

provided an advantage in nitrogen utilization (19.9 vs. 8.8%;  $P \leq 0.05$ ) over females consuming the higher level. Dietary ME measurements with females were similar at both threonine concentrations and ages. Threonine need appears to be considerably more extensive with males than females, and inadequacies with males that exceed repercussion on N-balance also create conditions that reduce the recovery of ME.

**Key Words:** Amino Acid, Broiler, Threonine

**198 Ideal ratio (relative to lysine) of tryptophan and threonine for chicks during the second and third week of life.** A.B. Batal\*, T.M. Parr, N.R. Augspurger, C.M. Parsons, and D.H. Baker, *University of Illinois, Urbana, IL USA.*

Three bioassays were conducted to determine the ideal ratios of Trp and Thr to Lys. Young male crossbred chicks (New Hampshire x Columbian) were fed diets based on corn gluten meal and synthetic amino acids (AA) that could be made singly deficient in Lys, Trp, or Thr. Diets for all assays contained 3,400 kcal ME/kg, and L-glutamic acid was used to make all diets (within and among assays) equal in protein at 23.8% of the diet. When fully fortified with each limiting AA, growth performance of chicks fed the corn gluten meal diet was equivalent to that observed with a 23% CP Met-fortified corn-soybean meal diet. True digestibility assessment of corn gluten meal in cecectomized roosters facilitated dose-titration studies (six dose levels for each AA) so that least squares fitted one-slope broken-lines and quadratic regression equations could be calculated to establish inflection points for both weight gain and gain:feed. Four battery pens of four chicks were fed one of six AA dose levels during the period 8 to 22-d posthatching. Weight gain and gain:feed responded quadratically ( $P < 0.01$ ) to increasing doses of digestible Lys (0.68 to 1.28%), Trp (0.09 to 0.24%), and Thr (0.41 to 0.81%). Broken-line least squares analysis predicted breakpoints for gain and gain:feed, respectively, of: Lys (0.85, 0.96%), Trp (0.16, 0.16%), and Thr (0.53, 0.53%). Requirement estimates based on quadratic regression fits (90% of upper asymptote) predicted requirements for gain and gain:feed, respectively, of: Lys (0.97, 1.03%), Trp (0.19, 0.18%), and Thr (0.61, 0.62%). Regardless of curve-fitting method, gain:feed requirements for Lys (but not Trp or Thr) were much higher than weight gain requirements. Using the higher of the broken-line requirement estimates for gain and gain:feed, ideal ratios (% of Lys) were: Lys (100), Trp (17), and Thr (55). The

Trp ratio is similar but the Thr ratio is lower than previous estimates made in our laboratory.

**Key Words:** Tryptophan, Lysine, Threonine

**199 Ideal ratio (relative to lysine) of isoleucine and valine for chicks during the second and third week of life.** T.M. Parr\*<sup>1</sup>, A.B. Batal<sup>1</sup>, N.R. Augspurger<sup>1</sup>, and D.H. Baker<sup>1</sup>, <sup>1</sup>*University of Illinois.*

Three bioassays were conducted to determine the digestible Lys, Ile and Val requirement of male crossbred (New Hampshire x Columbian) chicks during the period 8-20 days posthatching. The chicks were fed semi purified diets based on corn gluten meal (CGM) and amino acids (AA) that could be made singly deficient in Lys, Ile or Val. Diets for all assays contained 3,400 kcal ME/kg, and L-glutamic acid was used as a source of non-specific amino nitrogen to make all diets (within and among assays) equal in protein at 23.8% of the diet. When fully fortified with each limiting AA, growth performance of chicks fed the CGM diet was equivalent to that observed with a 23% CP Met-fortified corn-soybean meal diet. True digestibility assessment of CGM in cecectomized roosters facilitated dose-titration studies (six dose levels for each AA) so that least squares fitted one-slope broken lines could be calculated to establish inflection points for both weight gain and gain:feed. Each AA dose level in each assay was fed to four battery pens of four chicks. Quadratic ( $P < 0.01$ ) responses to each AA occurred when graded levels of digestible Lys (0.68 to 1.28%), Ile (0.45 to 0.95%) or Val (0.51 to 1.06%) were fed. Breakpoint requirement estimates for gain and gain:feed, respectively, were: Lys (0.85, 0.97%), Ile (0.59, 0.58%) and Val (0.74, 0.74%). Using the higher of requirement estimates for gain and gain:feed, ideal ratios (% of Lys) were: Lys (100), Ile (61) and Val (76). The Ile ratio was lower but the Val ratio was similar to previous estimates made in our laboratory. Breakpoint requirement estimates for gain and gain:feed were similar for all AA evaluated except Lys, where the requirement for feed efficiency was substantially higher than that for weight gain. Quadratic regression fits to the data so that 90% of the upper asymptote could be calculated predicted higher requirements than those predicted from the breakpoint of the broken-line responses.

**Key Words:** Ideal Ratio, Isoleucine, Valine

## PSA Nutrition: Feed Ingredients I

**200 Bioavailability of zinc and copper lignosulfate complexes in broiler chicks.** J.L. Grimes, J.W. Spears, and J.L. Godwin\*, *North Carolina State University, Raleigh, NC, USA.*

Chickens are usually fed inorganic minerals to meet their mineral requirements. However, organic chelated minerals have been shown to be more bioavailable in some studies than inorganic forms. Two trials (T1 & T2) were conducted to determine the bioavailability of Zn and Cu from lignosulfate complexes (LSC) relative to feed grade sulfate forms. In each trial there were 24 pens with 7 male chicks per pen. In T1, the treatments were as follows: 1) Control - no supplemental Zn (10.1 ppm Zn analyzed); 2) 7.5 ppm supplemental Zn from ZnSO<sub>4</sub>; 3) 15 ppm supplemental Zn from ZnSO<sub>4</sub>; 4) 7.5 ppm supplemental Zn from Zn LSC; 5) 15 ppm supplemental Zn from Zn LSC, and 6) 7.5 ppm supplemental Zn from Zn proteinate. In T2, the treatments were as follows: 1) no supplemental Cu (2.22 ppm Cu analyzed); 2) 1 ppm supplemental Cu from CuSO<sub>4</sub>·5H<sub>2</sub>O; 3) 3 ppm supplemental Cu from CuSO<sub>4</sub>·5H<sub>2</sub>O; 4) 1 ppm supplemental Cu from Cu LSC, 5) 3 ppm supplemental Cu from Cu LSC, and 6) 1 ppm supplemental Cu from Cu proteinate. The experimental design was a completely randomized design. In T1 on d 21, tibia Zn (TZ) and plasma Zn (PZ) were determined using four chicks per pen. In T2 on d 21, blood hemoglobin (Hb), liver Cu (LCu), bile Cu (BCu), and plasma Cu (PCu) were determined using four chicks per pen. Feed consumption, by pen, and BW were measured at d 0, 7, 14, and 21. Orthogonal contrasts were made to compare the effect of level and source of mineral on performance parameters in each trial. In T1, increasing dietary levels of Zn from all sources resulted in increased BW, BWG, TZ, and PZ. There was no effect of source on BW, BWG, TZ, or PZ. FC was improved by supplemental dietary Zn while source had no effect. In T2, there was no effect of level or source of Cu on BW, BWG, FC, or LCu. Both level and source of Cu increased BCu. Chicks fed the lower CuSO<sub>4</sub> level had higher BCu than those fed a similar level of Cu LSC. Hb and PCu were increased by supplemental Cu from both

sources. Dietary Zn and Cu LSC were similar in bioavailability to feed grade Zn and Cu sulfates.

**Key Words:** Zinc, Copper, Bioavailability

**201 Evaluation of tetrabasic zinc chloride and tribasic copper chloride for growth promotion and toxicity in chicks.** M.E. Persia\*, C.M. Parsons, and D.H. Baker, *University of Illinois, Urbana, IL USA.*

Concerns associated with increasing antibiotic resistance of bacteria have cast a negative shadow on the use of sub-therapeutic levels of antibiotics as growth promoters in animals. With increasing legislation prohibiting the use of antibiotic growth promoters, other methods of growth promotion should be explored. High levels of both Zn and Cu have been used in swine diets to promote growth, and high levels of Cu have been used to a lesser extent in poultry diets. The objective of this study was to evaluate two new Zn and Cu compounds, Tetrabasic zinc chloride (TBZC) and Tribasic copper chloride (TBCC), for growth promoting effects and maximum tolerable levels that can be fed in corn-soybean meal diets to chicks. In the first experiment, TBZC (61.8% Zn) was fed at levels of 0, 0.05, 0.10, 0.15, 0.30, 0.50, and 1.00% added Zn. In a second experiment, TBCC (59.8% Cu) was fed at levels of 0, 0.015, 0.025, 0.05, 0.075, and 0.10% added Cu. Feed grade CuSO<sub>4</sub> was also added to supply 0.10% Cu for comparison. In both experiments, four replications of five New Hampshire x Columbian chicks were fed each diet from 8 to 22 days of age. The experiments were conducted in batteries that were left dirty from previous chick exposure. In the TBZC experiment, no differences were seen in weight gain or feed efficiency from feeding up to 0.15% supplemental Zn. A significant reduction in weight gain and feed efficiency occurred at 0.30% added Zn and higher levels. The 1.00% Zn treatment also resulted in increased mortality. In

the second experiment, the addition of 0.015 to 0.050% Cu from TBCC had no effect on chick weight gain, feed intake or feed efficiency. Levels of Cu above 0.050% decreased growth performance. The growth depressions from TBCC and CuSO<sub>4</sub> (0.1% added Cu) were similar in magnitude. Our results indicate that at least 0.15% supplemental Zn from TBZC and 0.05% supplemental Cu from TBCC can be safely fed to chicks.

**Key Words:** Tetrabasic Zinc Chloride, Tribasic Copper Chloride, Growth Promotion

**202 The application of egg by-products as valuable protein supplements in broiler chicken diets.** L.D. Schmidt\*, B.A. Slominski, D. Boros, L.D. Campbell, and W. Guenter, *University of Manitoba, Winnipeg, MB, Canada.*

Egg by-products have received little attention as a poultry feedstuff despite their excellent amino acid profile, energy content and the presence of anti-bacterial proteins. The nutritive value of the egg by-products was evaluated in two experiments. The first experiment was a completely randomized design in which birds were fed corn-soy diets containing 8% of either fish meal (control), spray-dried technical albumen (SDTA), heat treated (hot room storage at 70°C for 72h) SDTA or heat treated spray-dried whole egg (SDWE). Similar body weight gains (529, 520, 480, 514 g/bird/14days) and feed conversion ratios (1.33, 1.34, 1.38, 1.32) were observed although a negative affect of heat treatment on the nutritive value of SDTA was evident. This was substantiated by reduced TME<sub>n</sub> content of SDTA following hot room storage (5.32 vs 4.54 Mcal/kg). Amino acid digestibility, as determined at the terminal ileum, averaged 80-90% for lysine, methionine, cystine and threonine. Based on the results of the first trial a long-term production trial was conducted. Five replicates of 60 birds were fed one of four wheat-soy diets: a positive control containing fish meal and antibiotic (PC), a negative control with no antibiotic added (NC), NC+SDTA and NC+SDWE. The test proteins were included at 6% in the starter phase and 5% in the grower phase. The body weight gain and feed conversion averaged 2.14, 2.12, 2.18, 2.25 kg/bird and 1.68, 1.66, 1.61, and 1.60 for PC, NC, NC+SDTA and NC+SDWE, respectively. The high performance observed for the SDWE diet was substantiated by an increased AME over the PC diet (3212 vs 2956 kcal/kg). In comparison to the PC diet, a trend towards reduced populations of Gram-negative *Enterobacteriaceae* was observed for NC+SDTA (7.78 vs 6.15 Log CFU/g feces). It is evident from this study that the substitution of fish meal with egg by-products could further improve broiler chicken performance.

**Key Words:** Egg by-products, Nutritive value, Broiler chicken

**203 Nutritional value of hydrolyzed whole swine for turkey poults.** S. D. Crow\*<sup>1</sup>, P. R. Ferket, and T. F. Middleton<sup>2</sup>, <sup>1</sup>NC State University, Raleigh, NC USA, <sup>2</sup>Ag ProVision, Kenansville, NC USA.

Hydrolyzed whole swine (HWS) meal is produced by an alternative rendering method: ground carcasses were blended with soybean hulls then processed by flash dehydration and dry extrusion. Two experiments were conducted to evaluate the feeding value of HWS for poults. In both experiments, 400 hen poults were randomly assigned to one of five dietary treatments with 10 poults/pen. Four isocaloric and isonitrogenous corn-soy meal based diets, containing different levels of HWS (0,5,10,15%), were formulated to contain 90% of NRC (1994) recommendation for amino acids. A positive control (C) corn-soy diet was formulated to meet 100% NRC (1994) recommendations. All diets contained 0.5% titanium dioxide as an indigestible marker. Poults were housed in Petersime battery cages and fed the experimental diets *ad libitum* from 0 to 18 d of age. Body weights and feed intake were measured at 7, 14, 18 d of age, and fecal samples collected 14-18 d to determine apparent metabolizable energy (AME) content of all experimental diets. Treatment effects were not observed in experiment 1: however, significant effects were observed between the HWS test diets and the C diet for feed to gain (1.37 vs 1.29 P<.006) and g protein intake/gain (2.81, 2.84, 2.83, and 2.76, P<.006). There were no significant differences in growth performance observed among the HWS test diets. In experiment 2, there were no treatment effects observed on weight gain; however, FCR was significantly different P<.001 among the 4 test treatments and the C, respectively (1.24, 1.23, 1.30, 1.36, 1.22), indicating AME of the HWS was over estimated. Based on the AME data, the HWS produced for experiments 1 and 2 was estimated to be above 5250 Kcal AME/kg and

5109 kcal AME/kg, respectively. This study demonstrated that HWS is a high-value feed ingredient that can be included up to 15% in poult diets without adverse effects on growth performance, provided accurate knowledge of energy value.

**Key Words:** Flash dehydration, Extrusion, Hydrolyzed whole swine

**204 Canola meal toasting can be eliminated as it has no positive effects on broiler performance.** R.W. Newkirk\*<sup>1</sup> and H.L. Classen, <sup>1</sup>University of Saskatchewan, Saskatoon, SK, Canada.

Elimination of toasting during the desolventization of canola meal (CM) would result in higher and more uniform amino acid availability but it is not known if such processing is required to reduce anti-nutritional or toxic factors in the meal. Therefore, the objective of this research was to study the effects of canola meal toasting on broiler chicken performance. Conventional toasted meal (TCM) and a hexane laden, non-toasted meal (NTCM) were collected from a crushing plant. NTCM was desolventized in a research desolventizer toaster without the use of sparge steam. The resulting meal contained low residual hexane and was yellow in color. The meals were fed to 3240 broiler chickens in a 2\*2\*6 factorial (2 sexes\* 2 types of meal\* 6 levels) with 45 birds per floor pen from 0-39 d. TCM and NTCM replaced 0, 20, 40, 60, 80 and 100% of the soybean meal (SBM) in wheat based diets. Elimination of toasting increased body weights from 0.606 and 2.148 to 0.618 and 2.181 Kg in 19 and 39 d chickens, respectively. It also improved gain to feed ratio (0-19 d) from 0.637 to 0.642 but did not affect mortality. Replacement of up to 80% and 60% of the SBM in the starter and finisher diets, respectively did not affect growth rate. Higher levels of TCM or NTCM significantly reduced growth rate and feed intake. Total mortality from 19 to 39 d and chronic heart failure (CHF) increased with level of CM addition from 5.19% to 13.89% and 1.85% to 9.63%, respectively. CHF in males, but not females was increased from 3.33 to 17.40% with CM level. In conclusion, elimination of toasting improved broiler growth and feed efficiency and was at least equal to TCM for other parameters. Therefore the production of NTCM may be commercially viable. The highest levels of TCM and NTCM reduced performance and increased mortality indicating maximum inclusion levels of 20 and 15% in starter and finisher diets, respectively.

**Key Words:** Canola meal, Toasting, Chronic heart failure

**205 Nutritional, physiological, and metabolic significance of canola meal sinapine in broiler chickens.** H. Y. Qiao\*<sup>1</sup> and H. L. Classen<sup>1</sup>, *University of Saskatchewan, Saskatoon, Saskatchewan, Canada.*

Sinapine (SNP) is the predominant phenolic compound found in canola meal (CM) and has been considered an anti-nutritional factor in laying hens. Research in broilers has not been known. An experiment was conducted to study the effect of level and source of dietary SNP on male broiler chickens (120 in total). SNP was fed in pure (SB; sinapine bisulphate), semi-purified (EE; CM ethanol extract) or in its native form in CM at three levels equivalent to 15, 22.5 and 30 % CM, and compared to a corn-soybean meal diet. Performance was measured from 0 to 18 days of age, after which birds were killed for measurement of all internal organs and collection of digesta samples for the study of nutrient retention, SNP digestibility, and volatile fatty acid (VFA) production. Feces was collected during the last two days of the experiment. Data were analyzed according to a one-way ANOVA. Dietary treatment did not affect growth rate, feed intake or weight of most organs. Exceptions were that feeding CM increased liver weight, and all diets containing SNP had lower empty cecal weight in comparison to the control. Dietary treatment did not affect VFA production in either the ileum or ceca. Both SB and EE treatments improved fecal AME and protein digestibility in comparison to the control. Digestibility of SNP ranged from 27 to 46 % and 54 to 75 % in the ileum and feces, respectively, and was affected by dietary source and level of diet inclusion. No SNP could be found in the ceca suggesting microbial hydrolysis in this area. Sinapic acid was found in feces samples from birds fed various sources of SNP indicating it is a hydrolysis product of SNP. Dietary SNP in three forms had no impact on the palatability of diets or demonstrate any anti-nutritional effects in the broiler chicken; SNP in SB form may actually provide a beneficial nutritional effect.

**Key Words:** Sinapine, Canola meal, Broiler chicken

**206 Nutrient characterization of guar meal fractions.** S.R. Conner, J.T. Lee\*, J. Carey, and C.A. Bailey, *Texas Agricultural Experiment Station.*

The annual legume, guar (*Cyamopsis tetragonoloba*) flourishes in arid climates such as north Texas. Currently guar is grown for its galactomannan polysaccharide gum that is utilized as a thickening agent in cosmetics, foods, feeds and oil field drilling mud. Guar meal is the by-product of gum production and has been used successfully in limited quantities as a source of vegetable protein in animal feeds. In the separation of the gum containing endosperm, two distinct fractions are obtained. The first fraction from the splitting of the guar bean has higher germ content and the second fraction removes the hull from the remaining endosperm. A third fraction results from a combination of approximately 22% fraction one and 78% fraction two. Nutrient profiles for the three fractions were determined by proximate and amino acid analysis. The crude protein content of the guar by-product meals averaged 45, 36, and 38% for fractions one through three, respectively. Methionine concentrations averaged 0.53, 0.44 and 0.45% while lysine averaged 2.00, 1.54 and 1.64%, respectively. Dry matter averaged about 91, 94 and 93%. Feeding studies suggest that guar meal can be a viable source of protein for poultry feeds.

**Key Words:** Guar meal, Proximate analysis, Chickens

**207 Evaluation of the feeding value of a non-GMO high-protein soybean meal in broiler diets.** B. Lenfestey\*, R. Wilson, J. Burton, and J. Brake, *North Carolina State University, Raleigh, NC USA.*

This study was conducted to establish the relative feeding value in broiler diets of a high protein, non-GMO soybean meal (cv. Prolina). Meals were made at a commercial plant from a commercial variety of soybean (Soy-48) and Prolina grown in the same geographical region. Prolina meal possessed higher fiber due to the relatively small lot of beans being air-dried while the standard soybeans were mechanically dried. The difference in soybean moisture caused more hulls to be retained during crushing. Toasted soy hulls or Solka Floc powdered cellulose were used to dilute the Soy-48 to a similar fiber level as that found in Prolina meal. Broiler starter (1.13 kg per bird) and grower diets were formulated to meet or exceed NRC (1994) minimums. Dietary treatments contained the soybean meal sources as follows: Soy-48, Soy-48 diluted with soy hulls (Soy-48+SH), Soy-48 diluted with Solka Floc (Soy-48+SF), and Prolina. The study consisted of four dietary treatments with 8 replicate pens of 25 male broilers per pen. The results showed that Prolina produced a larger BW throughout the study when compared to the appropriate controls, Soy-48+SH and Soy-48+SF, but not different from undiluted Soy-48. The 42-day BW for the Soy-48, Soy-48+SH, Soy-48+SF and Prolina diets were 2.73 kg, 2.67 kg, 2.68 kg, and 2.72 kg, respectively. Unadjusted feed conversion ratio (average = 1.83) showed a slight advantage for the Prolina as well. Percentage mortality was not different across the dietary treatments. The results demonstrate that Prolina SBM has potentially beneficial nutritive traits.

**Key Words:** Broiler, Body Weight, Feed Conversion

**208 Genetically modified rice containing lactoferrin and lysozyme as an antibiotic substitute in broiler diets.** Brooke Humphrey\*<sup>1</sup>, Ning Huang<sup>2</sup>, and Kirk Klasing<sup>1</sup>, <sup>1</sup>*University of California, Davis*, <sup>2</sup>*Applied Phytologics, Inc.*

Lactoferrin and lysozyme have antibacterial properties, and when combined together their activity is effective against bacteria along the epithelia. Two experiments were done to determine if genetically modified rice expressing human lactoferrin (LF) or lysozyme (LZ) protects the intestinal tract similar to sub-therapeutic antibiotics. Experiment one consisted of ten treatments: corn-soy diet (CS) + 15% conventional rice (control); CS + 0.1% LF; CS + 1.0% LF; CS + 5% LF; CS + 0.2% LZ; CS + 10% LZ; CS + 0.1% LF + 0.2% LZ; CS + 5% LF + 10% LZ; CS + antibiotics (Roxarsone at 0.025%, and Bacitracin at 0.05%). There were no differences in rate of gain or feed intake between any of the experimental rice diets compared to control or antibiotic diets. CS + 5% LF + 10% LZ had significantly better feed efficiency than the control rice diet. Chicks fed CS + 5% LF + 10% LZ had thinner lamina propria in the duodenum and jejunum compared to all other diets ( $p < 0.05$ ). The number of leukocytes per villi was lower in chicks fed lactoferrin, lysozyme, antibiotic, and combination diets compared

to controls ( $p < 0.05$ ). Experiment two had five diets: CS + 15% conventional rice; CS + 10% LZ; CS + 5% LF + 10% LZ; CS + antibiotic (Roxarsone at 0.025%, and Bacitracin at 0.05%); CS without rice. There was no effect of diet on rate of gain. Chicks fed CS + 10% LZ and CS + 5% LF + 10% LZ had significantly lower feed intake and significantly better feed efficiency than those fed the control rice diet ( $p < 0.05$ ). The results from these experiments demonstrate a potential of genetically modified lactoferrin and lysozyme rice to be used as a substitute for antibiotics.

**Key Words:** Lactoferrin, Lysozyme, Chicken

**209 Evaluation of high available phosphorus corn with and without phytase in diets for growing turkeys.** C. A. Fritts\*<sup>1</sup>, F. Yan<sup>1</sup>, H. L. Stilborn<sup>2</sup>, and P. W. Waldroup<sup>1</sup>, <sup>1</sup>*University of Arkansas*, <sup>2</sup>*DuPont Specialty Grains.*

This study was conducted to compare normal yellow dent corn (YDC) and high available phosphate corn (HAPC), fed with and without phytase, in diets fed to growing turkeys. The HAPC contains approximately 0.27% P of which 0.17% is estimated to be available to the poult. The YDC contains approximately the same total P but only 0.03% available P. Substitution of YDC with HAPC will reduce the amount of phytate-bound P in the diet and consequently reduce the amount excreted. Diets were formulated with either YDC or HAPC to contain NRC recommended levels of nonphytate P levels to 20 wk. By removal of dicalcium phosphate and adjusting limestone, test diets were produced that contained reduced levels of P (-0.0%, -0.05%, -0.10%, and -0.15% of NRC) for both the YDC and HAPC. Each of these was fed with or without 1000 units/kg phytase (Natuphos, BASF) for a total of 16 treatments. Each treatment was fed to three pens of 20 male turkeys to 20 wk. At 4, 8, 12, 16, and 20 wk birds were weighed, feed consumption determined, and two birds per pen killed for tibia ash determination. Source of corn had no significant effect on BW, feed conversion, or mortality during the study. Birds fed diets with HAPC had significantly greater tibia ash than those fed YDC at 4, 8, and 12 wk. Addition of phytase significantly improved BW at 4, 8, 12, and 16 wk; at 20 wk turkeys fed phytase were heavier but difference was not significant. Tibia ash was significantly improved at all ages by phytase. No interactions were observed between source of corn and phytase supplementation. Although no fecal samples were taken in this study, the use of HAPC in conjunction with phytase supplementation and reduced P levels should play an important role in a program to reduce P excretion by turkeys.

**Key Words:** High available phosphorus corn, Phytase, Turkeys

**210 Effect of dietary conjugated linoleic acid (CLA) on the growth and fat accumulation of broilers.** M. Du\*, K. C. Nam, S. J. Hur, H. Ismail, D. U. Ahn, and J. L. Sell, *Iowa State University.*

Two experiments were conducted to investigate the influence of dietary conjugated linoleic acid on the growth and fat accumulation in broilers. In experiment I, 50 three-week-old broilers (total 200 birds) were assigned to one of the diets containing 0%, 0.25%, 0.5%, or 1% CLA and fed for three weeks. In experiment II, 40 three-week-old broilers (total 120 birds) were assigned to one of diets containing 0%, 2%, or 3% CLA and fed for five weeks. Results showed that dietary CLA did not influence the growth, feed consumption, and abdominal fat accumulation in broilers. At the end of 3-wk feeding trial, the average body weight of broilers for Experiment I was about 2.20 kg per bird. For experiment II, after 5-wk feeding trial, the average body weights of birds were 4.04kg, 3.99 kg, and 3.93 kg for control, 2%, and 3% CLA groups, respectively, and were not significantly different. There were no differences in abdominal fat weight, liver fat content, serum triglyceride and cholesterol levels, and feces extractable lipid content. However, dietary CLA reduced monounsaturated fatty acid content, but increased saturated fatty acid content in tissues. Abdominal and subcutaneous fats from birds fed high levels of CLA (2% and 3%) were much firmer than those from control diet. The result of this experiment was unexpected, because dietary CLA has been consistently shown to reduce fat accumulation in rats, mice, and pigs. The reason for the ineffectiveness of CLA in reducing fat accumulation in birds is not clear. However, the major difference in fat metabolism between birds and rodents, where liver plays a central role in synthesizing triglycerides in birds and fat

tissues play a major role in rodents and pigs, could have contributed in part to the ineffectiveness of CLA in reducing fat accumulation in birds.

**Key Words:** Broiler, Conjugated Linoleic Acid, Fat Accumulation

**211 Conjugated linoleic acid alters egg yolk fatty acid composition and hepatic histopathology of laying hens.** Gita Cherian<sup>\*1</sup>, Troy B. Holsonbake<sup>1</sup>, Mary P. Goeger<sup>1</sup>, and Rob Bildfell<sup>2</sup>, <sup>1</sup>*Department of Animal Sciences, Oregon State University,* <sup>2</sup>*College of Veterinary Medicine, Oregon State University.*

The effect of dietary conjugated linoleic acid (CLA) along with n-3 polyunsaturated fatty acid (n-3 PUFA) on yolk fatty acid profile and hepatic lipid accumulation was investigated. Single Comb White Leghorn laying hens (n=40) were randomly assigned to four experimental diets containing 0, 0.5, 1.0, or 2.0% CLA. Menhaden oil was used as the source of n-3 PUFA. The total fat content of the diet was 3%. Hens were fed the diets for a period of six weeks. Six birds from each treatment were sacrificed and histopathological evaluation of the hepatic tissue was determined. Total lipid and fatty acid composition of the eggs were determined on day 1, 3, 6, 9, 12 and 15. Dietary CLA did not affect the total lipid content of egg yolk (P >.05). Addition of CLA resulted in an increase in saturated fatty acids (P <.05) with a concomitant reduction in monounsaturated fatty acids (P <.05) in the yolk. The amounts of CLA isomers (cis-9 trans-11, trans-10 cis-12) in the egg yolk were proportional to the levels of CLA in the diet (P <.05). The total CLA content in the egg yolk constituted to 0, 1.4, 2.7 and 5.4%, respectively (P <.05) on day 15 of feeding. Dietary CLA at all concentrations resulted in an increase (P <.05) in the total number of fat vacuoles in hepatocytes. The number of cells with 75% or higher lipid vacuolation in the cytoplasm were also increased (P <.05) by 2.0% CLA. Dietary CLA at all levels resulted in an increase (P <.05) in the total lipid content of hepatic tissue.

**Key Words:** Conjugated Linoleic Acid, Egg Fatty Acid, Liver Histopathology

**212 Feeding various dietary levels of high oleic high oil corn and typical yellow dent corn to laying hens. 1. Live performance and egg production.** H. L. Stilborn\*, M. Araba, D. W. Rice, M. Hinds, and B. L. Smith, *DuPont Specialty Grains, Des Moines, Iowa, USA.*

High oleic high oil corn (HOHOC) contains an elevated level of oleic acid compared to typical yellow dent corn (YDC), in addition to the increased oil (energy) present in the kernel. The benefit of HOHOC would be not only the increased metabolizable energy present but also the increased oleic acid, which may improve the oxidative stability and fatty acid profile of eggs. A study was initiated to examine if varying the percentages of HOHOC and YDC in layer diets would affect hen performance and egg production. Eighteen-week old hens were randomly assigned to cages and given a standard pre-conditioner diet prior to starting the study. Fifteen cages with 5 hens per cage were utilized per treatment. The corn-soybean meal based diets involved blending the corns at different levels to provide 5 diets: 100/0, 75/25, 50/50, 25/75 and 0% YDC/100% HOHOC. Isocaloric and isonitrogenous mash diets were fed ad-libitum for seven periods (28 days/period). Live performance and egg production parameters were measured during the study. Results indicate body weights of hens were not influenced by the blending level of each corn used in the study, since the diets were formulated to the same nutrient requirements. Feed intake/hen/day, feed/dozen eggs and feed/kg of egg were not affected by corn source or the blending level of each corn. Egg production increased as dietary HOHOC increased. The greatest egg production came from hens fed diets containing at least 50% of the corn source as HOHOC. Further additions of HOHOC to 75 or 100% of the dietary corn source numerically improved egg production compared to hens fed the 50/50 blend. Feeding HOHOC to laying hens in isocaloric and isonitrogenous diets supports similar live weights, feed efficiency (per dozen eggs or per kg of egg) and optimum egg production versus hens fed diets containing only YDC as the corn source.

**Key Words:** High oleic high oil corn, Laying hens, Live performance, Egg production

**213 Feeding various dietary levels of high oleic high oil corn and typical yellow dent corn to laying hens. 2. Egg quality parameters.** H. L. Stilborn\*, M. Araba, D. W. Rice, M. Hinds, and B. L. Smith, *DuPont Specialty Grains, Des Moines, IA USA.*

A study was initiated to examine how varying the inclusion levels of high oleic high oil corn (HOHOC) and typical yellow dent corn (YDC) in layer diets would influence egg quality parameters. Eighteen-week old hens were randomly assigned to cages and given a standard pre-conditioner diet prior to starting the study. Fifteen cages with 5 hens per cage were utilized per treatment. Corn-soybean meal based diets involved blending the corns at different levels to provide 5 diets: 100/0, 75/25, 50/50, 25/75 and 0% YDC/100% HOHOC. Isocaloric and isonitrogenous mash diets were fed ad-libitum for seven 28 day periods. Egg quality parameters, egg cholesterol, TBA values, yolk vitamin E content and fatty acid profiles were measured. Feeding hens diets containing HOHOC at 75 to 100% of the dietary corn source supported the heaviest egg weights compared to the treatment fed hens. Shell thickness, Roche color score as well as Minolta l, a and b values were not affected by corn source or the degree of corn blending. Albumen height was greatest from eggs of hens fed 25/75 and 0% YDC/100% HOHOC diets. Yolk and albumen weights were heavier from hens fed diets with at least 75% of the corn source represented by HOHOC. Egg TBA values generally increased with increased storage time. However egg TBA levels increased at a slower rate as dietary HOHOC inclusion increased, particularly during days 6 and 12 of storage. Yolk vitamin E levels increased and egg cholesterol content decreased as dietary HOHOC content increased. Yolk oleic fatty acid increased, linoleic decreased, oleic:linoleic ratio increased, conjugated linoleic acid decreased and monounsaturated fatty acid levels increased as dietary HOHOC inclusion level increased. Feeding HOHOC, especially at 75% of the dietary corn source, in isocaloric and isonitrogenous diets supported optimum egg quality parameters. Blending level between HOHOC and YDC tended to influence some egg parameters.

**Key Words:** High oleic high oil corn, Laying hens, Egg quality, Cholesterol, Fatty acids

**214 Nutritional evaluation of Bt (MON810) and Roundup Ready<sup>®</sup> corn compared with commercial hybrids in broilers.** A.M. Gaines\*, G.L. Allee, and B.W. Ratliff, *University of Missouri-Columbia.*

Experiments were conducted to compare the nutritional value of insect protected (containing CryIA (b)protein, Bt) corn, glyphosate-tolerant (Roundup Ready, RR) corn, their near isogenetic parents (BtC and RRC) and three commercial corn hybrids (C1, C2, and C3). In a 14-day growth assay, 3-day old male broiler chickens were weighed and allotted into 50 pens (6 birds/pen) using a complete randomized design. For each treatment, the five corn hybrids (Bt, BtC, C1, C2, and C3) were included in the diets at the same percentage. The performance parameters of ADG, ADFI, and G:F were determined. No differences were observed in terms of ADG; however, differences (P <.05) were detected for ADFI and G:F. Birds on the BtC diet had a lower ADFI while birds on the C1 diet tended to have poorer G:F. Subsequent to the 14-day growth assay experiment, 35 pens (6 birds/pen) were used to evaluate apparent metabolizable energy values. Diets consisted of only the corn hybrid supplemented with vitamins and minerals. Feed disappearance and fecal output were determined. Dry matter and gross energy values were obtained for the feed and fecal matter. No differences in apparent metabolizable digestibility coefficients were observed (P >.05) due to corn hybrid. In an additional 14-day growth assay, 3-day old male broiler chickens were weighed and allotted into 50 pens (5 birds/pen) using a complete randomized design. For each treatment, the five corn hybrids (RR, RRC, C1, C2, and C3) were included in the diets at the same percentage. The performance parameters of ADG, ADFI, and G:F were determined. No differences (P >.05) in performance parameters were observed. Following the growth assay, 35 pens (5 birds/pen) were used to evaluate apparent metabolizable energy values. No differences in apparent metabolizable digestibility coefficients were observed (P >.05) due to corn hybrid. In conclusion, Bt and RR corns were nutritionally equivalent to their near isogenetic parents; however, there were slight performance differences among the three commercial corn hybrids tested.

**Key Words:** Corn, Broiler, Growth