

138 Demonstrated effects of S6-strain Mycoplasma gallisepticum inoculation on hematocrit and serum calcium in two different flocks of commercial layers between 20 and 58 week of age. E. Y. Basenko^{*1}, E. D. Peebles¹, P. G. Gerard¹, S. L. Branton², and S. K. Whitmarsh¹, ¹Mississippi State University, Mississippi State, MS, ²USDA ARS, SCPR, Mississippi State, MS.

The effects of the S6 strain of Mycoplasma gallisepticum (S6MG) on blood characteristics of Leghorn chickens between 20 and 58 wk of age were examined. A total of 160 Hy-Line W36 strain hens were housed in negative pressure isolation units. Birds were inoculated with S6MG at either 10, 22 or 45 wk of age. Control birds received sham inoculation at 10 wk of age. Each treatment had 4 replicate units with 10 birds per unit. Birds were bled from a wing vein and the following blood characteristics were determined at Weeks 20, 24, 43, 47, and 58: hematocrit (HCT), plasma total protein, and serum cholesterol, triglycerides, and calcium (SCA). In this experiment, a different flock of birds was used to determine if effects due to S6MG inoculation on various blood parameters were similar to those in a previous study. Only the flock and housing arrangements were different in this trial. In the current trial, S6MG inoculation affected levels of plasma total protein, HCT and SCA. Birds inoculated with S6MG at 10 wk of age had significantly higher HCT levels when compared to controls at Week 20. At Week 58, HCT levels were significantly lower in birds inoculated with S6MG at 10 wk when compared to controls. Across Weeks 47 and 58, SCA levels were noted to be significantly higher in birds inoculated at 22 wk of age when compared to controls and those inoculated with S6MG at 45 wk of age. At Week 43, birds inoculated with S6MG at 22 wk of age had significantly lower SCA levels when compared to those inoculated at 10 wk. Only HCT and SCA were affected by S6MG treatment in both the current and previous trials. Furthermore, in both trials birds inoculated with S6MG at 45 wk of age had significantly lower SCA levels across Weeks 47 and 58 when compared to those inoculated with S6MG at 22 wk of age. It is concluded that HCT and SCA levels in commercial layers were affected during pre- and post-peak production. Effects of S6MG inoculation on HCT levels may be related to MG colonization of red blood cells and subsequent physiological compensatory responses in the bird. Future research will be conducted to further examine the relationships between endocrine status, SCA levels and eggshell quality in commercial layers after being inoculated with S6MG.

Key Words: Mycoplasma gallisepticum, Hematocrit, Serum calcium, Inoculation, Commercial layers

139 A turkey model for evaluating the efficacy of adsorbents to ameliorate the toxic effects of aflatoxin. D. R. Ledoux^{*1}, J. N. Broomhead¹, Y. C. Chen¹, A. J. Bermudez¹, G. E. Rottinghaus¹, and W. W. Robey², ¹University of Missouri, Columbia, MO, ²Cargill Feed Applications, Minnetonka, MN.

Two 21-day experiments were conducted to determine if the turkey could be used as a model for evaluating the efficacy of adsorbents (hydrated sodium calcium aluminosilicates, HSCAS) to ameliorate the toxic effects of aflatoxin (AF). Dietary treatments fed (5 reps of 5 poult) from day 1

to 21 in Exp. 1 included: (1) 0 µg AF/kg + 0% of HSCAS-A; (2) 0 µg AF/kg + 1.0% HSCAS-A; (3) 250 µg AF/kg + 0% HSCAS-A; (4) 250 µg AF/kg + 0.25% HSCAS-A; (5) 250 µg AF/kg + 0.50% HSCAS-A; (6) 250 µg AF/kg + 0.75% HSCAS-A; and (7) 250 µg AF/kg + 1.0% HSCAS-A. Exp. 2 was similar to Exp. 1, except a different HSCAS was used (HSCAS-B), the concentration of AF was 200 µg/kg, and there were 7 reps of 5 poults each. AF was supplied by *A. parasiticus* culture material that contained 986 mg AFB₁/kg. The addition of 1.0% HSCAS to the diets did not negatively affect (P > .05) poult performance in either experiment. In Exp. 1, compared with controls (P < .05), poults fed 250 µg AF/kg had lower body weight gains (BWG, 34%), reduced liver weights (LWT, 25%), and increased kidney weights (KWT, 26%). Supplemental HSCAS-A at ≥ 0.50% reduced the growth depressing effects of AF, whereas supplemental HSCAS-A at ≥ 0.25% and ≥ 0.75% reduced the negative effects of AF on KWT and LWT, respectively (P < .05). In Exp. 2, compared with controls (P < .05), poults fed 200 µg AF/kg had lower BWG (17%), reduced LWT (29%), and increased KWT (33%). Supplemental HSCAS-B at ≥ 0.75% prevented the growth depressing effect of AF (P < .05). Supplemental HSCAS-B at ≥ 0.50% reduced (P < .05) the negative effects of AF on KWT. Results indicate that both adsorbents were effective in reducing some of the toxic effects of AF in the young turkey. Data also suggest that the turkey is a more sensitive model for evaluating the efficacy of adsorbents to ameliorate the toxic effects of AF, and at levels reported to cause toxicity under field conditions.

Key Words: Adsorbent, Aflatoxin, Turkeys, Model

140 Incidence of breast blisters in turkeys and their effect upon meat quality. S. Kakarla^{*}, H. D. Chapman, and C. M. Owens, University of Arkansas, Fayetteville, ARK-72701.

Breast blisters, also known as "Enlarged Sternal Bursa", commonly occur in commercially reared turkeys. This study examined the effect of breast blisters on indices of meat quality including the decline in breast muscle pH post mortem and the L* value (a color measurement of lightness, determined on the posterior region of the left breast fillet). A flock of 250 day-old debeaked Nicholas tom turkeys were placed in 48 pens in groups of 15 per pen and reared to 14 weeks of age. At 14 weeks each bird was examined by manually palpating and visually inspecting the unfeathered skin for the presence of breast blisters. A total of 5.6% of the birds were found to have fully developed breast blisters. Fourteen birds with blisters, and a similar number of controls with no blisters were processed at 18 weeks of age. The breast meat from birds with blisters showed a significant (p<0.005) decrease in pH from 0.25 hrs to 4 hrs postmortem (6.04 and 5.80 at 0.25 and 4 hrs, respectively) as compared with control birds with no blisters (which showed a normal pH change of from 6.18 to 6.20 at 0.25 and 4 hrs). There was no significant difference in the L* value between the blister group and the control group. Since a rapid decline in muscle pH reduces the shelf life of meat, it is concluded that breast blisters not only affect costs due to the requirement for breast trimming, but also cause losses due to deterioration in meat quality.

Key Words: Turkeys, Breast blisters, Postmortem pH decline

Nutrition - Nutrition A

141 Effect of dietary calcium on intestinal phytase activity and phytate-phosphorus utilization in Pekin ducklings. J. K. Rush^{*1}, R. Angel², K. M. Banks¹, K. L. Thompson¹, and T. J. Applegate¹, ¹Purdue University, ²Univ. of MD, College Park.

Higher concentrations of calcium (Ca) in the diet may decrease phytate-phosphorus hydrolysis because of the chelation of Ca with the phytin molecule. Therefore, 192 drakes were fed 0.6, 0.8, 1.0, or 1.2 % Ca from 7 to 17 d of age (6 birds/pen and 8 pens/treatment). Non-phytate phosphorus (nPP) was determined to be 0.46 %. Excreta was collected from 15 to 17 d of age and the left tibia was collected at 18 d of age. Duodenal and jejunal mucosa was collected on 18 d of age from treatments with 0.6 and 1.2 % Ca for determination of intestinal phytase activity. Body weight gain was greatest when the ducklings were fed the 1.0 % Ca diet and different (P < 0.05) from that of the 0.6 % Ca, but not different (P > 0.05) from birds fed the 0.8 and 1.2 % Ca diet. Tibia ash percentage was not significantly affected by dietary Ca (P > 0.05). Tibia ash weight, however, was significantly greater in the birds fed 1.0 % Ca as compared with those fed 0.6 and 1.2 % Ca (P ≤ 0.05), but not significantly dif-

ferent than birds fed 0.8 % Ca (P > 0.05). Specific phytase activity within brush border vesicles prepared from intestinal mucosa and vesicle Ca concentration was not significantly affected by dietary Ca (P > 0.05). A positive correlation, however, was found between the Vmax and the Ca concentration within the vesicles (r=0.59, P < 0.02). In conclusion, maximal duckling growth and tibia ash weight was realized when birds were fed 1.0 % Ca, which is significantly greater than the current recommendation of 0.6 % Ca for ducks as reported by the National Research Council (1994). Contrary to previous work in broilers, intestinal phytase was not significantly affected by dietary Ca concentration in ducklings. Additionally, the vesicle Ca concentration did not negatively affect the kinetics of the phytase assay.

Key Words: Calcium, Intestine, Phosphorus, Phytase, Phytate

142 Citric acid improves phytate phosphorus utilization in two breeds of chicks fed a corn-soybean meal diet. K. A. Rafacz*, C. Martinez, J. L. Snow, D. H. Baker, and C. M. Parsons, *University of Illinois*.

Previous research in our laboratory has shown that citric acid improves phytate phosphorus utilization in crossbred chicks (New Hampshire x Columbian) fed a P-deficient corn-soybean meal diet. The current study was conducted to determine if citric acid is also effective in commercial broiler chicks (Ross x Ross). In two experiments, four replicate groups of five male crossbred chicks and male commercial chicks were fed corn-soybean meal diets varying in citric acid (CA) and nonphytate phosphorus (NPP) from 8-21 days of age. In Experiment 1, a 2x2x2 factorial design was utilized to evaluate the effect of two levels of CA (0 and 3%) and NPP (0.13 and 0.28%) in crossbred chicks and commercial chicks. The commercial chicks, but not the crossbred chicks, fed the 0.13% NPP diet were removed from the experiment after 3 to 5 days due to very poor growth and severe leg problems. Chick weight gain and tibia ash were significantly increased ($P < 0.05$) by CA in crossbred chicks fed 0.13% or 0.28% NPP and in commercial chicks fed 0.28% NPP. In Experiment 2, the same 2x2x2 factorial design was again used except that the NPP levels were increased to 0.18% and 0.33%. Once again, tibia ash was increased significantly ($P < 0.05$) with the addition of CA in both breeds of chicks, and the response was greater at 0.18% NPP than at 0.33% NPP. These results indicate that CA improves phytate phosphorus utilization in both crossbred (New Hampshire x Columbian) and commercial broiler chicks (Ross x Ross).

Key Words: Phosphorus, Citric acid, Phytate, Chicks

143 Effect of dietary available phosphorous and phytase in broiler breeders and dietary available phosphorus in broilers. C. V. Williams*, B. A. Lenfestey, and J. Brake, *North Carolina State University, Raleigh, NC USA*.

Four experiments were conducted to determine the effects of available phosphorus (AvP) and phytase (> 500 units/kg sourced from Alltech) in broiler breeders on their broiler progeny. In Exp. 1 and 2, chicks were hatched from a breeder flock reared on starter and grower diets consisting of 0.90% Ca and 0.45% AvP to 8 wk of age and a second grower diet with 0.80% Ca and 0.35% AvP to housing. A third grower and layer diet had four levels of AvP that included a normal level (0.40%), two intermediate levels (0.29 and 0.19%) and the lowest possible AvP created by removing all dicalcium phosphorus (0.08%) with and without phytase. Broiler chicks, hatched from eggs laid at 32 and 61 wk of age, were reared to 49 d on 0.25% AvP with phytase in Exp. 1 and 2. No significant differences were found in the broiler breeders or broilers. In Exp. 3 and 4, chicks were hatched from a breeder flock at 35 wk and 43 wk of age that had been reared as in the prior experiment but with 0.40% or 0.13% AvP with or without phytase in the breeder diet. In Exp. 3 the chicks were reared to 42 d on two levels of AvP (0.25 and 0.18%) with phytase. Chicks in Exp. 4 were reared to 42 d with four levels of AvP (0.25, 0.21, 0.16, and 0.12%) with phytase. The broiler breeders fed the 0.13% AvP without phytase diet exhibited high mortality (40%) but otherwise performed normally. A broiler breeder carry-over effect was seen in both Exp. 3 and 4 as the breeder diets with phytase produced broilers with decreased 42 d BW. The expected effects of broiler phosphorus levels were seen in both Exp. 3 and 4 in that as AvP was decreased there was an increase in broiler mortality and a decrease in broiler BW without effect on feed conversion. These data suggest that, under the conditions of this study, the addition of phytase to the broiler breeder diet may influence broiler performance in some instances and levels of AvP below 0.25% decrease broiler performance even in the presence of phytase.

Key Words: Broiler breeders, Phytase, Phosphorous, Broilers

144 Modified phosphorus program for reducing excreta phosphorus levels based on commercial feeding intervals for broilers. C. Fritts* and P. W. Waldroup, *University of Arkansas, Fayetteville AR*.

Recommendations for phosphorus programs designed to reduce excreta P must be based on feeding intervals used by the poultry industry. Two consecutive flocks of broilers were grown on diets fed 0-14, 14-35, 35-42, and 42-49 d. The control (IND) diet contained 0.45/1.00, 0.40/0.90, 0.35/0.80, and 0.30/0.80% nonphytate P/Ca for the respective periods. Modified P programs were based upon a series

of trials in our laboratory and were designed to support early skeletal growth followed by markedly reduced P levels. Three modified P programs were: MOD 1) 0.40/0.90, 0.30/0.80, 0.20/0.60, 0.15/0.50%; MOD 2) 0.40/0.90, 0.30/0.80, 0.20/0.60, 0.10/0.50%; MOD 3) 0.40/0.90, 0.30/0.80, 0.15/0.60, 0.15/0.60% nonphytate P/Ca, respectively. Each of the MOD programs was fed with or without 1200 U/kg phytase (Natuphos, BASF). Six pens of 70 males (Cobb 500) at a density of 0.7 ft² were assigned to each treatment in each trial. At the conclusion of each trial a sample of litter was taken and total and soluble P determined. Based on combined results from the two trials, the MOD programs did not significantly affect BW, FCR, or mortality at any age, compared to the IND program. Presence or absence of phytase had no significant effects on these parameters. Compared to the IND programs, the three MOD programs resulted in significant reduction in both total and soluble P in the litter with no significant differences among the three MOD programs. Addition of phytase significantly reduced litter total P in the MOD 1 treatment with no significant effect on the other MOD treatments. Soluble P in the litter was significantly reduced when phytase was added to MOD 1 and MOD 2 diets with no difference in the MOD 3 program. Cost of supplemental P, based on \$256/ton of dicalcium phosphate, was reduced by \$12,928, \$14,590, and \$13,868 per million birds for the MOD 1, MOD 2, and MOD 3 programs, respectively.

Key Words: Phosphorus, Excreta, Broilers, Eutrophication, Litter

145 A comparison of the efficacy of three phytase preparations in broiler chicks. E. M. Onyango*¹, M. R. Bedford², and O. Adeola¹, ¹*Purdue University*, ²*Zymerics Inc*.

The efficacy of three *Escherichia coli*-derived phytase preparations on the performance and nutrient utilization in broiler chicks was compared. Two hundred and sixteen 7-d-old male broiler chicks were grouped by weight into six blocks of six cages each. There were six birds per cage. Six corn-soybean meal-based diets were randomly assigned to cages within each block. The six diets were adequate-P-, very-low-P- and low-P- (negative control, NC) diets, and NC plus either preparation B, C or D at 1000 units/kg of feed. Preparations B and C were produced using two different yeast production systems, whereas preparation D was produced using a bacterial system. The chicks were fed the experimental diets from 7 to 21 d of age. Excreta samples were collected between 17-21 d of age. At the end of the study, blood was collected, chicks killed and tibiae removed from 3 birds per cage. All three phytase preparations outperformed ($P < 0.05$) the NC with respect to weight gain, with preparation B outperforming preparation C or D. Feed intake and feed efficiency among the three phytase preparations did not differ. All three preparations equally improved ($P < 0.05$) the bone mineral content and density, peak load, percent ash, P retention, and serum P levels. All three preparations increased ($P < 0.05$) Ca retention with phytase C or D showing a better retention of Ca than phytase B. All three phytase preparations showed similar P utilization as indicated by body weight gain and tibia bone characteristics.

Key Words: Broiler chick, Nutrient utilization, Phytase, Tibia ash, Bone densitometry

146 Effects of citric and ascorbic acid as mineral chelators, and vitamin D3 and calcium on efficacy of microbial phytase in a corn-soybean meal-based broiler starter diet. M. Afsharmanesh*¹, A. H. Samie¹, and J. Pourreza¹, *Isfahan University of Technology, Isfahan, IRAN*.

This study was conducted to determine the effects of phytase enzyme, organic acids (citric, ascorbic acid), vitamin D3 and Ca on broiler performance and nutrient digestibility in corn-soybean meal-based diet from 1 to 21 days of age. Broilers were fed the following based diets at either 0.79, or 0.90% of dietary Ca: 1) a negative control corn-based diet, 0.315% available P (NC); 2) NC + 500 phytase units/kg diet; 3) phytase + 2% citric acid; 4) phytase + citric acid + 200 mg/kg diet ascorbic acid; 5) phytase + citric acid + ascorbic acid + 200 g/kg diet vitamin D3; 6) NC plus 0.135% available P. The 12 dietary treatments were fed to four pen replicates of 20 birds each. Increasing dietary Ca from 0.79 to 0.9%, negatively influenced feed conversion ratio but improved feed intake and protein digestibility. Phytase addition improved body weight, feed conversion ratio, tibia ash and phosphorus and protein digestibility. Subsequent addition of citric acid and ascorbic acid to feed along with phytase increased 10, 8 and 57% body weight, feed efficiency and

phosphorus retention above level attained with negative control diet, respectively. The body weight of chicks that received the positive control diet (Diet 6) was similar to those that received the phytase and organic acids supplemented low-P diet. The tibia ash and phosphorus digestibility of broiler fed the diet containing, phytase enzyme, organic acids and vitamin D3 was 18 and 57% over the negative control, respectively. Data presented clearly indicated that supplementation of corn-soybean low-P meal-based diet with appropriate concentrations of phytase, citric acid, ascorbic acid and vitamin D3, leads to substantial increases in broiler performance and nutrient digestibility and would have an environmental benefit of reducing phosphorus and nitrogen concentration of broiler manure.

Key Words: Phytase, Citric acid, Ascorbic acid, Vitamin D3, Broiler

147 Content and bioavailability of phosphorus in distillers dried grains with solubles. C. M. Amezcua*¹, C. M. Parsons¹, and S. L. Noll², ¹University of Illinois, Urbana, IL, ²University of Minnesota, St. Paul, MN.

The bioavailability of the phosphorus in distillers dried grains with solubles (DDGS) in poultry has not been studied extensively. These experiments determined the phosphorus content of 22 samples of DDGS from various sources and the bioavailability of phosphorus from one DDGS sample using a chick assay. For the chick assay, a phosphorus deficient cornstarch-dextrose-soybean meal basal diet containing 0.10% nonphytate phosphorus was formulated. A standard curve was then constructed by adding 0, 0.05 and 0.1% phosphorus from KH_2PO_4 to the basal diet. In addition, two levels, 12.5% and 25% DDGS, were added to the basal diet to comprise five total treatments. New Hampshire x Columbian male chicks were fed the experimental diets from Day 8 to 22 post-hatch, and growth performance and tibia ash were measured. Bioavailability of phosphorus was estimated using the slope-ratio method where tibia ash was regressed on phosphorus intake from KH_2PO_4 or DDGS. The analytical results yielded total phosphorus values ranging from 0.62 to 0.77% among samples, with an overall mean of 0.73%. The bioavailability of the phosphorus in DDGS (% of total) determined by the slope-ratio method was 54%. The results of this study indicated that the phosphorus content of DDGS varies among samples and that approximately one-half or more of the total phosphorus is bioavailable.

Key Words: Distillers, Dried grains, Phosphorus, Bioavailability, Chick

148 The effects of copper source on performance and phosphorus retention in broiler chicks. K. M. Banks*, K. L. Thompson, J. K. Rush, and T. J. Applegate, Purdue University.

Copper (Cu) is often added to broiler diets at therapeutic dosages due to its anti-microbial and growth promoting effects despite alleged chelation with and reduced utilization of phytate phosphorus (P). Therefore male broiler chicks were fed diets containing 0 and 250 ppm Cu from Cu sulfate (SUL), Cu citrate (CIT), Cu lysinate (LYS) and Cu Chloride (CL) sources from 9 to 22 d of age (8 pens/treatment, 6 birds/pen). Dietary concentrations of non-phytate P and calcium were formulated to be 0.2 and 0.7% respectively. Body weight gain was not significantly different between treatments ($P > 0.05$). Supplementation with 250 ppm Cu from Cu LYS resulted in chicks having greater toe and tibia ash weights ($P < 0.001$) as compared to chicks fed Cu SUL, but was not significantly different from birds fed the Cu CL, Cu CIT and 0 ppm Cu diets. Supplementation with Cu LYS resulted in birds with a significantly greater toe ash percentage ($P < 0.0001$) as compared to Cu CIT, Cu SUL and the 0 ppm Cu diets, but was not significantly different than birds fed the Cu CL diet. With respect to tibia ash percentage, birds fed the Cu LYS diet resulted in a significantly greater % tibia ash ($P < 0.0001$) as compared to the Cu SUL and 0 ppm Cu diets, but was not significantly different than either the Cu CL or Cu CIT diets. Supplementation with 250 ppm Cu SUL or Cu CIT reduced apparent P retention by 0.029 and 0.053 % of the diet, respectively ($P < 0.05$) as compared to 0 ppm diet; whereas the apparent P retention when 250 ppm Cu LYS or Cu CL was fed was not significantly different from the 0 ppm Cu diet ($P > 0.05$). In conclusion, supplementation with 250 ppm Cu from either Cu CIT or Cu SUL resulted in decreased apparent P retention. Supplementation with either 250 ppm Cu CL or Cu LYS, however, demonstrated improved apparent P retentions such that they were not different than the 0 ppm supplemental Cu diet.

Key Words: Broiler, Copper, Phosphorus

149 Relative efficacy of a new, thermotolerant phytase in wheat-based diets for broilers. M. R. Bedford*¹, E. Koepf², M. Lanahan², J. Tuan¹, and P.F.S. Street¹, ¹Zymetrics, Minneapolis, MN, USA, ²Syngenta Biotechnology Inc, Raleigh, NC, USA.

The use of phytase is now widespread but its application is limited by its inherent instability to thermal processing. As a result there are several formulations offered for the current commercial products; a powder for mash diets, chemically coated products for moderately processed feed, and finally, for situations where processing is too vigorous, post pellet applied liquids. The current trial was designed to determine the relative efficacy of a single product in diets pelleted at 65, 75 or 85°C (temperature measured as pellets exit the die face). 50 mixed sex birds per pen were allocated to each of 5 replicate pens for each of 12 treatments. For each pelleting temperature (65, 75 and 85°C), 4 wheat-based diets were offered ad libitum in a two stage feeding programme (0-21d and 21-42d of age) which met all nutrient requirements (positive control, 0.40 and 0.38 % AvP in starter and finisher respectively) or were deficient in AvP only (0.22 and 0.21% in starter and finisher respectively). To the AvP deficient diets, a thermotolerant variant of an E coli derived phytase was added at 0, 250 and 500 U/kg feed. Weight gain, feed intake and FCR were recorded at 21 and 42 days of age. Data were analysed by ANCOVA with initial weight and intake (where appropriate) used as covariates. The reduced data set (excluding positive control) was analysed to determine the linear and quadratic effects of enzyme dose, pelleting temperature, and their interactions. Means from the full data set were separated by Tukeys HSD to determine the relative performance of the negative control treated diets with that of the positive controls across temperatures. There was a significant, linear, negative effect of temperature on both gain and FCR, with 75g of gain and 4 points in FCR being lost for each 10°C increment in die temperature. However, there were no interactions between temperature and enzyme dose for any parameter measured, indicating that the enzyme maintained its efficacy at all pelleting temperatures and was not degraded through thermal denaturation. There was a significant quadratic dose effect of enzyme on gain and FCR, the optimum being achieved at approx 250 units/kg feed, at which point performance was equivalent to that of the relevant positive control.

Key Words: Phytase, Thermotolerance, Processing temperature

150 Effect of fat type and enzyme supplementation on nutrient digestibility and broiler chicken performance. X. Meng*, B.A. Slominski, and W. Guenter, University of Manitoba, Winnipeg, Manitoba, Canada.

The interactions between fat type and enzyme supplementation were studied using a 2x2 factorial experiment with broiler chickens. Wheat/soybean meal/canola meal/peas-based diets containing 50g/kg of either crude canola oil or beef tallow, without or with enzyme supplementation, were formulated to meet 95% NRC nutrient requirement. Each diet was fed in a mash form to 9 replicate pens of 5 broilers. A multi-enzyme supplement contained xylanase, glucanase, cellulase, mannanase and pectinase activities. Body weight gain was not affected by the fat type although a significant ($P < 0.05$) improvement in feed to gain ratio (1.42 vs 1.47) was noted for the canola oil diet. Irrespective of the fat type, enzyme supplementation significantly improved body weight gain (494 vs 474g/14 d) and feed to gain ratio (1.41 vs 1.47). When compared to canola oil, tallow decreased ($P < 0.05$) jejunal and ileal fat, starch, total non-starch polysaccharides (TNSP) digestibilities and diet AMEn content. An improvement ($P < 0.05$) in jejunal fat (66.3 vs 58.5%), starch (87.1 vs 82.6%), nitrogen (41.1 vs 33.3%) and TNSP (10.7 vs -9.1%) with enzyme supplementation was demonstrated. Similar difference ($P < 0.05$) in ileal digestibility of fat (80.7 vs 77.6%), starch (95.1 vs 93.0%), nitrogen (75.5 vs 71.9%) and TNSP (20.0 vs 10.4%) was observed. A reduction ($P < 0.05$) in jejunal digesta viscosity (from 3.2 to 2.2 mPa.s) was noted for enzyme supplemented diets. Increased water-soluble NSP and decreased TNSP concentrations in different segments of the digestive tracts resulted from enzyme addition. There were significant fat enzyme interactions for both jejunal and ileal fat, starch and TNSP digestibilities, with enzyme effect being greater for tallow containing diets. It is evident from this study that alleviation of the antinutritive effects of NSP and improved nutrient digestion and absorption with enzyme supplementation would be more pronounced with the animal fat-based diets.

Key Words: Broilers, Fat, Enzyme, Nutrient digestibility

151 Live performance and meat yield responses of straight-run broilers to progressive concentrations of dietary energy maintained at a constant ME:Protein ratio. M. A. Hidalgo*, W. A. Dozier, III, A. J. Davis, and M. E. Freeman, *University of Georgia.*

According to a popular benchmark reporting service, a diverse array of metabolizable energy values is being used in formulating diets for broiler chickens. Reducing dietary energy concentration while maintaining a constant ME:Protein ratio has been shown to result in equivalent broiler performance as compared to utilizing high energy diets when broilers are marketed at 6.5 lb. This study examined the effects of progressive concentrations of dietary energy at a constant ME:Protein ratio on live performance and processing yields of broilers during a 37-d production period. A total of 2,592 Ross x Ross 308 straight-run broilers were sexed and 27 of each sex were commingled and randomly assigned to one of 48 floor pens. Birds were given a three-phase feeding program, which consisted of starter (0-17 d), grower (18-30 d), and finisher (31-37 d). Dietary treatments consisted of six feeding regimens (8 reps/trt): Regimen 1: starter - 1,350 kcal/lb, grower - 1,370 kcal/lb, and finisher - 1,400 kcal/lb; Regimen 2: starter - 1,370 kcal/lb, grower - 1,390 kcal/lb, and finisher - 1,420 kcal/lb; Regimen 3: starter - 1,390 kcal/lb, grower - 1,410 kcal/lb, and finisher - 1,440 kcal/lb; Regimen 4: starter - 1,410 kcal/lb, grower - 1,430 kcal/lb, and finisher - 1,460 kcal/lb; Regimen 5: starter - 1,430 kcal/lb, grower - 1,450 kcal/lb, and finisher - 1,480 kcal/lb; Regimen 6: starter - 1,450 kcal/lb, grower - 1,470 kcal/lb, and finisher - 1,500 kcal/lb. In general, body weight measurements were lower ($P < 0.05$) when broilers consumed Regimen 1 compared with the other regimens throughout each phase of growth. Feed conversion ratio was improved ($P < 0.05$) with Regimens 4, 5, and 6 compared with Regimen 1 from 18-30 d, 30-37 d, and 0-37 d as was feed consumption ($P < 0.05$) from 30-37 d and 0-37 d. Dietary treatments did not alter the incidence of mortality, abdominal fat percentage, chilled carcass yield, or the recovery of carcass parts. These data indicate reducing metabolizable energy content of the diet at a constant ME:Protein ratio allows similar live performance to be obtained without affecting meat recovery, but decreasing the energy content of the diets to sub-optimum concentrations adversely affected performance, which may be related to inadequate caloric and protein consumption.

Key Words: Broilers, Dietary energy, Meat yield

152 Use of single diet feeding programs for broilers. D. O. Skinner-Noble¹, F. Abraham*¹, J. G. Berry¹, and R. G. Teeter¹, ¹*Department of Animal Science, Oklahoma State University.*

Two trials were conducted to evaluate the usefulness of simplified feeding programs for broilers, both for simplicity and for their potential use as a simple management method to reduce early growth and its associated negative consequences. Trial 1 fed either a classical three-phase feeding program or the grower diet throughout to broiler females. Trial 2 fed the three-phase feeding program, the grower diet throughout, or the starter diet throughout to both male and female broilers. Broiler performance traits (BW, feed intake, feed conversion), carcass traits, income and feed expenses, and feed nutrient substrate and carcass deposition were recorded in both trials. In both trials, feeding the grower diet

throughout reduced early growth. Even though compensatory gain was exhibited, birds fed the grower diet throughout were not able to recover from this growth restriction by market age. Overall feed conversion was poorer for birds fed the grower diet throughout in both trials. Whereas feeding program affected feed costs, income was similarly affected by changes in BW, resulting in similar income less feed costs. Feeding program affected nutrient substrate intake. Similar carcass energy per kg of diet was observed for all feeding programs in both trials. Feeding the classical three-phase feeding program resulted in reduced percent protein intake, with greater final BW than the grower diet feeding program. Feeding the grower diet throughout increased carcass fat and decreased carcass protein, whereas feeding the starter diet throughout increased carcass protein and decreased carcass fat. The results of the current study indicate that feeding a grower diet throughout is not a practical method of growth restriction for broilers and that current phase feeding still is merited for broilers.

Key Words: Protein, Energy, Feeding program

153 Utilization of low crude protein diets fed to 0-3 wk broilers. S. E. Brooks*¹, H. M. Allen¹, and J. D. Firman¹, ¹*University of Missouri-Columbia.*

Commercial broilers were fed an industry type diet meeting the 1994 NRC requirements for the first week post-hatch. The diet was formulated to contain 23% CP and 3200 kcal of ME/kg. At day 7, birds were individually weighed, sorted by weight, and randomly assigned to pens, placing four birds per pen. Birds were housed in chick batteries while on study in a randomized complete block design. There were 9 treatments with 8 replications per treatment for a total of 72 pens. The 23% CP diet fed for the first week post-hatch served as the positive control. Treatments were titrated with respect to intact CP as follows: 20%, 19%, 18%, 17%, 16%, 15%, 14%, and 13%. Crystalline amino acids were added back to the diets to meet the amino acid levels found in the 23% CP diet. Glutamic acid was supplemented to bring all of the diets up to 20% protein equivalent. All diets were formulated on a digestible basis to be isocaloric and isonitrogenous. Birds were fed and watered *ad libitum* for the duration of the study. At the conclusion of the study, birds were euthanized and weighed. There were found to be no significant differences ($P \leq 0.05$) in average bird gain for all treatments ranging from the 23% CP treatment to the 15% CP treatment. It appears that while there was not a significant difference in bird gain with respect to the 14% CP treatment when compared to others, growth was beginning to decline. Differences in average bird gain were found to be significant for the 13% CP treatment. Feed:gain and feed consumption revealed no significant differences among treatments. The results of this study indicate that feeding a 15% CP diet and crystalline amino acid supplementation can achieve similar growth and performance as that of a 23% CP diet. This marked reduction in crude protein will not only provide an effective cost saving to producers but also aids in the reduction of excess nitrogen pollution to the environment.

Key Words: Broiler, Low protein

Nutrition - Nutrition B

154 Response of small broilers to feeds varying in nutrient density or the presence of a prestarter feed. J. B. Hess*¹, S. F. Bilgili¹, R. W. Gordon², T. J. Frost², and E. R. Miller³, ¹*Auburn University, Auburn, AL*, ²*Gold Kist Inc., Atlanta, GA*, ³*Aviagen N.A., Albertville, AL.*

This trial examined the feeding of three amino acid densities and a prestarter program to mixed-sex broilers to 34d of age. The control program (C) was similar to feeds used commercially, with lysine densities of 113, 109 and 111% of NRC for the three feed program. TSAA densities were 109, 125 and 125 % of NRC. Additional trt had protein/amino acid densities of 107% (M) or 115% (H) through all three feeds. A prestarter was fed (1/2 lb./bird) in trt PS, with the C starter fed for the remainder of the 19d starter period. Control grower and withdrawal were fed to trt C and PS from 19d to 34d. Ross 308 cross broilers were placed at 0.70 sqft./bird with equal numbers of each sex per pen. There were 8 replicates per trt. At termination, 5 males and 5 females were processed

for carcass yield determination at both Auburn University and at Aviagen's facilities in Albertville, AL. BW were altered at 19 and 34d, with H (highest plain of protein/amino acid nutrition) showing significantly better weights. At 19d, Trt M and PS were intermediate, although this affect was lost by 30 and 34d. BW were higher than desired due to excellent growing weather between 30 and 34d (4.21 lb). Mortality was low, with no significant differences noted in cumulative mortality among trt. Adjusted FCR was not different between trt at 19 or 34d, although FCR trended lower with increasing AA density. Adjusted FCR was significantly lower for H at 34d. No differences were noted in interim FCR numbers. BW of birds selected for processing showed trends similar to that seen in the live portion of the trial. Lean carcass and chilled WOG yields followed body weight trends, with H showing the best yields. Birds fed a prestarter (PS) showed intermediate yields in the Auburn results and highest yields in the Albertville results. Fat yield was lowest in the highest density treatments, with no advantage to a prestarter. Front half weight was highest in birds from H, with PS intermediate. Increased nu-