

**M25 Observations on the comparative stability of five commercial pigmenter products.** R. V. Snyder\*, B. Hajar, and A. G. Yersin, *Kemin Industries, Des Moines, IA.*

Purified xanthophyll products used to pigment egg yolks share a common susceptibility to oxidation and thus loss of their pigmenting ability. Changes in the production processes of pigmenters can reduce their susceptibility to degradation. Objectively demonstrating slower degradation rates of one pigmenter compared to competing products would be an advantage in the market place. The results from a series of kinetic experiments have allowed the ranking of five commercially available pigmenting products. Employing a pseudo first-order kinetic model, the rate constants for the loss of total xanthophylls and trans-lutein contents were estimated for five neat pigmenting products and for the products when mixed with a vitamin and mineral feed premix. The results indicated that pigment losses were accelerated when mixed with the premix product and that there were statistically significant differences in the rates of degradation of color and lutein content. The advantage of using a kinetic description of the degradation process is that direct comparisons of time to lose a set proportion of the initial activity or the activity lost in a given time can be calculated and compared from separate experimental determinations.

**Key Words:** xanthophylls, pigmenter, stability, degradation, kinetics

**M26 Comparison of commercial adsorbent products Using an in vitro binding assay.** D. Sanders\* and A. G. Yersin, *Kemin Industries, Des Moines, IA.*

Six commercial adsorbent products were tested for their ability to bind a series of mycotoxins using a two-step binding model. Each product was tested for binding efficiency at three dosages, 1, 3 and 5 mg/ml. The mycotoxins tested included aflatoxin (B1, B2, G1 and G2), zearalenone, deoxynivalenol, ochratoxin and fumonisin B1 at concentrations of 5 ppb each, 300 ppb, 1 ppm, 200 and 300 ppb, respectively. The in vitro assay includes an adsorption step, which is conducted at pH 3.0 and

measures a reduction in mycotoxin solution concentration. The second step measures the degree to which the toxin can be desorbed and is determined by re-suspending the test material, with adsorbed mycotoxins, in a clean pH 6.8 buffer. Efficiency is determined by comparing the initial challenge toxin concentration to the final desorbed solution toxin levels. Several products showed binding efficiency (greater than 50%) for aflatoxins, zearalenone and fumonisin B1. However most products tested showed little (less than 10%) binding efficacy for deoxynivalenol or ochratoxin, with limited absorption seen in the former and complete desorption in the latter.

**Key Words:** zeolite, mycotoxin, desorption, adsorption, clinoptilolite

**M27 The effect of shrimp waste meal as dietary replacement for fish meal in diet of broilers.** B. O. Iyamu\*<sup>1</sup> and E. O. Uwagboe<sup>2</sup>, <sup>1</sup>*Ministry of Agriculture and Natural Resources, Benin, Edo State, Nigeria.*, <sup>2</sup>*Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria.*

Shrimp waste meal is of high nutritional value, palatable and of pleasant aroma which is considered as a potential substitute for fish meal. This study was carried out to ascertain the effect of shrimp waste as a replacement for fish meal in broiler diet. One hundred and fifty day old chicks were allotted to five experimental diets with three replicates of 10 birds each for a period of 5 weeks in completely randomized design. Diets 1-5 contained 100% FM (Fish Meal) at 0% SWM (Shrimp Waste Meal), 75% FM at 25% SWM, 50% FM at 50% SWM, 25% FM at 75% SWM, and 0% FM at 100% SWM accordingly. Diets were Iso-Nitrogenous. Diets were subjected to ANOVA (Steel and Torrie, 1980).

At the end of the 5th week there were no significant difference ( $P \leq 0.05$ ) between the treatment mean for average weight gain, average dry matter intake, feed-gain ratio and protein efficiency. This suggest that SWM could replace FM for protein in diet of broilers.

**Key Words:** shrimp waste meal, replacement, fish meal, diet, broilers

## Nutrition II

**M28 Effect of protease enzyme on performance and ileal digestibility of broilers grown to 42 days of age in floor pens.** A. Favero\*<sup>1SC</sup>, A. Maiorka<sup>1</sup>, C. Rocha<sup>1</sup>, M. D. Appelt<sup>1</sup>, and J. O. B. Sorbara<sup>2</sup>, <sup>1</sup>*Universidade Federal do Paraná, Curitiba, PR, Brazil.*, <sup>2</sup>*DSM Nutritional Products, São Paulo, SP, Brazil.*

This experiment investigated the effects of supplementing diets with different levels of crude protein (CP) and apparent metabolizable energy (AME) with or without a protease (RONOZYME<sup>®</sup> ProAct declared 75000 PROT/g, analyzed 78067 PROT/g) on the performance, digestible energy (DE) and the ileal digestibility of nitrogen and fat of broilers. The diets were formulated to be similar to commercial diets with corn, soybean meal and meat-bone-meal. The experimental design was a 2 x 2 x 2 factorial arrangement of treatments to evaluate 2 CP and amino acid levels, 2 AME levels and 2 protease levels (0 and 200 ppm: 15000

PROT/kg feed). The difference between the two levels of CP was 7.5% while digestible Lys, TSAA and Thr differed by 15% from the control, and the difference between the two levels of AME was 3%. Each diet was fed to 11 pens of 22 male broilers raised in floor pens from d 1 to d 42. At d 42, five birds/pen were euthanized, for ileal collection and energy, nitrogen and fat digestibility was determined (1% of Celite was added to the withdraw feed as indigestible marker). No interaction (CP x AME x Enzyme) was observed in any performance parameters analyzed. Broiler performance was superior ( $P \leq 0.01$ ) in birds fed the higher levels of CP and AME. Protease supplementation significantly ( $P \leq 0.01$ ) improved feed conversion ratio compared to the non-supplemented groups. A lower daily feed intake ( $P \leq 0.05$ ) was observed during the grower period (21 to 42 d of age) on the treatments with the higher level of AME compared with the low level. Birds fed high CP levels improved ( $P \leq 0.05$ ) ileal nitrogen, fat and DE while high AME levels increased ( $P \leq 0.01$ )

DE. Supplementation with the protease increased ( $P \leq 0.01$ ) ileal crude protein, fat and gross energy digestibility by proximally 5% when the treatments with the highest level of CP and AME were compared with and without protease. This study showed that protease supplementation significantly improved the performance of broilers raised to 42 days of age independent of the CP or AME levels of the diet.

**Key Words:** enzyme, protease, performance, digestibility

**M29 Non-phosphorus effects of dietary phytase in broiler Japanese quail.** A. Sheikhlar\*, A. B. Kasim, A. R. Alimon, and M. Radfar, *Department of Animal Science, Serdang Selangor, Malaysia.*

Two experiments were conducted to determine the optimum dietary calcium and total phosphorus (Ca:tP) ratio and the effect of phytase on the retention of dry matter (DM), apparent metabolizable energy (AME), crude protein (CP) and trace minerals including Cu, Mg, Zn, K and Fe in broiler quail. Experimental design for both experiments was completely randomized design. In the first experiment 360 locally bred (IKTA) Japanese day-old broiler quails were randomly allocated to 3 treatments, with 4 replicates of 30 birds. Three iso-caloric and iso-nitrogenous corn-soy bean meal (C-SBM) diets were formulated to contain Ca and tP at ratios of either 1.66 (based on NRC recommendation, Treat 1), 1.81 (Treat 2) and 1.96 (Treat 3) and fed ad libitum from day 1 to 21. Gain: feed (G:F) was measured on a weekly basis. DM, AME, CP and microminerals retention were determined by measuring chromium oxide as an indigestible marker in feed and feces at 3 weeks of age. The results showed increasing the Ca:tP ratios decreased gain: feed ( $P < 0.05$ ) significantly. Increasing the ratios of Ca:tP from 1.66 to 1.96 significantly ( $P < 0.05$ ) increased retention of DM, AME and Mg. However, there were no significant difference ( $P > 0.05$ ) in retention of CP and Fe. There was a significant ( $P < 0.05$ ) decrease in retention of Cu, Zn, K with increase in Ca:tP ratios. Based on the these result the Ca:tP ratio of 1.81 was found to be the optimum ratio for improved response to the addition of dietary phytase to the diet. In the second experiment 600 day-old broiler quails of similar breed were randomly allocated to 5 treatments, with 4 replicates of 30 birds. Five iso-caloric and iso-nitrogenous C-SBM diets supplemented with different levels of phytase namely 0 FTU (Treat A), 250 FTU (Treat B), 500 FTU (Treat C), 750 FTU (Treat D) and 1000 FTU (Treat E) were fed from day 1 to day 21. Graded dietary phytase enhanced retention of DM, AME, Cu, Zn, CP significantly ( $P < 0.05$ ). However, the retention of Mg, Fe and K increased slightly, but were not significant. It can be concluded supplemental phytase had positive effect on AME, CP, DM and other microminerals in broiler quails.

**Key Words:** phytase, calcium phosphorus ratio, broiler quail, retention, microminerals

**M30 Effect of incremental red blood cell (RBC) addition on growth performance of broilers.** E. Fruge\*<sup>SC</sup>, S. Powell, T. Bidner, and L. Southern, *Louisiana State University, Agricultural Center, Baton Rouge.*

Three experiments (Exp.) were conducted to determine the effect of RBC addition (0, 0.5, 1, 2, 3, 4, 5, 6, and 7%) on growth performance

of broilers fed diets with supplemental L-Arg and L-Ile (AA-adequate) or diets with no supplemental L-Arg and L-Ile (AA-deficient). Male (Exp. 1) or male and female (Exp. 2 and 3) Ross 708 broilers (0 to 18 d of age) were used in brooder batteries. Treatments had 5 to 7 reps with 6 chicks per pen. In all Exp., Diet 1 was a C-SBM control diet with no added RBC. Diet 2 had 0.5% RBC, which is the level of RBC that does not require supplemental L-Arg and L-Ile. All Diets were formulated to contain 1.36% total Lys and TSAA:Lys of 0.75, and all other nutrients (except for Arg and Ile in the deficient diets) were formulated to meet or exceed the NRC requirements. In Exp. 1, the dietary treatments were 0, 0.5, 1, 2, and 3% RBC with supplemental L-Arg and L-Ile. There was no effect ( $P > 0.10$ ) of RBC addition on growth performance. In Exp. 2, the RBC additions were 0, 0.5, 1, 2, 3, 4, 5, 6, and 7% with supplemental L-Arg and L-Ile as needed. With increasing levels of RBC, there was a linear and quadratic effect on gain (ADG,  $P < 0.06$ ) and feed intake (ADFI,  $P < 0.02$ ) but not gain:feed (G:F,  $P > 0.10$ ). The RBC addition increased or did not affect ADG up to the 6% addition. The response in ADFI was similar but the 7% RBC addition decreased ( $P < 0.04$ ) ADFI. Experiment 3 was similar to Exp. 2 but the RBC additions were with or without supplemental L-Arg and L-Ile. Broilers fed AA-adequate diets had a linear and quadratic effect (increase then decrease) in ADG ( $P < 0.01$ ) and ADFI ( $P < 0.07$ ) but a linear increase in G:F ( $P < 0.01$ ). The RBC did not affect ADG up to 6% with supplemental AA, but ADG was decreased by 7% RBC. The response in ADFI was similar, but ADFI was decreased ( $P < 0.02$ ) by 6 and 7% RBC. Feed efficiency was increased by RBC. Broilers fed the AA-deficient diets had a linear and quadratic decrease in ADG, ADFI, and G:F ( $P < 0.01$ ). Red blood cell addition up to 6% can be added with supplemental AA, and up to 2% RBC without supplemental AA with no detrimental effects on growth performance.

**Key Words:** broiler, red blood cells, growth

**M31 Evaluation of the effects of dietary enzymes on broiler performance and gut morphology during live coccidia oocyst vaccination.** C. L. Walk\*<sup>SC1</sup>, C. Novak<sup>4</sup>, A. Cowieson<sup>2</sup>, J. Remus<sup>3</sup>, and A. P. McElroy<sup>1</sup>, <sup>1</sup>Virginia Tech, Blacksburg, <sup>2</sup>Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom, <sup>3</sup>Danisco Animal Nutrition, St. Louis, MO, <sup>4</sup>Land O'Lakes, Inc., Kansas City, MO.

An experiment was conducted to evaluate the effects of dietary enzymes on broiler performance, bone ash, and gut morphology when using a live coccidia oocyst vaccine. One-day-old, Cobb 500 straight run broilers were obtained from a commercial hatchery and half were sprayed with a live coccidia vaccine. Chicks were weighed and placed in battery brooders according to eight dietary treatments ( $n = 108/\text{treatment}$ ). Dietary treatments were positive control (PC; 0.90% Ca and 0.45% npP), negative control (NC; 0.80% Ca and 0.35% npP), NC + phytase (NC+P), NC + protease (NC+Pr), NC + xylanase (NC+X), NC+P+Pr, NC+P+X, and NC+P+Pr+X. Birds were weighed and feed intake measured on days 7 and 18. Enzyme supplementation did not significantly affect feed intake (FI) or body weight gain (BWG). Phytase supplementation improved ( $P < 0.05$ ) feed conversion (FC) compared to protease supplementation at day 7. Phytase or xylanase improved FC compared to the NC and NC+Pr at day 18. Feed conversion was not different among any other dietary treatments. Coccidia vaccination reduced FI and BWG but did not affect FC. There were no diet and vaccine interactions. Percent tibia ash was reduced in NC, NC+Pr, and NC+X diets compared to all other diets at day 7. Similarly at day 18, percent tibia ash was

reduced in NC+Pr and NC+X diets compared to NC+P and NC+P+X diets. There were no differences in tibia ash among any other dietary treatments or with vaccination. Gut morphology was significantly affected by diet, vaccination, and interaction of diet and vaccination. Villi height, crypt depth, and villi height to crypt depth ratio were significantly different between diets. Vaccination with live coccidia oocysts increased villi height in the duodenum and jejunum, and diet by vaccine interactions affected gut morphology in as well. Mortality was not affected by diet or vaccination. These data indicate selected dietary enzymes may improve broiler performance during live coccidia oocyst vaccination by improving gut morphology, which may result in improved intestinal integrity.

**Key Words:** phytase, protease, xylanase, broilers, coccidia

**M32 A preliminary assessment of phytase enzymes on live performance and tibia breaking strength.** A. L. Shaw\*<sup>SC1</sup>, J. P. Blake<sup>1</sup>, and R. W. Gordon<sup>2</sup>, <sup>1</sup>*Department of Poultry Science, Auburn University, Auburn, AL*, <sup>2</sup>*Koch Foods, Chattanooga, TN*.

An experiment was conducted to evaluate the effects of three phytase enzymes on performance and bone quality of broilers. Male Ross 708 chicks (960) were placed on new bedding in 48 pens (20 birds/pen with 8 reps/trt). All birds were fed a corn-soybean meal diet (22% CP, 3086 kcal/kg) adequate in all nutrients but available phosphorus (aP). Dietary treatments were created using 3 aP levels and 3 phytase enzymes: 1) standard P (.45% aP), 2) marginal P (.35% aP), 3) low P (.25% aP), 4) low P + phytase A, 5) low P + phytase B, 6) low P + phytase C. All 3 enzymes are classified as a 6-phytase with optimal activity occurring at pH 2.5-3.5, 5-5.5, and 4.5, respectively. Phytases A and B were of bacterial origin, while phytase C was fungal derived. All diets were pelleted at 79 °C, crumbled, and provided through 35 days of age. Individual body weights and feed consumption were recorded weekly and feed efficiency was corrected for mortality. Each week, 24 birds per treatment were sacrificed for tibia evaluation. Each tibia having its associated muscle was broken using a TA-HDi texture analyzer (Texture Technologies, Scarsdale, NV). Supplementation of the low P diet with phytases A and C improved body weight (P<0.001) similar to birds on the standard P diet, while phytase B supplemented birds led to weights parallel to the marginal P level. Generally, consumption from 0-35 d was only reduced (P<0.01) for birds receiving the low P diet. Broiler tibia strength most resembled (P<0.001) birds on the standard P diet when phytases A and C were included in the low P diet while birds given phytase B had strengths corresponding to the moderate P through week 4 which rose to the standard P treatment in the final week. These results suggest that broiler performance and bone mineralization responded best to either phytase A or C given the parameters of this study.

**Key Words:** available phosphorus, bone strength, broiler, phytase

**M33 Combination effects of phyzyme XP and avizyme 1502 on broiler performance and carcass traits.** M. Arguelles-Ramos\*<sup>SC1</sup>, J. Brake<sup>1</sup>, and P. Plumstead<sup>2</sup>, <sup>1</sup>*Department of Poultry Science, North Carolina State University, Raleigh*, <sup>2</sup>*Danisco Animal Nutrition, Marlborough, United Kingdom*.

Two experiments were performed to determine the effects of Phyzyme XP phytase (PXP) and Avizyme 1502 (XAP) on broiler

performance and carcass traits. In both experiments, 2304 chicks were randomly distributed to four dietary treatments consisting of Positive Control (PC), Negative Control (NC), NC+PXP and NC+PXP+XAP. The PC diet series was formulated to contain 3070, 3150, and 3200 kcal ME/kg for the starter, grower, and finisher diets, respectively. The ME in all NC diets was 150 kcal ME/kg lower than that of the PC diets with similar levels of all other nutrients. PXP was added at 500 FTU /kg diet to treatments 3 and 4 and replaced 0.12% Available P and 0.1% Ca from dicalcium phosphate. XAP was added at 0.05% to treatment 4 and supplied 300 U xylanase, 400 U amylase and 4000 U protease/kg diet. Diets were formulated using corn, soybean meal, and 10% distillers dried grains with solubles (DDGS) as primary ingredients. Pen BW by sex and feed consumption and FCR was determined at 0, 16, 35, and 41 d of age. At 42 d one male broiler per pen was killed to evaluate carcass traits. In Experiment 1, male broilers fed diets with enzymes (NC+PXP+XAP (2478 g) and NC+PXP (2471 g) were significantly heavier at 41 d than those fed the PC diet (2412 g), while male broilers fed the NC diet (2437 g) were intermediate. Similarly, in Experiment 2, male broilers fed the NC+PXP+XAP diet (2712 g) were heavier than those fed the NC (2637 g) and PC (2641 g) diets, while the NC+PXP diet (2653 g) was intermediate. Female BW, FCR, and carcass traits at 41 d did not differ between treatments. Results suggested that supplementation of a combination of XAP and PXP enzymes was more effective than using PXP alone and was able to increase male broiler BW (by 69 g at 41 d of age) when diets contained corn/soy/DDGS as primary ingredients.

**Key Words:** feed enzymes, broilers, amylase, protease, xylanase

**M34 Effect of dietary nucleotide supplementation on performance, intestinal tract development and histology of broilers.** B. Y. Jung\*<sup>SC</sup> and A. B. Batal, *University of Georgia, Athens*.

Two experiments (Exp) were conducted to determine the effects of nucleotide supplementation on broiler performance, intestinal tract development and histology. In Exp 1, 1-d-old male broilers were placed in Petersime battery boorders and maintaining on a 24h lighting schedule in a thermostatically controlled room. Chicks were randomly assigned to 3 dietary treatments; 0, 0.25 and 0.50% Torula yeast supplementation which contained approximately 62% nucleotides (0.38, 0.53, and 0.66% calculated nucleotide contents, respectively) with 6 replicate pens containing 10 chicks each. Broiler performance and relative intestinal tract weight and length did not differ among birds due to the nucleotide addition. It appears that the supply of nucleotides from the basal diet is sufficient for the growth of birds when they do not appear to be stressed. In Exp 2, 1-d-old male broiler chicks were placed in floor pens equipped with hanging tube feeders, a Ziggity watering system and dirty pine wood shavings with a stocking density of 0.71 Ft<sup>2</sup>/bird. Chicks were randomly assigned to 4 dietary treatments; 0, 0.25% Torula yeast, 2% and 6% of a commercial nucleotide product which contained approximately 3.4% nucleotides (0.37, 0.52, 0.42 and 0.52 calculated nucleotide contents, respectively) for the starter period (1-14d of age) with 6 replicate pens containing 56 chicks each. After 14d of age birds were fed a common grower diet until 32d of age. The Torula yeast as source for nucleotides and 2 and 6% of the commercial nucleotide product addition to the diets significantly (P < 0.05) improved body weight gain and feed conversion as compared to birds fed control diet from 0 to 24 d of age (1003, 1022, 989, and 964 g/chick respectively; 1.43, 1.41, 1.43, and 1.47 feed/gain, respectively) under dirty litter conditions and

stocking density stress. Nucleotides supplementation may be beneficial for birds during periods of stress.

**Key Words:** nucleotides, broilers, performance, stress

**M35 Dietary N,N-dimethyl glycine (DMG) improves technical performance in broilers depending on dosage and dietary fat source.**

I. D. Kalmar\*<sup>SC1</sup>, J. Buyse<sup>2</sup>, and G. P. J. Janssens<sup>1</sup>, <sup>1</sup>*Ghent University, Belgium*, <sup>2</sup>*Catholic University of Leuven, Belgium*.

**Introduction** DMG, which is a modified amino acid that is in small amounts ubiquitously present in organic material, is reputed to be involved in a variety of biological roles. The current large-scale study intended to evaluate effects of dietary DMG in broiler rations, with either vegetal oil or animal fat as main fat source, on production and slaughter performance.

**Materials** 1500 one-day-old broilers (Cobb-500) were housed in 50 pens of 30 birds each until day 42. The study comprised a complete block design in which 5 doses of DMG (0, 100, 200, 500 and 1000 ppm) were added to rations with either animal fat (chicken fat) or vegetal oil (soy oil) as main fat source. Following performance traits were calculated: feed conversion ratio (FCR), weight gain, mortality and production value (PV). Next, at the end of the trial, one bird per pen was euthanized and systematically dissected.

**Results** In general, weight gains were quite high (2760 g after 42 days) and FCR was very good (1.634), further the average mortality rate was relatively low (4.5%). Yet, numerically, weight gain and FCR generally improved with increasing DMG level when fed the vegetal oil diet and showed optimal values at 500 ppm when fed the animal fat diet. Moreover, a significant positive linear effect was found between DMG level and PV as final economical response value, when fed the vegetal oil diet ( $P < 0.05$ ). Next, significant quadratic and linear effects on slaughter characteristics were all in favour of the tested feed supplement. Finally, DMG showed a significant, negative linear effect on TBARS when fed the vegetal oil diet.

**Discussion** This trial demonstrates several, beneficial effects of DMG in spite of the limited margin for improvement of technical performance due to the overall highly efficient growth in this trial. Further, these data indicate that the nature and magnitude of effects as well as optimal dose of DMG depend on the main fat source of the diet.

**Key Words:** nutrition, broiler, feed additive, dimethyl glycine, technical performance

**M36 Effects of post pellet liquid fat application accuracy on broiler performance.** C. Chewning\*<sup>SC</sup>, C. Stark, and J. Brake, *North Carolina State University, Raleigh*.

A study was conducted to evaluate the effects of the accuracy of post pellet fat application on broiler performance. Fat application is routinely used to monitor feed quality and explain shrink at feed mills and poor application of fat is believed to affect bird performance and production cost. The study was designed to test the effect of over and under application of poultry fat to broiler feed post pelleting. A total of 1,024 male broiler chicks were randomly assigned to one of four treatment

diet series with 8 replicate pens per treatment and 32 birds per pen. Fat was applied post pelleting to a common corn-soy diet to produce three treatment fat levels (80, 100, and 120% of target), birds on the fourth treatment were randomly fed the 80, 100, and 120% fat diets to match the nutrient package fed to birds assigned to the 100% treatment. Diets were formulated to contain a total of 7.7, 7.4, and 6.3% fat in the starter, grower, and finisher feeds, respectively. BW and feed consumption were determined at 14, 35, and 45 d of age and feed conversion (FCR) calculated. Feed was analyzed for crude fat and the percentage total fat fed to the birds was calculated for each diet. Results showed that the birds received 84%, 103%, and 124% of target in the starter feed, 85%, 101%, and 121% of target in the grower feed, and 78%, 98%, and 115% of target in the finisher feed for the respective 80, 100, and 120% treatments. There were no effects on BW and FCR at 35 d of age but birds fed the diet that contained 80% fat from 35 to 45 d exhibited poorer FCR in comparison to the other treatments (1.74 versus 1.59, 1.62, and 1.63). The results indicated that under application of fat (80%) to finisher feed produced poorer FCR with males that reached 3,161 g BW at 45 d while over application of fat simply increased feed costs and will create shrink at the feed mill.

**Key Words:** post pellet fat application, broilers, pellets, poultry fat, feed mill shrink

**M37 The effects on broiler growth performance of glycine supplementation at varying levels of dietary methionine and cystine in low crude protein diets.** S. Powell\*<sup>SC</sup>, T. D. Bidner, and L. L. Southern, *Louisiana State University, Agricultural Center, Baton Rouge*.

Two experiments were conducted to investigate Gly addition to reduced crude protein corn-soybean meal diets for Ross x Ross 708 broilers with varying levels of TSAA achieved by varying dietary Met and Cys levels. Treatments had 6 replicates with 6 broilers per pen. The experiments were conducted in brooder batteries and were from 0 to 18 d posthatching. All diets contained 0.394% Biolys and were formulated to provide a standardized ileal digestible (SID) Lys of 1.27%. In Exp. 1, there were 8 diets: Diets 1 to 3 were 3 ratios of Met to Cys (60:40, 50:50, and 40:60) calculated on a mole for mole basis at a TSAA:Lys of 0.68; Diet 4 was a positive control with Met:Cys ratio of 50:50 at 0.76 TSAA:Lys; and Diets 5 to 8 were Diets 1 to 4 with added Gly to a total of 2.32% Gly+Ser. Glycine did not affect gain (ADG) or feed intake (ADFI); however, gain:feed (GF) was increased ( $P < 0.03$ ) by Gly supplementation. An increase in Cys and a decrease in Met resulted in a decrease ( $P < 0.03$ ) in ADG but no effect on ADFI or GF. In Experiment 2, SID Met was kept constant at 0.45% and SID Cys was increased in 0.05% increments from 0.35 to 0.50% and these diets were fed without and with supplemental Gly to a total of 2.32% Gly+Ser. Glycine supplementation had no effect on ADG, ADFI, or GF. There was a linear increase ( $P < 0.09$ ) in ADG and ADFI with increasing Cys supplementation; however, there was no effect on GF. The Gly addition tended to increase GF in diets with 0.35 or 0.4% Cys but had no effect or decreased GF in diets with 0.45 or 0.50% Cys ( $P < 0.11$ ). These data indicate that Gly increased GF in broilers fed suboptimal levels of Met and Cys but not at Cys levels at or above the requirement.

**Key Words:** broilers, glycine, cystine, methionine

**M38 The effect of methionine source, phytase and 1- $\alpha$ -OH cholecalciferol on phytate phosphorus utilization in young broiler chicks.** A. Liem<sup>\*SC</sup>, G. M. Pesti, and H. M. Edwards Jr., *University of Georgia, Athens.*

Various factors such as phytase supplementation, vitamin D derivatives, and organic acids (including 2-hydroxy-4methylthio butanoic acid (HMB)) have been demonstrated to influence phytate phosphorus utilization in poultry. The objective of this study is to quantitate the effect of methionine source, phytase and 1- $\alpha$  OHD<sub>3</sub> and their interactions on phytate phosphorus utilization in broiler chicks.

An experiment with 240 Cobb x Cobb chicks were conducted in a battery brooder from 1-16 days of age. The chicks were randomly allocated to a 2 x 2 x 2 factorial arrangement of treatments with 2 methionine sources (DL-Methionine (DLM) and HMB) added at 0.2% of the diet, phytase added at 0 or 500 U/kg diet, and 1- $\alpha$  OHD<sub>3</sub> at 0 or 5  $\mu$ g/kg. All supplements were added to a P-deficient diet containing 0.5% total P, and 0.25% available P. The criteria measured were body weight gain (BWG), feed efficiency, incidence of phosphorus-deficiency rickets, bone ash, and phytate P disappearance from the GI tract.

HMB supplemented chicks had higher BWG, and bone ash (mg/tibia), and lower P-deficiency rickets incidence compared to the birds fed DLM. Phytase and 1- $\alpha$  OHD<sub>3</sub> reduced P deficiency rickets incidence and increased bone ash (%). There were no 3 way interactions between the factors for any the criteria measured. There were methionine source x phytase, and methionine x 1- $\alpha$  OHD<sub>3</sub> interactions for P rickets incidence. The reduction of P rickets incidence by addition of phytase or 1- $\alpha$  OHD<sub>3</sub> was diminished when HMB was fed (DLM vs HMB = 33.5% vs 15.5% reduction by phytase; and 25.5% vs 1.5% by 1- $\alpha$  OHD<sub>3</sub>). An interaction between methionine source and 1- $\alpha$  OHD<sub>3</sub> was also observed for percent bone ash. The addition of 1- $\alpha$  OHD<sub>3</sub> increased bone ash (%) in chicks fed DLM, but not in chicks fed HMB.

While phytase and 1- $\alpha$  OHD<sub>3</sub> have been reported consistently to increase phytate P utilization, addition of organic acid (in this case HMB) can influence the birds' responses to phytase and 1- $\alpha$  OHD<sub>3</sub>.

**Key Words:** phytate phosphorus, 1- $\alpha$ -OH cholecalciferol, phytase, bone ash, methionine source

**M39 Digestible lysine and threonine requirements of male turkeys from days 50 to 63, and days 71 to 84.** L. B. Linares<sup>\*SC1</sup>, E. A. Guaiume<sup>1</sup>, R. B. Shirley<sup>2</sup>, D. Hoehler<sup>3</sup>, D. R. Ledoux<sup>1</sup>, and J. D. Firman<sup>1</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Ajinomoto Heartland LLC, Chicago, IL, <sup>3</sup>Evonik Degussa Corp., Kennesaw, GA.

Two experiments were conducted to determine the digestible lysine (dLys) and digestible threonine (dThr) requirement of Nicholas male turkeys from days 50 to 63 (Phase III), and days 71 to 84 (Phase IV). In both phases, birds were raised in floor pens and randomized across 13 treatments. Sharing a common summit diet, there were 6 doses for each amino acid requirement study, plus an additional industry control diet. A total of 768 birds were used in Phase III (8 birds/pen) and 672 birds were used in Phase IV (7 birds/pen). In Phase III, a reduced low CP corn-soybean meal-peanut meal basal diet (21.5% CP, 3150 kcal/kg ME) supplied 0.90% dLys and 0.39% dThr. To determine the requirement for dThr, the level of dLys was maintained at 1.32% while dThr levels ranged from 0.39% to 0.87%, in 0.08% increments across 7 dietary treatments. For the dLys requirement, the level of dThr was

maintained at 0.87% while dLys levels ranged from 0.90% to 1.32%, in 0.07% increments across the 7 dietary treatments. The positive control (PC) diet was an industry average diet containing 25% CP. Broken-line analysis from SAS estimated the requirement for dLys in Phase III to be 1.15% for BWG and 1.12% for F:G, and the requirement for dThr to be 0.63% for both BWG and F:G. In Phase IV, a reduced CP (19% CP, 3200 kcal/kg ME) corn-soybean meal-peanut meal basal diet supplied 0.79% dLys and 0.40% dThr. To determine the requirement for dThr, the level of dLys was maintained at 1.15% while dThr levels ranged from 0.40% to 0.79%, in 0.065% increments. For the dLys requirement, the level of dThr was maintained at 0.79% while dLys levels ranged from 0.79% to 1.15%, in 0.06% increments. The PC industry average diet contained 21.5% CP. Broken-line analysis from SAS estimated the dLys requirement in Phase IV to be 1.01% for BWG and 1.03% for F:G, and the dThr requirement to be 0.57% for BWG and 0.58% for F:G.

**Key Words:** turkeys, amino acid requirements, digestible lysine, digestible threonine

**M40 In ovo feeding effects on post-hatch development of the small intestinal epithelium of turkey poults.** D. V. Bohórquez<sup>\*SC</sup>, J. E. de Oliveira, C. M. Ashwell, and P. R. Ferket, *North Carolina State University, Raleigh.*

Post-hatch survival and growth characteristics are associated with enteric development and function in turkeys. *In-ovo* feeding (IOF) enhances digestive capacity, feeding behavior and quality of poults, but little is known about its influence on the morphometrical and ultrastructural development of small intestine epithelium during the perinatal period. Two groups of eggs were injected at 23 days of incubation with either 0.4ml of a .4% saline solution or 0.4ml of an IOF solution. At hatch, 120 poults from each treatment were randomly distributed among 24 cages (10 poults/cage) and reared to 11d. Body weights (BW), cumulative feed conversion ratio (cFCR) and mortality rates were evaluated at 1, 4 and 11d. Samples were collected for jejunum histomorphometry (light microscopy) and ultrastructural (electron microscopy) analysis at each time point. Jejunum gene expression was surveyed at 4d using a focused microarray designed for 320 unique gene sequences selected from the chicken genome. Also, expression of membrane-bound MUC1 and secretory MUC2 mucin genes was evaluated by real-time PCR at 4d and 11d. Although there were no treatment effects on BW at hatch, the IOF group had 16% greater (P<0.05) apparent villus surface area than controls and electron micrographs revealed they also had more mucus secretion. At 4d, IOF down-regulated gene expression involved in smooth muscle growth, and up-regulated gene expression of intestinal disaccharidases, epithelial cell growth, thyroid receptors, and innate immune response (P<0.01). MUC1 and MUC2 genes were up-regulated (P<0.05) in the IOF group at 4d, and MUC2 up-regulation persisted in IOF poults until 11d. Although histomorphometrical differences dissipated with age, the IOF birds had 5% higher BW (P<0.05) and 6% lower cFCR (P<0.05) by 11d compared to controls. *In-ovo* feeding turkey embryos enhances morphological development and the protective mucus blanket of the small intestinal epithelium, which may improve nutrient utilization resulting in higher BW and better cFCR post-hatch.

**Key Words:** gut development, electron microscopy, gene expression, turkeys

**M41 The effects of DDGS inclusion on pellet quality and pelleting performance.** A. C. Fahrenholz\*<sup>SC</sup>, K. C. Behnke, and L. J. McKinney, *Kansas State University, Manhattan.*

A set of experiments was conducted to determine the effects of distillers dried grains with solubles (DDGS) on pellet quality and pelleting performance when used in corn-soy diets. All batching and mixing, processing, and subsequent testing was completed at the Department of Grain Science Feed Processing Center at Kansas State University. Observations on the viability of using DDGS were based on pellet durability index (PDI), energy usage measured in kilowatt-hours per ton (KWH/ton), production rate, and bulk density. In the pilot experiment DDGS were added to a non-nutritionally balanced diet as a replacement for corn at levels of 10%, 20%, 30%, and 40%. There were no observed significant differences in pellet quality across all levels of DDGS addition, but there were differences in production rate and bulk density. In the second experiment DDGS were added to a formulated diet at levels of 10%, 20%, 30%, and 40%, and each was compared to a control diet. In this experiment all ingredients were varied to retain nutritionally similar diets. In this case energy consumption showed no significant differences among treatments, while pellet quality, throughput, and bulk density all showed significant differences. In the final experiment DDGS were pelleted and then reground and added at levels of 10%, 20%, and 30% to a formulated diet. These diets were then pelleted and compared to a control diet with no added DDGS and to diets with unprocessed DDGS added at the same levels. At levels above 10% the diets containing unprocessed DDGS had significantly lower pellet quality than the control, while the diets containing pelleted and reground DDGS showed no significant difference from the control at any level. Significant effects were also observed for production rate, energy consumption, and bulk density. The researchers concluded that the use of standard DDGS in pelleted feeds is certainly feasible, and although pellet quality may be significantly lower for feeds containing DDGS, the practical value is likely not affected. Further, the data demonstrates some benefits of using DDGS that have been pelleted and reground.

**Key Words:** DDGS, pelleting, PDI, throughput, reground

**M42 The interactive effects of glycine, creatine, and fishmeal supplementation to corn-soybean meal diets on broiler growth performance.** A. Waguespack\*<sup>SC</sup>, T. Bidner, and L. Southern, *Louisiana State University, Agricultural Center, Baton Rouge.*

Two experiments were conducted to evaluate growth performance of Ross x Ross 708 broilers fed supplemental Gly, creatine, or fishmeal (FM) in corn-soybean meal (C-SBM) diets. Both experiments were conducted in brooder batteries from 0 to 18 d posthatching. Treatments had 6 reps with 6 birds per pen. In both experiments, all diets were formulated to provide 1.27% standardized ileal digestible Lys. In Exp. 1, dietary treatments were: control (C), C + 0.283% Gly, C + 0.05% creatine, C + 0.11% creatine, and C-SBM + 3% FM. The addition of FM increased ( $P < 0.10$ ) gain (ADG) and the Gly addition tended to increase ADG compared with broilers fed the C diet. Gain:feed (GF) was increased ( $P < 0.04$ ) by the Gly addition, both creatine levels, and by FM compared with the C diet. In Experiment 2, the purpose was to determine the additive effects of supplemental Gly, creatine, and FM. The dietary treatments were control (C), C + 0.357% Gly, C + 0.05% creatine, C-SBM + 3% FM and all possible 2 way combinations. The data were analyzed as three 2x2 factorially arranged experiments (Gly x FM, Gly x creatine, and creatine x FM). In the Gly x FM analysis, FM increased ( $P < 0.02$ ) ADG and feed intake (ADFI), and Gly increased (Gly x FM,  $P < 0.05$ ) GF more in broilers fed the C diet than in those fed the diet with FM. In the Gly x creatine analysis, creatine increased ( $P < 0.05$ ) ADG, and Gly increased (Gly x creatine,  $P < 0.08$ ) GF in broilers fed the C diet but not in those fed the diet with creatine. In the creatine x FM analysis, FM increased ( $P < 0.02$ ) ADG and ADFI. In general, there was an increase in ADG and GF in broilers fed FM compared with those fed the C diet, but there was no further increase in these responses by addition of Gly or creatine to the diets with FM. The individual or combined additions of Gly and creatine increased ADG and GF to levels that were not different from those of broilers fed the diet with FM. These data suggest that FM increased growth performance of broilers and that all or part of this response is due to the FM providing Gly and creatine.

**Key Words:** broilers, glycine, creatine, growth

## Processing and Products / Pathology / Physiology

**M43 Comparison of organ weights of two strains of broiler chickens.** O. M. Sogunle\*, O. T. Sonubi, L. T. Egbeyale, O. O. Adelaye, and A. O. Fanimu, *University of Agriculture, Abeokuta, Ogun State, Nigeria.*

This study was conducted to compare the organ weights of Arbor acre and Marshal MY strains of broiler chickens at both starter and finisher phases. A total of 198 a-day old broiler chickens (99 birds per strain) were used in the experiment which lasted 28 days (1-28days) for the starter and 28 days (29-56days) for the finisher phases, respectively. The birds were replicated thrice to contain 33 birds per replicate. The data obtained were subjected to a t-test at 5% level of significance. The results showed that live weights of the birds increased ( $P > 0.05$ ) with age but higher in Arbor acre (1.33) at the finisher phase. However, the dressing percentage ( $P > 0.05$ ) gave higher values of 72.5 and 85.5 for Marshal MY strain at the starter and finisher phases, respectively. In addition, Marshal MY strain had the higher percent liver values of 2.66 and 2.18 at both starter and finisher phases, respectively but showed

significant ( $P < 0.05$ ) difference only in the starter phase. It was concluded that Marshal MY strain is a better strain to Arbor acre when the dressing percentage is considered in poultry meat production.

**Key Words:** Marshal MY, arbor acre, organ weights, liver, dressing percentage

**M44 Cacass evaluation of finishing broilers fed fermented cocoa bean shell-based diets.** A. O. Akinsoyinu\*<sup>1</sup>, M. D. Olumide<sup>2</sup>, and R. A. Hamzat<sup>3</sup>, <sup>1</sup>Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria, <sup>2</sup>Kolmat Farms Limited, Erunmu, Ibadan, Oyo State, Nigeria, <sup>3</sup>Purdue University, West Lafayette, IN.

Proper handling of many agro-allied by-products has the potentials of enhancing their utilization as feed ingredients. Cocoa bean testa constitutes economic waste in that the cocoa industries in Nigeria invest huge