days 0, 7, 11, 21, 24, 27, 29, 31, 34, and 42). No clear positive effect of the urease inhibitor treatments was observed on equilibrium ammonia concentration prior to day 31. From day 31 to 42 the treated pens tended to have reduced concentration. Variability between pens was substantial thus this reduction was not significant. Litter moisture content tended to be dry (20-25% moisture) and it is possible the observed variability in equilibrium ammonia concentration was associated with litter moisture differences, with higher moisture content litter having greater potential for microbial activity. From these experiments it is unclear whether urease inhibitors would offer a reduction of ammonia emissions from broiler houses.

Key Words: urease inhibitor, ammonia release, broiler litter

W38 Mannan oligosaccharides effects on litter bacteria levels. K. S. Macklin*¹, J. P. Blake¹, B. A. McCrea², R. A. Norton¹, J. B. Hess¹, and S. F. Bilgili¹, ¹*Auburn University, Auburn, Alabama*, ²*University of California, Davis.*

Four successive trials were performed in which litter bacterial levels were measured in birds fed one of three corn-wheat based diets: one supplemented with Bacitracin Methyline Disalicylate (BMD), one containing mannan oligosaccharide (MO) (Bio-mos, Alltech, Nicholasville, KY) and a control diet that had no additional supplementation (CON). Each diet was replicated in 10 pens containing 50 birds/pen. Birds for all four trials were raised on used litter to 6 weeks of age under standard management conditions. Litter samples were collected before chick placement and immediately after bird removal from three locations within each pen and mixed in a sterile bag. Samples were then serially diluted and plated on the following media: plate count agar (PCA) for determining total aerobic bacteria, reduced tryptic soy agar with 5% sheep red blood cells (RBA) to determine anaerobic bacterial numbers, and MacConkey agar (MA) for total enteric bacterial numbers. Media was then incubated at 37C under appropriate conditions for 24 hours than counted. CFU/g counts were transformed using log₁₀ and analyzed using General Linear Model with P<0.10.

Trial 1 produced no differences (P>0.10) for the bacterial counts between the three diets. Counts at the end of Trial 2 showed significantly lower bacterial counts with MO on PCA (11.25) and RBA (9.93) than the CON (11.72 and 10.22) group, with the BMD group (11.41 and 10.15) producing intermediate results. MA produced no statistically significant differences between the three diets. Trial 3 produced no differences (P>0.10) for the bacterial counts between the three diets at the conclusion of the trial. At the end of trial 4, MO produced lower bacterial counts than either BMD or CON on all three media types. Given the results observed in these four trials, the use of MO and BMD as a feed supplement reduces total aerobic, anaerobic, and enteric litter bacterial counts

Key Words: mannan oligosaccharides, litter, bacteria

W39 Microarray-based analysis for SNPs associated with high or low humoral immune response in the chicken. T. Geng* and E. J. Smith, *Virginia Polytechnic Institute and State University, Blacksburg.*

Natural immune response continues to be of importance in the poultry industry. Developing markers for humoral immune response to sheep

red blood cells (SRBC) offer the opportunity to identify and select birds for high or low natural immunity. Using nine birds from lines divergently selected for low (4) or high (5) anti-SRBC for over 40 generations, we screened for informative SNPs with microarrays from Illumina, Inc. As a result, 2733 SNPs were successfully genotyped. A total of 191 informative SNPs were identified in the samples screened. Fifty seven of the informative SNPs appeared to be line-specific. Most of the line-specific SNPs are distributed over several chromosomes, including Chromosome 1 (8), 2 (9), 4 (6), 15 (4), 16 (4), and Z (11). Furthermore, 25 of them were located within (7 SNPs) or near (18 SNPs) previously reported immunity-related genes. In addition to the novel candidate markers, the results appear to validate 6 of 7 candidate markers previously identified by us through other genome analysis methods. These findings may provide a useful resource for identifying genes that control humoral immunity in *Gallus gallus*.

Key Words: single nucleotide polymorphism, humoral immune response, gallus gallus

W40 SLC11A1 and Prosaposin gene polymorphism associations with antibody kinetics in adult chickens. A. S. Ahmed^{1,2}, J. R. Hasenstein², and S. J. Lamont^{*2}, ¹College of Agriculture, Cairo University, Cairo, Egypt, ²Iowa State University, Ames.

Our goal was to increase knowledge of genes controlling antibody response kinetics in chickens. We identified single nucleotide polymorphisms (SNP) in two genes and examined their association with antibody response kinetics in hens. Two biological candidate genes were studied, natural resistance associated macrophage protein 1 (SLC11A1, or NRAMP) and Prosaposin (PSAP). An F2 population was produced by mating G0 highly inbred (< 99%) males of two MHC-congenic Fayoumi lines with G-B1 Leghorn hens. The F2 hens (n=158) were injected twice with SRBC, a T-dependent antigen, and whole fixed BA, a T-independent antigen. Blood samples were obtained preceding each immunization, at 7 d after primary, and at 4, 7, 10, 18, 32, and 63 d after secondary immunization, and used to measure agglutinating antibody titers. Secondary phase parameters of minimum (Ymin) and maximum (Ymax) titers, and time needed to achieve minimum (Tmin) and maximum (Tmax) were estimated from the seven post secondary immunization titers with a non-linear regression model. The equilibrium phase parameter was the mean titer of the last three collected samples. A 642 bp fragment of SLC11A1 had a T/G SNP at 314 bp between lines. A 647 bp fragment of PSAP had a G/A substitution at 25 bp between the lines. The F2 individuals were genotyped by using PCR-RFLP. General linear model tests were conducted for associations of genotypes with antibody response parameters and body weight at 0, 2, 6, 12, and 20 wk. The SLC11A1 gene SNP and body weight at 12 wk were significantly ($P < 0.02$) associated. The PSAP gene SNP was significantly associated with BA antibody level at 7 days after secondary immunization ($P < 0.04$), Ymin of BA ($P < 0.04$), and body weight at 20 wk ($P < 0.05$). The current study demonstrated that the SNP detected within the immune function genes affect antibody kinetics for BA, and may also have a role as effector or regulatory factors for body weight.

Key Words: antibody, SLC11A1, PSAP

W41 The complete sequence and analysis of the turkey (Meleagris gallopavo) mitochondrial genome. X Guan*, K. B. Gyenai, and E. J. Smith, Virginia Tech, Blacksburg.

The mitochondrial genome (mtGenome) is an extra-chromosomal and maternally inherited DNA molecule whose expression is essential in vertebrate biology for processes such as energy production, metabolism, cellular homeostasis, and apoptosis. These processes are important because they affect diseases like dilated cardiomyopathy, diabetes, cancer and Alzheimers in eukaryotes including human and model species such as the mouse. Despite this importance, the mtGenome has been very little-studied in birds, especially economically important poultry species. The turkey (*Meleagris gallopavo*), for example, the second most important poultry species, even lacks a complete mtGenome sequence. In this study, we used PCR-based methods involving 35 primer-pairs developed from mitochondrial DNA of the chicken and other species to generate and validate a complete turkey mtGenome sequence. The total length of the sequence was 16,968 bp. The sequence showed 85% nucleotide similarity with the chicken (*Gallus gallus*) mtGenome. As expected, annotation using bioinformatics tools revealed that the turkey mtGenome has 13 genes and 24 RNA (22 tRNA and 2 rRNA) sequences. The mtGenome sequence is a resource that will be useful in evaluating the role of the mitochondria in turkey biology as well as in defining genetic relatedness among turkey varieties, an interest of our group.

Key Words: turkey, mitochondrion genome, DNA sequence

W42 Genetic analysis of relatedness among commercial and heritage turkeys. D. Kamara*, K. B. Gyenai, K. C. Lin, and E. J. Smith, Virginia Tech, Blacksburg.

Consumer interest in Heritage turkeys continue to grow and are rapidly becoming an important source of revenue for a different group of farmers, especially organic growers. The increasing demand for the heritage turkeys poses an important concern about the utility of the knowledge of the commercial turkey, the most-widely studied, in understanding their biology. Understanding the genetic relationships between commercial and non-commercial turkeys may help address this concern and to determine the usefulness of the heritage varieties in breeding programs that could involve introgression of novel genes important for economic traits including disease resistance. The objective of this research was to conduct molecular genetic analysis of relatedness among commercial and heritage domestic turkeys using microsatellite DNA markers and a gene-based SNP. A total of 10 microsatellite markers were used to genotype 25 birds from each of 5 heritage turkey varieties including Narragansett, Bourbon Red, Blue Slate, Spanish Black, and Royal Palm. A naturally-occurring ApaL I recognition site matching a SNP in cardiac troponin T was used as the basis for SNP-based phylogenetic analysis of the six populations by PCR-RFLP. Results of the microsatellite analysis showed that the Bourbon Red and Blue slate were closely related to the commercial strain, and the Royal palm and Spanish black were the least related. The SNP-based analysis showed a closer relationship between the Narragansett, Spanish Black, and the commercial turkey and between the Blue Slate, Bourbon Red, and Royal Palm. Though the two marker-types appear inconsistent, together, however, they provide for the first time, an opportunity to more fully define the relatedness among heritage and commercial turkeys.

Key Words: heritage turkeys, DNA markers, phylogenetic relatedness

W43 Estimation of repeatability for body weight of Ross broilers in Iran. H. Naeemipour*, N. Afzali, H. Farhanfar, and A. Riasi, *Birjand University, Birjand, Iran.*

A total of 1917 weight records obtained from a feed experiment consisting of 240 Ross broilers was used to estimate repeatability of body weight trait over a period of 8 weeks. The experiment was undertaken in the animal research unit of agriculture faculty of Birjand University of Birjand in Iran. In the model, fixed environmental effects of sex, week and ration were statistically significant ($P < 0.05$). Restricted maximum likelihood (REML) & Henderson III (HIII) statistical methods were used to estimate variance components. The repeatability of body weight records were found to be 0.267 and 0.264 based upon REML and HIII methods, respectively.

Key Words: Ross broilers, repeatability, body weight

W44 Correlation coefficients between some traits in commercial hen layers. A. Riasi* and H. Naeemipour, *Birjand University, Birjand, Iran.*

Correlation coefficients between some traits of commercial hen layers was studied using 192 Single Comb White Leghorn hens from 100 to 112 wk of age. The age, specific gravity of eggs (GR), shell thickness (SHT), shell weight (SHW), shell weight to egg weight (SHW/EW), yolk colour index (YCI), feed conversion rate (FCR), feed consumption (FC), egg production (EP), packed-cell volume (PCV), triglyceride (TG), total cholesterol (Chl), HDL cholesterol (HDL), and LDL cholesterol were studied. The SAS software (1990) was used for statistical calculations. Results show that the correlation coefficients between some traits were positive and the other ones were negative. The highest significant correlations were found between age and TG (0.67) ($P < 0.01$), age and SHT (-0.63) ($P < 0.01$), age and YCI (-0.31) ($P < 0.05$), age and Chl (0.49) ($P < 0.01$), FC and EP (0.55) ($P < 0.01$), FC and PCV (0.29) ($P < 0.05$), FC and LDL (0.26) ($P < 0.05$), FC and Chl (-0.34) ($P < 0.01$), EP and FCR (-0.85) ($P < 0.01$), EP and HDL (-0.30) ($P < 0.05$), LDL and TG (-0.37) ($P < 0.01$), LDL and Chl (-0.88) ($P < 0.01$), SHW and SHW/EW (0.69) ($P < 0.01$). The correlation coefficients between SHW and SHT, FCR and PCV, age and PCV were not significant ($P > 0.05$). It is concluded that some physiological characteristics of hen layers are able to be estimated by common traits.

Key Words: correlation coefficient, traits, hen layer

W45 16S rDNA analysis of the intestinal microbiota in turkey poults in response to antibiotic use. K. Bos*, D. Karunakaran, and T. Rehberger, *Agtech Products, Inc., Waukesha, Wisconsin.*

The gastrointestinal tract of a turkey poult harbors a dense and metabolically active microbial community. During the poult production phase, antibiotics are used as an intervention tool to control gastrointestinal disease. However, the effects of antibiotics on the gastrointestinal microbial community are poorly understood. The early development of gastrointestinal microflora affects both the immune system and performance. Traditionally, culture plating methods have been used to characterize microbial populations in the gastrointestinal tract of turkey poults. Unfortunately, these techniques are limited in their ability to detect only cultivable microorganisms. The objective of this study was to assess the microbial diversity and succession of the

bacterial community in the gastrointestinal tract of turkey poults with and without penicillin using denaturing gradient gel electrophoresis (DGGE). Three penicillin applications; penicillin in feed, penicillin in water, and penicillin in feed and water along with a control of no penicillin, were examined in this study. The gastrointestinal tract of three representative birds from each of 25 houses representing 14 sites were dissected, sampling the duodenum, jejunum, and ileum. Genomic DNA was extracted, amplified using PCR, and then visualized by DGGE. MANOVA results indicated that replicates within each treatment group possess similar microbial communities, while microbial communities differ significantly between treatments ($p < 0.001$). MANOVA results also identified bacteria which were prominent in each treatment group. Bacteria correlated with good performance and the use of penicillin were identified by DNA sequencing as *Lactobacillus spp.* Overall, DGGE has been an effective tool to monitor the microbial diversity and succession in response to antibiotic treatments.

Key Words: DGGE, turkey poult

W46 Vitrification of the inner perivitelline layer of chicken eggs for use in the sperm-egg interaction assay. D. C. Bongalharo*^{1,2}, A. S. Flores¹, V. Severo¹, V. C. Gonzalez¹, B. R. Curcio², M. C. Macedo Jr.², and J. C. Deschamps², ¹*Biology Institute, Federal University, Pelotas, RS, Brazil,* ²*Biotechnology Center, Federal University of Pelotas, Pelotas, RS, Brazil.*

The sperm:egg interaction assay is a good predictor of the fertilizing potential of semen. The ability of chicken sperm to interact with the egg can be measured by counting the number of holes in the inner perivitelline layer (IPVL) of a fresh egg. However, IPVL is viable for a short period of time and must be prepared within 24 hours of the test. Preservation of IPVL for long periods of time in liquid nitrogen would facilitate the sperm:egg interaction assay. This work aimed to develop a protocol for IPVL vitrification. IPVL squares from the same egg were washed with mDPBS/BSA, equilibrated for 1 minute in vitrification solution 1 (VS1 - 1.4 M DMSO and 1.8 M EG) and transferred to VS2 (2.8 M DMSO, 3.6 M EG, 0.6 M saccharose, and 1% X-1000). After 1 minute in VS2, they were envased in 0.5 ml straws (each straw contained from 4 to 8 IPVL squares cut from the same egg, immersed in VS2 solution), refrigerated in nitrogen vapour for 1 min, and then immersed in liquid nitrogen. For thawing, the straws were removed from liquid nitrogen, and gently agitated in the air for 15 seconds. Both ends of the straws were cut and the straw content was placed in thawing solution 1 (TS1 - 0.5 M saccharose and 0.4% BSA in PBS). The number of membranes recovered was counted, and they were consecutively transferred to TS2 (0.25 M saccharose and 0.4% BSA in PBS), and TS3 (0.125 M saccharose and 0.4% BSA in PBS). The IPVL squares remained in each TS for 1 minute, with gentle agitation of the plate in order to spread the membranes. At last, the IPVL squares were placed in 1% NaCl solution and were ready to be used in the sperm:egg interaction assay. There were no statistical differences (Wilcoxon Signed Rank test, $P > 0.05$) in the number of holes made by the same sample of sperm in fresh and vitrified membranes (respectively, 159.5 ± 17.7 and 146.0 ± 17.7 holes/mm² of IPVL, mean and standard error, $n = 123$) and the percentage of intact membrane's recovery after the freezing-thawing process was 80%.

Key Words: vitrification, IPVL, sperm:egg interaction

W47 Some observations on molting female Japanese quail.

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Molting is the natural process in birds of shedding and renewing feathers. Photoperiod, season of the year, feed and water restrictions, and other stress factors are considered contributing factors. During our growth studies with laying female birds (age=125 d; room temperature= ~ 72 °F; LD 16:8), we noticed in mid-November that some birds were shedding feathers dorsally and around the neck and losing weight. The birds were weighed regularly and divided in two groups: molting (n=18) and non-molting (n=15). Blood was collected from the wing vein for determining PCV, glucose, and total plasma protein values. Some birds from both groups were euthanized for evaluation of the status of reproductive organs and the maturation of ovarian follicles. Total plasma proteins were determined by using lab refractometer (T2-Ne Atago Co), glucose using a glucometer (Elite XL), and PCV using microhematocrit tubes. Besides shedding feathers, loss in body weight (115 vs. 132g) and cessation in egg production, the molting birds had a relative increase in glucose (284 vs. 243 mg/dl) and PCV (48 vs. 42 %) values, and decrease in total plasma proteins (3.78 vs. 5.96 g/dl). In the molting birds, the weights of the oviducts were drastically reduced (1.6 vs. 4.82 g). The ovaries were also regressed and devoid of maturing follicles. There was evidence of resorption of old follicles in some birds. During the molting period, the females were hard to distinguish from males with respect to breast feather colors. The birds recovering from molting resumed egg production and returned to normal blood values. Our observations indicate that the above mentioned changes in the molting birds resulted from the disruption of gonadotropin and gonadal hormone secretions. The data is also being analyzed with respect to the dynamics of circulating leukocytes and hormones. Accordingly, the molting process is likely to impact reproductive, endocrine, blood, and growth studies in birds.

Key Words: female Japanese quail, molting, oviducts

W48 Leptin and its neural effector can modulate long bone growth in the chick.

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Leptin is a potent hormone that can regulate feed intake and energy balance in domesticated and wild birds. It can act centrally, through activation of hypothalamic nuclei and the sympathetic nervous system, or directly on peripheral tissues. Studies in mammals suggest that leptin also can be a potent modulator of the skeleton. It is not known if this function of leptin and its neuroendocrine circuitry exists in poultry. To explore this mechanism for linking nutritional status, energy balance and skeletal quality, a bone explant culture model was used to test effects of chicken leptin (cLEP) and the sympathetic neurotransmitter, norepinephrine (NE), on the growth of embryonic chick bones. Contralateral pairs of tibiotarsi bones were dissected from day 10 chick embryos and incubated individually with cLEP (1 μ M), NE (10 μ M) or transforming growth factor- β (TGF β : 10 ng/ml-control for tissue viability). After 5 days in culture, measurements were taken of the length of proximal condyles and width of the mineralized band at the diaphyseal-epiphyseal junction as estimates of longitudinal growth and chondrocyte maturation respectively. cLEP treatment resulted in an increase in condyle length (CO 3.96 \pm 0.06 mm; cLEP 4.21 \pm 0.07 mm; p=0.0003) as well as the mineralized band (CO 318 \pm 35 μ m ; cLEP 640 \pm 77 μ m; p=0.006). Similar effects were observed with NE treatment on length (CO 4.65 \pm 0.08 mm; NE 5.04 \pm 0.11 mm; p=0.006)

and mineralization (CO 514 \pm 57 μ m; NE 680 \pm 52; p=0.04). In contrast, TGF β had no effect on length and reduced mineralization (CO 510 \pm 81 μ m; TGF β 260 \pm 52 μ m; p=0.0003), consistent with its role as an inhibitor of proliferation and maturation. Immunohistochemical and quantitative real time PCR analysis for the expression of Type X Collagen, a marker of chondrocyte maturation, further supported these results. For example, NE treatment resulted in a \sim 2-fold increase in Type X expression (f=2- $\Delta\Delta$ Ct; f=2.13 \pm 0.29). In addition, analysis of BrdU incorporation suggest a positive effect of leptin and NE on chondrocyte proliferation. These results provide compelling evidence that leptin and its effectors may function to regulate skeletal growth and homeostasis in poultry.

Key Words: leptin, norepinephrine, skeleton

W49 Pituitary levels of a putative gonadotropin inhibiting hormone receptor mRNA fluctuate during a reproductive cycle in the chicken. G. Y. Bedecarrats*, M. Shimizu, and M. Zeini, *University of Guelph, Guelph, ON, Canada.*

Although gonadotropin inhibiting hormone (GnIH) has been shown to inhibit the release of luteinizing hormone in several species, its effect on the reproductive axis in chickens has been controversial. Recently, two putative chicken GnIH receptors have been identified (RFamide-related peptide receptor, RFRPR, and neuropeptide FF receptor, NPFFR). However, whether their expression pattern changes during a reproductive cycle is not known. Thus, the objective of this study was to detect and quantify RFRPR mRNA in pituitaries and brain tissues from hens and roosters at various reproductive stages. Pituitaries, diencephalon, brain stem, cerebrum and cerebellum were collected from White Leghorn females at 4 different reproductive stages (immature, peak of lay, mid-lay, and end-of-lay) and from males at 3 reproductive stages (immature, 4 weeks and 40 weeks post-photostimulation). The presence of RFRPR mRNA was first detected by RT-PCR using primers designed to amplify the full length receptor. After PCR, RFRPR could be visualized in all tissues examined. To further determine if RFRPR gene expression was dependant on the reproductive status of the animal, levels of mRNA were quantified in individual pituitary glands and hypothalami by semi-quantitative real time PCR using primers spanning intron 2. In both males and females, mRNA levels in the pituitary gland were significantly higher in immature birds than in photostimulated birds (p<0.05). However, this difference was no longer significant towards the end of the laying period in hens. In the diencephalon, no significant changes were observed between reproductive stages, although levels tended to decrease after photostimulation in females. Interestingly, levels in the pituitary gland were consistently lower than in the diencephalon (p<0.05). In conclusion, GnIH receptor mRNA levels in the pituitary gland fluctuate during a reproductive cycle in both male and female chickens with the lowest levels observed around sexual maturity.

Key Words: gonadotropin, chicken, receptor

W50 Characterization of structure and tissue distribution of chicken GPR39. I. Yamamoto*, M. Numao, and M. Tanaka, *Nippon Veterinary and Life Science University, Musashino, Tokyo, Japan.*

GPR39 belongs to the subfamily of G protein-coupled receptors containing 7 transmembrane domains, and shows high homology to ghrelin receptor, GHSR (McKee et al., 1997). GPR39 has recently

been characterized as a specific receptor for a novel anorexic peptide hormone, Obestatin, isolated from rat stomach (Zhang et al., 2005). Obestatin is generated from the proprotein for ghrelin by a proteolytic cleavage and shows opposing action to ghrelin in weight regulation. The chicken ghrelin propeptide contains an amino acid sequence homologous to that of rat obestatin, suggesting that obestatin is produced in chicken tissues. In this study, we performed cDNA cloning for chicken GPR39 and characterized expression profiles of its mRNA in chicken tissues.

Total RNA was extracted from chicken tissues and GPR39 cDNA was cloned by RT-PCR using primers designed from the putative GPR39 gene sequence appeared in chicken genome database. The cDNAs for 3'- and 5'- regions were cloned by RACE. Realtime PCR analysis for GPR39 mRNA expression was carried out using primers derived from Exon 2 (sense) and Exon 3 (antisense) of GPR39 gene. Values for GPR39 mRNA were normalized to values for ribosomal protein S17 mRNA.

Chicken GPR39 cDNA was cloned from duodenum. The cDNA was about 3.0 kb in length and encoded 462 amino acids. The amino acid sequence showed significant homology to human (62.6%), mouse (62.6%) and rat (65.3%) GPR39. Realtime PCR analysis revealed that chicken GPR39 mRNA was expressed in all the tissues examined with highest levels in the duodenum where the expression level was rapidly increased during post-hatch period. These findings suggest that obestatin might be generated as a ligand for GPR39 in chicken.

Key Words: GPR39, obestatin, cDNA

W51 Comparison of antimicrobial sensitivity of *Escherichia coli* strains isolated from broilers in United States of America and Mexico. C. Rosario*, *Universidad Nacional Autónoma de Mexico, Mexico, D.F., Mexico.*

Since 1950, control measures for *E. coli*-associated diseases have depended mostly on the prophylactic and therapeutic use of certain antibiotics. However, this practice has provided a selective pressure for antimicrobial resistance genes and as a result, many bacteria associated with chickens and poultry meat are now resistant to antimicrobial agents. The purpose of the present work was to determine the resistance patterns of several *E. coli* strains isolated from broilers in USA and Mexico and compare these patterns. For this reason 76 *E. coli* strains isolated from young broilers and Mexico and 70 strains from cull chicks in USA were analyzed to determine the sensitivity to different antimicrobial agents. Results showed higher resistance levels among Mexican strains than those seen in USA isolates (Table 1). Moreover, the multi-resistant patterns were more frequent and complex among the Mexican strains. These findings are interesting since avian strains are considered a potential source of genes that encode for antimicrobial resistance and virulence factors for humans. In addition, a relationship between virulence and resistance to antibiotics has been established recently, since resistance and virulence are both adaptive mechanisms acquired to enhance survival under stressful conditions.

Table 1. Antimicrobial Resistance among Mexican and American Strains of *Escherichia coli*

Antimicrobial Agent	Mexican Strains	American Strains
Amikacin	0	0
Ciprofloxacin	47	0
Enrofloxacin	55	0
Nitrofurantoin	10	0
Trimethoprim/sulfa	72	6
Ampicillin	64	10
Piperacillin	39	9
Gentamicin	5	77
Kanamycin	24	53

Key Words: *Escherichia coli*, antimicrobial resistance, broilers

W52 Differences among turkey (*Meleagris gallopavo*) varieties for the incidence and severity of toxin-induced dilated cardiomyopathy. K. B Gyenai* and E. J. Smith, *Virginia Tech, Blacksburg.*

Round heart disease, which is characterized by dilation of the left ventricles, is reported to cause as much as five percent mortality in commercial turkey poults. Its etiology, however, remains little understood. Using a toxin-induced model earlier described by others, we investigated differences among genetically distinct turkey varieties in the incidence and severity of RHD. The turkey varieties compared included Blue Slate (BS), Bourbon Red (BR), Narragansett (N), Royal Palm (RP), Spanish Black (SB), and commercial birds. The birds were fed either a standard commercial starter diet (control) or a starter-diet containing 700 ppm furazolidone (treatment) ad libitum to 33 days-of-age. The incidence and severity of RHD in control and treatment birds were evaluated based on percent mortality and echocardiography using left ventricular end-diastolic dimension (LVEDD), left ventricular end-systolic dimension (LVESD), and fractional shortening as primary indicators. As a result, mortality within the varieties ranged from 40 to 70%, with the lowest in the BR and the highest in the commercial turkeys, respectively. Similarly, the commercial and N birds had the highest LVEDD and LVESD measurements while the BR was the lowest, though not significantly different from those for RP. These data suggest for the first time, the response of turkeys to furazolidone-induced RHD may have a genetic basis.

Key Words: round heart disease, turkeys, genetics

W53 Effect of mannanoligosaccharides and enzymes on antibody titers against Newcastle. M. C. Oliveira*¹, D. E. Faria Filho², D. F. Figueiredo², R. A. Gravena², R. H. Marques², and V. M. B. Moraes², ¹*University of Rio Verde, Rio Verde, GO, Brazil,* ²*State University of São Paulo, Jaboticabal, SP, Brazil.*

Mannans are components of pathogen-associated molecular patterns and considered as stranger compounds to the host, resulting in increased immune response. This study evaluated the effect of

including mannanoligosaccharides (MOS) and/or enzymes in broiler diets on antibody titers against Newcastle disease. A total of 750 one-day-old Cobb chicks were distributed into a completely randomized experimental design in a $2 \times 2 + 1$ factorial scheme with two levels of MOS (0 and 0.1% until 21 days and 0.05% from 22 to 42 days of age), two levels of enzymes (0 and 0.05%), and a positive control diet with 125 ppm of colistin sulfate and 10 ppm of virginamycin as growth promoters and 51 ppm of salinomycin as anticoccidial, in a total of five treatments with five replicates. Enzymes were comprised of cellulase, protease and amylase. Birds were originated from batches vaccinated against Newcastle at 14 and 36 days and 10, 15 and 22 weeks of age. All the vaccines contained live virus, except for those applied on 22nd week. The birds were vaccinated against Newcastle disease (live virus, type B1, sample B1) at 14 days of age, through drinking water. They were also submitted to water fasting two hours before vaccination. For serum analyses, blood samples were collected weekly through jugular vein puncture in two birds per replicate. The first and last collections were done at 7 and 42 days of age, respectively. Blood samples were centrifuged and serum was analyzed for antibody titers. The inclusion of enzymes did not affect significantly ($P > 0.05$) the antibody titers. There was no significant interaction ($P > 0.05$) between positive control and factorial, or MOS and enzymes on antibody titers against Newcastle disease. However the inclusion of MOS resulted in increased ($P < 0.03$) antibody titers in the 3rd ($1.49 \times 2.04 \log_{10}$), 4th ($2.38 \times 2.78 \log_{10}$) and 5th ($2.51 \times 2.81 \log_{10}$) weeks of age. In conclusion, the inclusion of MOS in broiler diets increased the immune response to vaccinations against Newcastle disease.

Key Words: additives, immune modulation, prebiotic

W54 Humoral immunity measurements of tom turkeys grown on Sel-Plex/Bio-Plex trace mineral diets. P. Cotter^{*1}, A. Sefton², and C. Novak³, ¹*Framingham State College, Framingham, Massachusetts*, ²*Alltech-Canada, Inc., Guelph, ON, Canada*, ³*Virginia Tech, Blacksburg*.

Trace minerals including Zn, Mn, Cu and Se are known to influence avian immunity. Differential affects have also been detected in studies comparing organic vs. inorganic minerals. We wished to determine if humoral immune differences could be detected in toms grown on organic vs. inorganic trace elements. We chose to study natural anti-Gal antibodies known to occur in a variety of avian species. The plasma antibody component is mostly IgM however IgG is also present. Anti-Gal antibodies are found in bile and are likely composed of both IgA and IgG. Rabbit erythrocytes expressing anti-Gal receptors are agglutinated and lysed by turkey plasma. Bile anti-Gal was determined using glutaraldehyde stabilized rabbit cells. Bile IgA_B, known to be sensitive to diet, was measured by radialimmunodiffusion using black turtle bean lectin.

Plasma and bile were sampled on days 49, 84, and 133. The experimental diets were: a negative control, a positive control, and two regimens of BioPlex/Selplex.

Dietary treatments were not associated with differences in HA or lysis of either plasma or bile on day 49 nor was there any dietary affect on bile IgA_B. Dietary differences were detected on day 84 in both HA titers and bile IgA_B. The highest and lowest HA titers were found in the negative and positive controls respectively ($P < 0.01$), while both the BioPlex/Selplex regimens were intermediate. Higher IgA_B was found in the positive control diet compared with either BioPlex/SelPlex treatment. HA titer differences were also detected on day 133 with higher titers in the positive control compared with either

BioPlex/SelPlex treatment. Complement levels on day 133 were higher in the positive control compared to the negative control ($P < 0.02$) and the BioPlex/SelPlex treatments were intermediate. Collectively the data indicate that the anti-Gal system has the sensitivity to detect nutritional influences on immunity and these observations further extend its utility to the study of trace minerals.

Key Words: organic trace minerals, immunity, nutrition

W55 Methods in heat-stabilization of *gallus domesticus* Immunoglobulin Y (IgY). E. A. Bobeck^{*}, D. L. Trott, M. E. Cook, and M. Yang, *University of Wisconsin, Madison*.

Post-pellet application of heat-labile protein (i.e. enzymes, antibodies, and peptides) has become the industry standard in recent years; however, heat-stabilization of these proteins would permit pre-pellet application. Development of a pilot steam conditioning system which models industry steam conditioning was necessary to create a laboratory model for testing encapsulation strategies and heat stability of proteins prior to large-scale production. Egg yolk antibody is an example of a protein increasingly being used in animal feeds. The objective of this project was to attempt to improve the heat stability of egg yolk proteins and to test a steam conditioning chamber engineered to model commercial conditioning prior to feed pellet manufacture. Ligand-specific whole egg liquid was mixed with no carbohydrate, 12% trehalose or 6% sorbitol plus 6% corn starch. Egg preparations were spray dried at 90C. The antibody powder was added to broiler feed and subjected to 10s of steam conditioning at 82C, then pelleted. Antibody was extracted from the feed and antibody ligand binding activity following encapsulation and heat treatment was assessed by a ligand-specific enzyme-linked immunosorbent assay (ELISA). Loss of optical density (OD) reading following heat processing relative to pre-processing was 87% for the control, 45% for trehalose and 84% for the sorbitol plus starch-treated egg products. In the trial involving an engineered pilot conditioner, ligand-specific egg yolk was mixed with 0 or 24% trehalose, freeze dried, and then mixed into feed. Feed samples were conditioned at 85C for up to 60s and then removed from the chamber. Ligand binding activity was assessed using ELISA. Loss of OD reading was similar between the two treatments at 10s (ca, 20%), 45 and 25% at 30s and 50 and 37% at 60s for the control and 24% trehalose treated egg yolk antibody, respectively. At this time, a direct comparison of antibody loss under commercial heat treatment of feeds is not readily piloted in a bench scaled conditioner, however, trehalose does appear to offer some heat stability to egg antibody in both the commercial and piloted conditioners.

Key Words: antibody heat stability, trehalose, IgY

W56 Influence of pediococcus-based probiotic on coccidiosis in broiler chickens. S.-H. Lee¹, H. Lillehoj^{*1}, D.-W. Park¹, R. Dalloul¹, Y.-H. Hong¹, and J. Lin², ¹*Animal and Natural Resources Institute, ARS, USDA, Beltsville, Maryland*, ²*Imagilin Technology, Frederick, Maryland*.

Coccidiosis is the major parasitic disease of poultry and is caused by the apicomplexan parasites *Eimeria*. Drugs and live vaccines are the two main control measures of the disease; however, due to increasing concerns with prophylactic drug use and high cost of vaccines, alternative control methods are needed. Recent evidence that various dietary and live microbial supplements can influence host

immunity against enteric diseases prompted us to investigate the role of a *Pediococcus*-based probiotic on coccidiosis in broiler chickens. In the present study, we examined body weight gains, oocyst shedding, and antibody responses of broilers fed the commercial probiotic MitoGrow[®] (MG). Day-old chicks were fed either a standard broiler diet (control) or one of two probiotic diets supplemented with 0.1% (MG 0.1) or 0.2% (MG 0.2) of MitoGrow, and orally challenged with 5,000 or 10,000 sporulated oocysts of *Eimeria acervulina* (EA) or with 5,000 *Eimeria tenella* (ET) oocysts of at 2 weeks of age. In EA-infected birds, 0.1% MitoGrow improved ($P < 0.05$) weight gain as compared to the other two groups, and reduced ($P < 0.05$) oocyst shedding in

birds infected with 5,000 EA oocysts. In ET-infected birds, MitoGrow also reduced oocyst shedding and was more effective at the 0.1% level while there was no significant effect on weight gain. In those birds, *Eimeria*-specific antibody levels were higher ($P < 0.05$) in the MitoGrow-fed groups compared to the control group especially in MG 0.1 birds. These results demonstrate that this *Pediococcus acidilactici*-based probiotic effectively enhances the resistance of birds and partially protects against the negative growth effects associated with coccidiosis, particularly when supplemented at 0.1% of the diet.

Key Words: *pediococcus*, broiler, coccidiosis