

lymphocyte responses since thymocyte proliferation tended to be lower with lysine concentrations at 1500 μ M.

Key Words: Acute Phase Response, Lysine, Lymphocyte

285 Effect of testosterone and lead on T cell maturation in the developing thymus. I. Hussain*, M. Piepenbrink, and R. Dietert, *Department of Microbiology and Immunology, College of Veterinary Medicine, Cornell University, Ithaca, NY.*

The developing immune system is particularly sensitive to environmental and hormonal influences. Genders can differ in this sensitivity as well. Because the heavy metal, lead, can suppress Th-1 associated function among perinatal thymocytes and cause a systemic loss of postnatal Th-1 function, we investigated the ability of *in ovo* administered lead and testosterone to alter thymocyte maturation. Cornell K-strain chick embryos were injected via the air sac on embryonic (E) day 8 with either testosterone (12.5 μ g/egg in ethanol) or 15% ethanol in 100 μ l volume. The groups then received either lead acetate (200 μ g/egg) or sodium acetate (control) on E 12 of incubation by the same route. On E 20, thymuses from 4-5 female embryos per group were harvested in sterile Hanks balanced salt solution on ice, and thymocytes were separated using Ficoll. Tri-color flow cytometry was performed with fluorescent-conjugated antibodies against chicken-CD3, CD4, CD8, TCR1 and TCR2 surface molecules and data were analyzed using the MIXED procedure of SAS. Lead did not induce changes among the cell surface markers measured in this study. However, testosterone administration caused changes in both the CD4+CD8+ and CD4+CD8- cell populations ($P \#8804$ 0.05). Testosterone treatment followed either by sodium or lead acetate injection caused a statistical increase in CD4+CD8+ cells (73.23 ± 2.77 % and 79.85 ± 2.77 % with sodium or lead acetate, respectively) compared either with ethanol and sodium acetate or ethanol and lead acetate treatments (69.68 ± 2.77 % or 68.98 ± 2.77 %, respectively). Additionally, testosterone treatment significantly lowered the percentage of CD4+CD8- cells from 7.61 ± 1.3 % (control)

to 4.2 ± 1.3 % or 4.63 ± 1.3 % (for testosterone with either sodium acetate or lead acetate, respectively). Therefore, sex hormonal balance can modulate thymocyte maturation, but cellular validation of lead-induced alterations would require the use of additional Th-specific markers. Supported by USDA grant NE-60/NE-1016.

Key Words: Immune Development, Thymus, Cell Populations

286 Immunocompetence measurements of frizzle and normally feathered genotypes issued from different maternal lines of chicken. M. M. Fathi, S. A. El-Safy*, and A. Galal, *Poultry Prod. Dept, Faculty of Agric., Ain Shams University.*

An experiment was conducted on frizzled and normally feathered genotypes issued from two different maternal lines either Golden-Montazah (GM), an Egyptian local breed, or Brown Hy-Line strains during the summer season of Egypt. The immunocompetence parameters that were assessed for the offspring were lymphoid organ weights, cell-mediated immune response (PHA-P), globulin level in serum and heterophil/lymphocyte ratio. The results of CBH response showed that the frizzled genotypes had a significantly greater dermal swelling response to PHA-P compared to normally feathered sibs. The frizzled genotypes also exhibited larger bursa and thymus (as a percentage of body weight) compared to the normal genotypes in the two dam lines. A significantly genotype-dam line interaction for globulin level was observed. However, the frizzle gene increased globulin level in chickens issued from GM dams and the reverse was true in chickens issued from Hy-Line. The H/L ratio was significantly higher in both genotypes of Hy-Line dams compared to counterparts of GM ones. We concluded that under the conditions of the current study, the frizzle chickens are hyper-responders compared to normal plumage birds, especially those issued from Golden-Montazah breed.

Key Words: Frizzle Gene, Immunocompetence Parameters, Maternal Lines

PSA-Nutrition: Feed Additives and Phytase

287 *In vitro* and *in vivo* evaluation of simultaneous supplementation of α -galactosidase and citric acid on nutrient release, digestibility and growth performance of broiler chicks. T. Ao*¹, A. H. Cantor¹, A. J. Pescatore¹, M. J. Ford¹, and J. L. Pierce², ¹University of Kentucky, Lexington, ²Alltech Biotechnology Center, Nicholasville, KY.

Experiments were conducted to evaluate the effects of simultaneous supplementation of α -galactosidase and citric acid on 1) *in vitro* nutrient release from soybean meal, and 2) *in vivo* nutrient digestibility and growth performance of broiler chicks fed a corn-soy diet. In Experiment 1, an *in vitro* model was used to simulate the chicken's digestive process in the crop and from the crop through the small intestine. Graded levels of α -galactosidase (0 to 13,792 units/kg) and citric acid (0 or 20 g/kg) in a factorial arrangement were added to soybean meal, which was used as the substrate. Reducing sugars were measured at the end of both phases. Increasing enzyme levels linearly ($P < 0.001$) increased release of reducing sugars in both phases. Addition of citric acid with α -galactosidase further increased enzyme activity, resulting in a significant interaction ($P < 0.001$). In Experiment 2, 144 1-d-old male broiler chicks were randomly distributed among 24 replicate cages of six chicks contained in three blocks, to provide six replicate groups for each of four treatments. Two levels of α -galactosidase (0 or 1724 units/kg) and of citric acid (0 or 20 g/kg) were added in a factorial arrangement to a low-energy (2730 Kcal ME/kg) corn-soy diet. Alpha-galactosidase ($P < 0.05$) increased body weight gain, feed intake, NDF digestibility and dietary AME_n. Citric acid increased ($P < 0.05$) the digestibility of DM, NDF and CP. Compared with the unsupplemented diet, weight gain and feed intake were depressed ($P < 0.01$) by adding citric acid alone, but not by the addition of both citric acid and α -galactosidase. Simultaneous supplementation of α -galactosidase and citric acid increased ($P < 0.05$) dietary AME_n and digestibility of DM, NDF, and CP, and improved ($P < 0.05$) feed to gain ratio. These results suggest that acidification of poultry diets may improve the effectiveness of exogenous α -galactosidase.

Key Words: Alpha-Galactosidase, Citric Acid, Broilers

288 Effect of virginiamycin in diets with adequate or reduced dietary calcium or available phosphorus for 0 to 18 d-old broilers. T. O'Connor-Dennie* and L. L. Southern, *LSU Ag Center, Department of Animal Science, Louisiana State University, Baton Rouge.*

Based on previous research in our laboratory, the addition of virginiamycin (Vm) to diets with reduced available P (aP) or Ca improved the negative effects associated with deficiencies of these minerals. To further investigate this response, two additional experiments (EXP) were conducted to evaluate the effect of Vm in diets with adequate or reduced Ca (EXP 1) or aP (EXP 1 and 2) on daily gain (ADG), daily feed intake (ADFI), gain:feed, bone breaking strength, bone ash percentage, and mg of ash in 0 to 18 d-old chicks. In EXP 1, there were six treatments with six replications of five chicks per replicate. The dietary treatments were: 1) a corn-soybean meal (C-SBM) diet with 1.00% Ca and 0.45% aP; 2) C-SBM with 0.70% Ca and 0.45% aP, 3) C-SBM with 1.00% Ca and 0.25% aP; Diets 4 to 6) as Diets 1 to 3 with 9 ppm Vm. Reducing dietary aP decreased ADG, ADFI, and BS ($P < 0.01$). Reducing dietary Ca decreased BS and gain:feed ($P < 0.06$) but had no effect on ADG or ADFI. The addition of Vm to the low aP diets tended to decrease BS (aP x Vm, $P < 0.06$) but had no effect on ADG or ADFI. The addition of Vm to the low Ca and control diets increased BS ($P < 0.03$). In EXP 2, there were twelve treatments with six replications of six chicks per replicate. The dietary treatments were: Diets 1 to 4) C-SBM with 1.00% Ca and 0.15, 0.25, 0.35, 0.45% aP; Diets 5 to 8) as Diets 1 to 4 with 11 ppm Vm; and Diets 9 to 12) as Diets 1 to 4 with 22 ppm Vm. Daily gain, ADFI, gain:feed, BS, bone ash percentage, and mg of ash per tibia were increased ($P < 0.01$) as dietary aP levels were increased. The addition of Vm, regardless of supplementation level, increased ADG and BS in chicks fed diets with 0.35% and 0.45% aP, but Vm had no effect or decreased ADG and BS at the 0.15 and 0.25% aP levels (aP x Vm, $P < 0.05$). These results indicate that Vm, added at 11 or 22 ppm, will partially overcome the negative effects associated with aP deficiency at dietary levels of 0.35% aP or greater.

Key Words: Chicks, Phosphorus, Virginiamycin

289 Intestinal bacterial populations in broiler chickens fed on high protein diets with and without added guar gum. J. P. Dahiya*, D. C. Wilkie, A. G. Van Kessel, B. Laarveld, and M. D. Drew, *University of Saskatchewan, Saskatoon, SK, Canada.*

Necrotic enteritis is a worldwide poultry disease caused by *Clostridium perfringens*. An experiment was conducted to study the effects of dietary protein level and source and a soluble non-starch polysaccharide (guar gum) on the intestinal populations of various microbes in broiler chickens. Six groups of 12 birds (in duplicate) were provided with a medicated ideal protein-balanced corn-based starter crumble from day 0 to 21 of age. From d 21 onwards, six experimental diets (23, 40, 40% crude protein) with fish meal and soybean meal as main protein sources and with and without added 1% guar gum were fed in a 2 X 3 factorial arrangement of treatments. All birds were orally challenged with *C. perfringens* type A both culture from d 21 to 27. Total anaerobes, *C. perfringens*, total aerobes and *Lactobacilli* spp. were enumerated in ileal and cecal contents on d 35, 39 and 42. Nine (6.25%) birds died during the first 4 days of diet shift, but lesions typical of necrotic enteritis were seen in only three of them. There was a significant ($P < 0.05$) increase in the *C. perfringens* and total anaerobes count in cecum, but not in ileum due to guar gum addition. There were no significant effects of protein on the *C. perfringens* numbers except on d 42 in cecum where counts were significantly ($P < 0.05$) higher in birds fed SPC-based diet. Viscosity and the clostridial counts were significantly ($P < 0.05$) correlated in the cecum on d 35, 39 and 42, and in ileum on d 35. There were no significant differences in the *Lactobacilli* and total aerobic counts between different treatment groups. The viscosity and the pH of ileal contents were significantly higher and lower, respectively in birds fed diets with added guar gum. The pH of ileal contents was significantly ($P < 0.05$) higher in SPC-fed birds compared to control and fish meal-fed birds. Hence, it was concluded that the guar gum was associated with increase in *C. perfringens* and total anaerobes but the protein level had little effect on populations of these bacteria.

290 Organic acids improve phytate phosphorus utilization in chicks fed a corn-soybean meal diet. K. A. Rafacz*¹, C. M. Parsons¹, and R. A. Jungk², ¹*University of Illinois, Urbana*, ²*PMP Fermentations Products Inc., Peoria, IL.*

Previous research from our laboratory has shown that citric acid improves phytate phosphorus (P) utilization in chicks fed a P-deficient corn-soybean meal diet. The current study was conducted to determine if other organic acids are effective, with emphasis on gluconic acid. Two experiments were conducted in which four replicate groups of five crossbred chicks (New Hampshire X Columbian) were fed a P-deficient (0.16%) nonphytate P diet from 8-21 days of age. In Experiment 1, a completely randomized design was utilized to evaluate the effects of two levels of sodium gluconate (Na Glu), calcium gluconate (Ca Glu), and glucono-delta-lactone (GDL) and one level of HMB (2-hydroxy-4-methylthio butanoic acid as Alimet[®]). The diets were formulated to contain 1.5% or 3% of the gluconates or 1% HMB. Chick weight gain and tibia ash were significantly increased ($P < 0.05$) by Ca Glu (1.5%), Na Glu (1.5 and 3%), GDL (1.5 and 3%), and HMB (1%). In Experiment 2, a 4x2 factorial design was used to evaluate the effect of 2% of Na Glu, Ca Glu, and citric acid (CA) in two diets containing either 0.16 or 0.45% nonphytate P. All diets were formulated to be isocaloric and equal in Ca, Na, and Cl. Tibia ash was significantly increased ($P < 0.05$) by all three organic acids in chicks fed the 0.16% nonphytate P diet but not in chicks fed the 0.45% nonphytate P diet indicating that the responses were due to increased P utilization. The results of this study show that Na Glu, Ca Glu, GDL, HMB, and CA improve phytate P utilization in chicks fed a corn-soybean meal diet.

Key Words: Organic Acids, Chicks, Phosphorus

291 Phytase and 1 α -OH cholecalciferol (1 α -OH D₃) supplementation to broilers during the starting and growing/finishing phases. J. P. Driver*, G. M. Pesti, R. I. Bakalli, and H. M. Edwards, Jr., *The University of Georgia, Athens.*

There is considerable data in the literature on the efficacy of exogenous phytase supplementation for very young, starting, broiler chickens. However there is limited information on exogenous dietary phytase for growing/finishing broilers older than 21 days. Supplemental 1 α -OH D₃ has been shown to have qualitatively similar and quantitatively additive effects to exogenous phytase supplementation. An experiment was

conducted with 4 replicate pens per treatment of 30 broiler chicks from 0 to 35 days of age in litter covered floor pens. All birds were fed corn, soybean meal and soybean oil based diets and raised in houses which precluded any UV light penetration. From 0 to 18 days the birds were fed a 23% protein diet with 0.6% Ca, 0.5% total P (tP) and 0.24% non-phytate P (nPP). From 19 to 35 days the birds were fed a 19% protein diet with 0.3% Ca, 0.37% tP and 0.14% nPP. Eight replicates were fed a control diet with 0.9% Ca, .71% tP and .45% nPP 0-18 days, and 0.8% Ca, .71% tP and .45% nPP from 18-35 days. A supplement of 1000 FTU Natuphos 5000[®] phytase and 5 μ g/kg 1 α -OH D₃ (P+1A) was supplemented during the starter (0-18 days) or grower/finisher (18-35days) phases. The incidences of rickets and tibial dyschondroplasia were measured at 18 and 35 days. Un-supplemented chicks performed well but had considerable leg problems (1705 g gained and 2.096 g feed/g gain). Chicks fed P+1A during the starter (1886 g and 1.97 g/g) or grower/finisher phases (1733 g and 2.12 g/g) did not perform as well as those fed P+1A throughout (1933 g and 1.92 g/g). Boilers fed P+1A throughout performed as well as the controls (1940 g and 1.92 g/g) without any indication of increased leg problems. It is concluded that properly supplemented diets with as little as 0.3 % Ca and 0.14% nPP may be fed to broilers older than 18 days of age if properly supplemented with exogenous phytase and 1 α -OH D₃.

Key Words: Broiler, Phytase, 1-alpha-OH Cholecalciferol

292 Efficacy of an *Escherichia coli* phytase on growth performance, nutrient utilization and bone characteristics in broiler chicks. E. M. Onyango*¹, M. R. Bedford², and O. Adeola¹, ¹*Purdue University, West Lafayette, IN*, ²*Zymetrics Inc., Marlborough, Wiltshire, UK.*

An *Escherichia coli*-derived phytase was compared to that of a commercially available *Peniophora* phytase in order to evaluate its efficacy in improving growth performance and nutrient utilization of broiler chicks. One hundred and forty four 7-d-old male broiler chicks were grouped by weight into six blocks of six cages with four birds per cage. Six corn-soybean meal-based diets were randomly assigned to cages within each block. The six diets were adequate P and low P diets containing (g P/kg diet) 7.7 and 3.9, respectively; and low P diet plus either the *Escherichia coli*-derived phytase or the *Peniophora* phytase at 500 or 1000 units/kg of feed. The chicks were fed the experimental diets from 8 to 22 d of age. Excreta samples were collected between 17-21 d of age. At the end of the study, chicks were killed and left tibiae removed from the birds. The *Escherichia coli*-derived phytase compared with *Peniophora* phytase was more efficacious in improving weight gain ($P < 0.01$), feed intake ($P < 0.001$), toe ash ($P < 0.05$), tibia ash ($P < 0.001$) and total tract phosphorus retention ($P < 0.001$). There was a linear response to the *Escherichia coli* phytase in weight gain ($P < 0.05$), feed intake ($P < 0.01$), and tibia ash ($P < 0.01$) and phosphorus retention ($P < 0.001$). Both phytase sources improved total tract amino acid retention ($P < 0.05$). The *Peniophora* phytase improved ileal retention of most amino acids ($P < 0.05$). The *Escherichia coli*-derived phytase was efficacious in improving broiler growth performance, bone characteristics, and total tract retention of phosphorus and amino acids.

Key Words: Broiler Chick, *Escherichia coli* Phytase, Nutrient Utilization

293 Dietary Phytates Increase Endogenous Losses in Ducks and Chickens. E. M. Onyango*¹, E. K. Asem², J. S. Sands³, and O. Adeola¹, ¹*Department of Animal Sciences, Purdue University, West Lafayette, IN*, ²*Basic Medical Sciences, Purdue University, West Lafayette, IN*, ³*Danisco Animal Nutrition, Marlborough, Wiltshire, UK.*

The role of different forms of phytate on the regulation of endogenous losses in ducks and chicken was investigated. Forty eight 10-wk-old male ducks or broiler chickens were grouped by weight into eight blocks of 6 cages with one bird per cage. On the first day of experimentation, birds were fed by intubation the following six diets: dextrose alone or dextrose plus either phytic acid, magnesium-potassium-phytate, phytase (1000 U), phytic acid plus phytase, or magnesium-potassium-phytate plus phytase. All excreta were collected continuously during the 54 h following feeding and frozen until analyzed. Excreta were freeze-dried, ground and analyzed for dry matter, and their content of energy, nitrogen, mucin and sialic acid. Ducks fed magnesium-potassium-phytate excreted more nitrogen ($P < 0.05$) than those fed dextrose alone but

the amount excreted was similar to that excreted by ducks fed phytic acid. This however was not true for chickens. The highest amount of crude mucin was excreted by ducks and chickens fed magnesium-potassium-phytate followed by those fed phytic acid ($P < 0.05$). Ducks and chickens fed either phytic acid or magnesium-potassium-phytate excreted higher ($P < 0.05$) amounts of sialic acid than those fed dextrose alone. Addition of phytase to the diets did not reduce the endogenous losses observed in the ducks or chickens. In conclusion, presence of either phytic acid or magnesium-potassium-phytate in diet induces an increase in endogenous losses in ducks and chickens.

Key Words: Chicken, Duck, Endogenous Loss

294 The effect of phytase on performance of broilers fed high and low phytate phosphorus diets. M. Manangi* and C. Coon, *Department of Poultry Science, University of Arkansas, Fayetteville.*

A 42-d broiler experiment was conducted to determine the effect of added microbial phytase (Phyzyme#8482XP 5000G) to low and high phytate phosphorus (P) diets on broiler performance, ileal P retention and % tibia ash. The experiment consisted of 12 treatments with 2 levels of phytate P; 1) low phytate (LP) group-0.24% and 2) high-phytate (HP) group-0.32%. Both LP and HP groups had respective positive controls (PCs) and 5 basal diets with graded levels (0, 250, 500, 750 and 1000 FTUs/kg diet) of added phytase. A total of 1536 one day old male Cobb 500 broiler chicks were allotted to 48 pens with 32 chicks per pen and 4 pens per diet. A significant ($P < 0.001$) phytase effect was found for body weight gain, feed intake, feed: gain ratio, ileal P retention and tibia ash % for both LP and HP groups on day 42. Supplementation of 250 FTUs phytase/kg diet for both LP and HP basal diets produced equivalent body weights ($P > 0.05$) to comparable respective PCs. Supplementing 500 FTUs phytase/kg diet in both LP and HP groups resulted in a comparable ($P > 0.05$) % tibia ash to respective LP and HP positive control groups. The LP basal diet supplemented with 250, 500, 750 and 1000 FTUs phytase/kg diet was fed to broilers from 1-42d. The phytase produced increased body weights of 365, 403, 440 and 240 grams, increased ileal P retention by 9.83, 9.12, 8.17 and 15.76% and increased tibia ash % by 4.29, 6.4, 8.42, and 7.93, respectively. The same phytase supplementation in the HP basal diets increased body weights by 478, 568, 570 and 395 grams, ileal P retention increased by 7.21, 9.93, 10.91 and 20.62% and tibia ash % increased by 4.46, 10.67, 10.12, and 10.79, respectively. Based on body weight gain and % tibia ash, feeding 500 units of phytase/kg diet from 1-42d replaced 0.14% of non-phytate P in both LP and HP diets. An additional increase in body weight, ileal P retention and tibia ash % in the HP supplemented groups compared to LP groups due to increase in phytase levels/kg diet could be attributed to more substrate (phytate P) concentration.

Key Words: Phytase, Phytate P, Ileal P

295 Effects of various phytase concentrations in diets with low-phytate corn on broiler chick performance and metabolizable energy. N. J. Baker*, A. S. Parsons, N. P. Buchanan, and J. S. Moritz, *West Virginia University.*

Research indicates a reduction of phosphorus content in fecal excreta with the supplementation of phytase to corn-soybean based diets or with the use of low phytate corn (LPC) in broilers. This study examined how 0 to 3 wk broiler chicks are impacted by concomitant phytase supplementation with LPC (0.136% phytate P by analysis) in the diet. Various levels of phytase (250, 500, 750, 1000, 2000 FYT/kg) from either 2500 or 5000 FYT/g of dry *Peniophora lycii* phytase product were used as experimental treatments. Efficacy of treatments was determined using a response curve created with monocalcium phosphate providing 0.23%, 0.28%, 0.33%, and 0.38% levels of available phosphorus. All diets that included phytase contained 0.23% available phosphorus, 0.8% calcium and LPC. Following a 6-day pre-test, 576 broiler chicks were randomly assigned to one of the 12 dietary treatments, with 8 replicates and 6 birds per cage. Measurements of live performance, tibia ash, mineral digestibility, and apparent metabolizable energy (AME) were obtained. Increasing phytase concentration led to a linear increase in live weight gain ($P = 0.0309$) and a linear decrease in feed conversion ($P = 0.0010$). At enzyme levels greater than 250 FYT/kg, digestible phosphorus, calcium, and AME increased ($P < 0.05$). The two *Peniophora lycii* products, when used to make similar experimental treatments, did not differ regarding performance, mineral digestibility and AME ($P > 0.05$). Thus,

phytase supplementation in diets containing LPC had a positive impact on broiler chick growth.

Key Words: Broiler Chick, Low Phytate Corn (LPC), Phytase

296 Performance and phosphorus excretion of chicks fed conventional or low-phytate corn-soybean meal diets without or with phytase. E. G. Xavier, G. L. Cromwell*, and M. D. Lindemann, *University of Kentucky, Lexington.*

An experiment was conducted to assess diets containing normal (N) corn and N soybean meal (SBM) or low-phytate (LP) corn and LP, low-oligosaccharide SBM, without or with phytase (Natuphos[®], BASF; 750 units/kg), on performance and excretion of total and soluble P by chicks. The two corns were near-isogenic and the two SBM were from near-isogenic soybeans. They were provided by Pioneer Hi-Bred International. The N-corn, LP-corn, N-SBM and LP-SBM contained 0.25, 0.26, 0.70, and 0.77% total P and 0.05, 0.17, 0.22, and 0.55% non-phytate P. Chicks (3-d-old, 63 g initial weight) were fed 10 diets for 14 d. Diets 1 to 5 were N-corn + N-SBM with 0.75, 0.66, 0.66, 0.57, and 0.57% total P, respectively, with Diets 3 and 5 containing phytase. Diets 6 to 10 were LP-corn + LP-SBM with 0.60, 0.51, 0.51, 0.42, and 0.42% total P, with Diets 8 and 10 containing phytase. Diets 1 and 6 contained the same amount of non-phytate P (0.47%) and similar amounts of bioavailable P (0.45 and 0.43%). Diets were fed to five replications of six chicks/pen in batteries. Daily gain was reduced as dietary P was decreased to the lowest level ($P < 0.05$), and phytase did not overcome the reduction in growth (25.6, 24.7, 24.7, 22.5, 22.7, 26.4, 25.4, 26.0, 23.7, 23.0 g/d for chicks fed Diets 1 to 10, respectively). Tibia strength and ash followed similar patterns (11.2, 9.2, 9.9, 6.3, 7.3, 12.5, 10.5, 11.1, 7.8, 8.0 kg; 41.2, 39.3, 40.7, 35.0, 36.1, 42.2, 40.2, 41.0, 37.3, 37.3%). Daily excretion of total P (112, 100, 95, 87, 80, 58, 48, 45, 40, 34 mg/d) and soluble P (2.9, 1.3, 1.6, 1.0, 1.4, 1.7, 0.8, 0.8, 0.9, 0.7 mg/d) both decreased ($P < 0.05$) as dietary P decreased and the amounts were less ($P < 0.05$) in chicks fed the LP-diets. Inclusion of phytase tended ($P < 0.10$) to decrease total P excretion, but phytase did not affect soluble P excretion ($P > 0.05$). Compared with the conventional diet at the NRC level of non-phytate P (Diet 1), feeding LP-corn and LP-SBM in combination with phytase (Diet 8) reduced total P excretion by 60% and soluble P excretion by 72% without negatively impacting performance or bone traits.

Key Words: Chicks, Phosphorus, Phytase

297 Effects of dietary organic acid and phytase supplementation on performance and calcium and phosphorus utilization in laying hens. M. Sari, A. G. Onol, M. Daskiran*, and O. Cengiz, *Adnan Menderes University Faculty of Veterinary Medicine, Adnan Menderes University, Aydin, Turkey.*

An experiment was conducted to determine the effects of dietary organic acid and phytase supplementation on performance and calcium and phosphorus utilization in laying hens. Two hundred 23-wk-old Brown Nick layers were randomly allocated into 50 cages (42x50 cm) each containing 4 birds. Corn-soybean meal based rations were used. Five dietary treatments were formed as followed: (1) a basal ration with no supplemental P (- control) (2750 kcal ME/kg, 17% CP, 0.34% total P, 3.8% Ca), (2) basal ration supplemented with dicalcium phosphate (1.4%) (+ control), (3) basal ration supplemented with 0.035% phytase (ZY Phytase II-5), (4) basal ration supplemented with 1.0% organic acid (Salstop SD) and (5) basal ration supplemented with both 0.0035% phytase and 1.0% organic acid. Water and feed were provided for ad libitum consumption and a lighting program of 16 h light : 8 h dark was applied throughout the study. Each dietary treatment had 5 replications and each replication comprised two adjacent cages. Basal diet with no supplemental P resulted in body weights that were lower ($P < 0.05$) than those of hens fed diets supplemented with phytase, organic acid, or both. Hens fed diets supplemented with dicalcium phosphate, phytase, and organic acid and phytase had higher egg production ($P < 0.001$) (91.3, 86.1, and 93.7% respectively) compared to hens fed either basal diet (78.5%) or basal diet with organic acid supplementation (78.6%). Additionally, the unsupplemented or organic acid supplemented corn-soybean meal diet had lower feed consumption and higher feed conversion ratio ($P < 0.01$). Hen tibia ash and serum calcium levels were not affected by the dietary treatments whereas diets supplemented with dicalcium phosphate, phytase, and phytase + organic acid had higher ($P < 0.01$) serum inorganic phosphorus. The results of this study indicate that dietary phytase improves P utilization in corn-soybean meal based

diets with no supplemental P and acidification of gastrointestinal tract may further improve this utilization.

Key Words: Organic Acid, Phytase, Laying Hen

298 Effect of a thermo-tolerant phytase on performance and bone ash in broilers fed variable levels of dietary nutrients. C. W. Wyatt*¹, M. R. Bedford¹, T. Parr², and S. Davis², ¹Zymetrics Inc., Golden Valley, MN, ²Colorado Quality Research, Wellington, CO.

Two studies investigated the effect of a thermo-tolerant E.coli-derived phytase (QuantumTM) on performance and bone parameters of broilers fed diets varying in content of available phosphorus (AP), metabolizable energy (ME) and total lysine (TLYS). A 48-day floor pen trial used 80 pens of 16 male broilers fed corn/soya/meat-bone meal based diets formulated to commercial averages (AS) or below. A four phase positive control (PC) diet was fed with .91, .82, .76, .69% calcium (CA) and .45, .39, .34, .30% AP, and two negative control (NC) diets were formulated to contain less AP(.09% or .12%), ME(26 or 45kcal/kg) and TLYS(.01 or .03%), respectively for each phase. 250, 500 or 1000 U phytase/kg diet were supplemented to each NC resulting in 10 treatments. At day 40 and 48, the initial reduction in AP, ME and TLYS did not affect performance, but further nutrient removal reduced performance compared to the PC. Supplementing all NC diets with at least 250U/kg phytase improved performance to equal or better than the PC. Lowering AP significantly reduced 48 day femur ash, but this was restored to equal or better than the PC on adding phytase. A second 50-day floor pen trial using 88 pens of 16 male broilers was conducted to determine the impact of phytase on growth, bone ash and breast yield in corn/soya/meat-bone meal based diets varying in ME. As above, a four phase PC diet was fed and three NC diets were formulated to contain less AP(.12%) and TLYS(.01%) and ME lowered by 30, 45 and 60kcal/kg, respectively. 500 or 1000 U phytase/kg of diet were supplemented to the three NC diets resulting in 8 treatments. At day 40 and 50, reducing the amount of dietary AP, ME and TLYS resulted in significantly poorer BWT and cFCR, but further reduction in ME did not result in additional losses in performance. Adding 500 U/kg and 1000U/kg phytase to the NC equilibrated performance with that of the PC for the 45 and 60kcal reduced diet respectively. In these studies. EC phytase was able to return NC performance to that of the commercial PC, although the level of phytase needed would depend on the reduction in dietary nutrient levels.

Key Words: Broiler Chick, Escherichia Coli Phytase, Performance

299 The influence of an E.coli derived phytase on performance of turkeys fed phosphorus deficient diets. M. R. Bedford* and C. L. Wyatt, Zymetrics Inc., Golden Valley, MN.

The effect of a thermo-tolerant E.coli-derived phytase (Quantum) on performance of turkeys fed phosphorus deficient diets to 84d was investigated. In experiment 1, each treatment consisted of 6 replicates of 15 BUT T8 birds. A positive (PC) and negative control (NC) corn/wheat/soya based ration containing 0.7, 0.5 then 0.5 or 0.35, 0.2 then 0.2% AvP in the starter, grower and finisher was employed. All other nutrients met or exceeded NRC requirements. 0, 100, 300, 900 or 2700 units/kg of an E.coli derived phytase (QuantumTM) was added to the NC to give 6 diets. Performance was monitored at 28, 56 and 84 d of age. At 28 d of age, intake and gain were depressed on feeding the NC but were restored to values equivalent to the PC at 900 units/kg feed.

At 56d of age, intake, gain and FCR deteriorated on feeding the NC, and only on feeding 2700 U/kg was performance restored to PC levels. At 84 days of age, performance on the NC was poorer than the PC and was not restored even on the 2700U/kg treatment. In experiment 2, 11 male Nicholas turkeys were assigned to 6 replicate pens per treatment. There were 5 treatments, a PC, (meeting all NRC requirements) and a NC which contained 0.14% less AvP in each of the 4 phases fed supplemented with 0, 200, 500 or 1250 units of an E.coli derived phytase (Quantum). At 21d the NC performed significantly worse than the PC in terms of FCR only, and this was restored on use of 500 units of phytase or more. By 84 days gain was marginally depressed on feeding the NC and restored on use of even the lowest level of phytase. FCR was unaffected by treatment. Intake tended to drop on feeding the NC and was restored on feeding phytase. These data suggest that the use of moderate levels of phytase can easily compensate for moderate dietary reductions in AvP, but if severe reductions are made, then the subsequent losses in performance are not readily apparent until late on in the growth phase. As a result, short term tests on the bioequivalency of phytase for replacement of inorganic P are likely flawed in their conclusions when applied to full production periods.

Key Words: Phytase, Turkeys, Performance

300 Efficacy of Phyzyme[®] XP phytase in broiler diets containing different levels of calcium and non-phytate phosphorus: performance, bone ash and mineral retention. D. R. Ledoux*¹, J. N. Broomhead¹, and J. S. Sands², ¹University of Missouri, Columbia, ²Danisco Animal Nutrition, Marlborough, Wiltshire, UK.

A six-week floor pen study was conducted to determine the efficacy of Phyzyme[®] XP, in corn-soybean meal-based diets containing different Ca & P levels, on performance, tibia ash, and P retention in broiler chickens. A 3 X 4 factorial arrangement of dietary treatments from hatch to week 3 included 3 Ca & non-phytate P (npP) levels (0.80 & 0.25%, 0.85 & 0.30%, and 0.90 & 0.35%) and 4 levels of Phyzyme[®] XP (0, 250, 500, and 750 U/kg diet). From week 3 to 6, dietary phytase levels were kept the same but Ca & npP levels were reduced (0.70 & 0.15%, 0.75 & 0.20%, and 0.80 & 0.25%). The starter basal diet contained 21.74% CP and 2920 kcal ME/kg, and the grower basal diet contained 19.5% CP and 3010 kcal ME/kg. Six pens of 25 chicks each were assigned to each dietary treatment from day 1 to 42. Significant (P < 0.05) Ca & npP level by phytase interactions were observed for feed intake (FI) at weeks 3 and 6, and for body weight gain (BWG) at week 6. Feed intake, BWG, and FCR were also affected (P < 0.05) by phytase treatment at both weeks 3 and 6, with chicks fed phytase outperforming chicks fed no phytase. Chick performance was not affected (P > 0.05) by Ca & npP at 3 weeks, but were affected (P < 0.05) at 6 weeks, with the best performance observed in chicks fed the 0.90% Ca & 0.35% npP combination. Significant interactive and main effects were observed for tibia ash (%) at 6 weeks, with the response to phytase differing among the Ca & npP levels. Both 3 and 6 week P retention were improved (P < 0.05) by phytase supplementation. Combination of Ca & npP did not affect P retention (P > 0.05) at week 3, but did affect P retention (P < 0.05) at week 6. No Ca & npP by phytase interaction for P retention occurred at either weeks 3 or 6. Results indicate that Phyzyme[®] XP was effective in improving phytate P utilization, and efficacy was influenced by Ca & npP level.

Key Words: Phytase, Mineral Retention, Broilers

Poultry Reproductive Physiology

301 Effect of heat stress on production, reproduction hormone levels, acid-base status, and liver expression of heat shock protein-70 observed in three varieties of laying hens. D. J. Franco*, L. Robeson, and M. M. Beck, University of Nebraska, Lincoln.

Thirty-two hens of each strain (Brown, W98, W36) at 38 weeks of age, were allowed to acclimatize for two weeks at 22C, and then were exposed to heat stress (HS) at 35C for two weeks with two additional weeks at 22C to recover. Production parameters (PP) and mortality rates (MR) were collected for each phase. Reproductive hormone levels (RHL) were obtained from blood collected at each phase. Acid base status (AB), Intestinal calcium uptake rate (CaT), and liver expression of HSP70 data

were obtained from samples collected before and during HS exposure. The data for PP and RHL were analyzed using the SAS program 1999 version 8.0 as repeated measure in a 3x3 factorial experiment with a level of significance of 0.05. The data for liver expression of HSP70, AB, and CaT were analyzed in a 3x2 factorial experiment with a level of significance of 0.1. Differences among means were obtained based on LSD test. Brown birds performed least well during subsequent HS, with a higher reduction in egg production and a lower CaT. Most of the PP were reduced in all the birds during HS; however, the highest reduction in egg weight was observed in the W36 hens. AB was characterized by an increase in blood pH and a reduction in PCO₂ during HS. PO₂ showed a small positive increment during HS only for the W36 and HCO₃ levels