An experiment was carried out to estimate zinc requirement and its equivalency value of phytase for broiler chickens. A total of 768 male Ross 308 broiler chicks were used to evaluate the response of broiler chicks to basal diet supplemented with phytase, and or zinc oxide. Basal diets formulated for starter, grower and finisher periods and contained 24 mg/kg zinc. Basal diets supplemented with experimental diets for making 16 dietary treatments. Experimental design was a completely randomized design in a 4 × 4 factorial arrangement. Treatments replicated 4 times, each had 12 birds. Each pen was equipped with 1 plastic pan feeder, 1 bell drinker, and covered by 5 cm wood shavings in height. Birds received mash diet from 1 to 42 d of age and, had free access to water and feed, and a 24-h photo schedule was applied. Weekly weight gain, feed intake, FCR, and livability of chicks were measured. At the end of the experimental period, carcass characteristics were measured. Effect of dietary zinc concentration on body weight at 42 d of age were significant (P < 0.01). Zinc requirements for optimum body weight gain during 0 to 42 d of age were estimated by different models. Fitted quadratic model estimated 60.1 mg/kg (P < 0.001; R² = 0.21) zinc requirement for final body weight. Added phytase to the basal diet increased final body weight numerically, but this effect was not statistically significant (P > 0.14). Zinc equivalence value of phytase at 42 d of age was estimated to be 56.2 percent.

**Key Words:** zinc equivalency, phytase, broiler chicken

**100 Comparison of liquid and dry forms of phytase plus carbohydrase for broilers fed a nutritionally inadequate diet.** D. Wu*, R. A. Swick, and S. B. Wu, University of New England, Armidale, NSW, Australia.

The objective of this study was to compare the efficacy of a liquid multiple-enzyme complex (Rovabio Max) containing phytase and carbohydrases to that of dry phytase (Phyzyme) and xylanase (Porzyme) in broilers. Body weight (BW), FCR, ileal digesta viscosity and bone mineralization were measured. A total of 1008 1-d old Ross 308 male chicks were randomly allocated to 28 floor pens and 4 treatment groups with 36 birds per pen and 7 replicates per treatment. Starter (0–10 d), grower (10–24 d) and finisher (24–42 d) feeds were fed. The treatments were: positive control (PC) meeting Ross 308 nutrient specs for ME and digestible amino acids (DAA); negative control (NC) which contained 100 kcal/kg ME, 2.0% DAA, 0.15% available P and 0.12% Ca less than PC; NC plus liquid enzyme complex (NCL); NC plus dry xylanase and phytase (NCD). On d 24, BW (kg) was 1.303bc, 1.262c, 1.381ab and 1.398a for PC, NC, NCL and NCD respectively (P < 0.05) with no FCR differences observed (P > 0.05). On d 42, BW (kg) was 3.246a, 3.128bc, 3.493a and 3.433a, while FCR was 1.633ab, 1.654b, 1.605a, 1.604a for PC, NC, NCL and NCD respectively (P < 0.05). Viscosity of ileal digesta on d 24 was reduced (P < 0.05) by 32% for NCL and 46% for NCD when compared with NC. Tibia ash (% of dry bone) tended to be greater (P = 0.08) in NCL (42.2%) and NCD (42.2%) than NC (40.3%) or PC (40.2%). In conclusion, there is no difference between enzyme forms in broiler performance or intestinal viscosity measurements. Both forms of enzymes are effective in improving growth performance and reducing intestinal viscosity in broiler chickens fed a nutritionally inadequate diet.

**Key Words:** phytase, xylanase, carbohydrase, growth performance, viscosity

**101 Effect of increasing supplemental phytase concentration in the diets fed to Hubbard × Cobb 500 male broilers from 1 to 42 days of age.** A. Campasino*, T. York2, C. Wyatt2, and W. A. Dozier III1, 1 Auburn University, Auburn, AL, 2AB Vista Feed Ingredients, St. Louis, MO.

The supplementation of phytase has been reported to result in extra phosphoric effects in broiler chickens, by improving nutrient digestibility. The objective of this study was to examine the effects of feeding male broilers diets having progressive additions of supplemental phytase concentrations on growth performance and carcass characteristics. Seven dietary treatments were utilized: a positive control (PC, adequate phosphorus, calcium and sodium), negative control (NC; reduction in phosphorus and calcium), NC with 4 different concentrations (FTU/kg) of phytase (NC+400, NC+800, NC+1,200, NC+1,600), and a low energy diet (Low E). Diets 1 to 7 were supplemented with a carbohydrase. Diet 8 was used to evaluate the energy sparing effects of the carbohydrase used in diets 1 to 7. Fourteen hundred Hubbard × Cobb 500 1-d-old chicks were randomly distributed into 64 floor pens (25 chicks per pen; 0.09 m²/bird). Diets were fed in 3 dietary phases: starter (1 to 14 d), grower (15 to 28 d), and finisher (29 to 42 d); body weight and feed consumption were determined at the end of each dietary phase. Following a 12 h feed withdrawal period, 8 birds per replicate pen were randomly chosen to determine weight and yield of whole carcass, abdominal fat, and pectoralis major and minor muscles. Progressive supplementation of phytase decreased (P = 0.052) cumulative feed conversion ratio. Broilers fed diets containing 1,600 FTU/kg were 87 and 31 g heavier (P = 0.04) for carcass and total breast meat weight compared with birds receiving the NC+400 diets. Broilers consuming the NC+400 diet did not differ (P > 0.05) in growth performance and meat yield compared with birds provided PC diet. Birds fed the Low E diet had similar (P ≥ 0.05) growth performance and meat yield compared with PC fed birds. These data indicated that phytase supplementation beyond the need for phosphorus enhances growth performance and carcass characteristics.

**Key Words:** enzyme, broiler, phytase


Three studies (T1, T2, and T3) were conducted to evaluate the effect of a novel, heat-stable xylanase (Xyl) on the growth performance of broiler chicks from hatch until 3 weeks of age when included in wheat-soybean based rations. T1 and T2 were both designed as 3 × 2 factorials, with 3 energy levels (2800, 2950, and 3100 kcal/kg ME), and 2 levels of Xyl (0 or 800 U Xyl activity/kg of feed). Diets in T1 were fed in mash form and diets in T2 were pelleted at 85°C and then crumbled. T3 was designed as a 3 × 2 factorial with 5 levels of Xyl inclusion (0, 200, 400, 800, 1600 U Xyl activity/kg of feed) and 2 feed forms (mash and crumble); all treatments in T3 were formulated to have 2800 kcal/kg ME. The xylanase was added to the diets in a dry form during feed
Footpad dermatitis (FPD) in broilers has been reported to be affected by dietary protein and energy levels. Additionally, a potential use of exogenous enzymes to assuage FPD has been described. One experiment was conducted to evaluate the effects of amino acid density (AA), level of fat application post-pellet (FL), and xylanase inclusion (X) in corn-soybean diets with DDGS on broiler FPD. A total of 2,112 d-old male Ross 708 were placed in 96 pens with 22 broilers each. Treatments consisted in 16 combinations of 2 AA (Low and High with 10% difference), 2 levels of FL with difference of 100 kcal/kg ME between levels (0 and 100) and 4 levels of X (0, 8000, 16000 and 32000 BXU/kg). Diets for starter, grower, and finisher phases were formulated from 1 to 16, 17 to 35 and 36 to 49 d of age, respectively. Severity and extension of FPD were assessed at 14, 37 and 49 d using a 4 level scale for each parameter. Data were analyzed as 2 × 2 × 4 factorial design using a Poisson probability model in a CRBD. Results indicated an effect (P ≤ 0.05) of AA on FPD severity for the 3 evaluations. High AA increased severity score in the 3 evaluations. At 37d X level of 8000 and 32000BXU decreased (P < 0.01) FPD severity in comparison with 0 level of X. Extension of lesions was affected (P < 0.05) by AA and X interaction at 14d. At 37d, High AA increased (P < 0.01) FPD extension. Additionally an effect (P < 0.01) of X was observed at 37d. Level of 8000BXU reduced lesion extension in comparison with 16000BXU and 0 levels, though it was not statistically different from 32000BXU. Furthermore, AA had an effect on FPD extension at 49d. Low levels of AA reduced FPD extension. In conclusion, it was observed that diets formulated with High AA increased FPD severity and extension during the whole grow-out period. Nevertheless, results indicated a reduction of FPD by inclusion of xylanase in corn-soybean diets.

Key Words: footpad dermatitis, amino acid, energy, xylanase

103 Effect of dietary amino acid density, inclusion level of fat and xylanase levels on footpad dermatitis severity and extension in broilers. M. J. Da Costa *, E. O. Oviedo-Rondón1, C. B. V. Rabello1,2, W. Nogueira1,3, J. Barbosa1,4, K. Claassen1, and C. L. Wyatt5, 1Prestage Department of Poultry Science, North Carolina State University, Raleigh, 2Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil, 3Universidade Estadual Paulista, FVMZ, Jaboticabal, São Paulo, Brazil, 4Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brazil, 5AB Vista, Plantation, FL.

Footpad dermatitis (FPD) in broilers has been reported to be affected by dietary protein and energy levels. Additionally, a potential use of exogenous enzymes to assuage FPD has been described. One experiment was conducted to evaluate the effects of amino acid density (AA), level of fat application post-pellet (FL), and xylanase inclusion (X) in corn-soybean diets with DDGS on broiler FPD. A total of 2,112 d-old male Ross 708 were placed in 96 pens with 22 broilers each. Treatments consisted in 16 combinations of 2 AA (Low and High with 10% difference), 2 levels of FL with difference of 100 kcal/kg ME between levels (0 and 100) and 4 levels of X (0, 8000, 16000 and 32000 BXU/kg). Diets for starter, grower, and finisher phases were formulated from 1 to 16, 17 to 35 and 36 to 49 d of age, respectively. Severity and extension of FPD were assessed at 14, 37 and 49 d using a 4 level scale for each parameter. Data were analyzed as 2 × 2 × 4 factorial design using a Poisson probability model in a CRBD. Results indicated an effect (P ≤ 0.05) of AA on FPD severity for the 3 evaluations. High AA increased severity score in the 3 evaluations. At 37d X level of 8000 and 32000BXU decreased (P < 0.01) FPD severity in comparison with 0 level of X. Extension of lesions was affected (P < 0.05) by AA and X interaction at 14d. At 37d, High AA increased (P < 0.01) FPD extension. Additionally an effect (P < 0.01) of X was observed at 37d. Level of 8000BXU reduced lesion extension in comparison with 16000BXU and 0 levels, though it was not statistically different from 32000BXU. Furthermore, AA had an effect on FPD extension at 49d. Low levels of AA reduced FPD extension. In conclusion, it was observed that diets formulated with High AA increased FPD severity and extension during the whole grow-out period. Nevertheless, results indicated a reduction of FPD by inclusion of xylanase in corn-soybean diets.

Key Words: footpad dermatitis, amino acid, energy, xylanase

104 The effects of pelleting and glucanase supplementation in barley based diets on feed manufacture, broiler performance, and gut viscosity. A. E. Lamp* and J. S. Moritz, West Virginia University, Morgantown.

Feeding broilers barley based diets, high in β-glucan, requires special consideration primarily due to effects on increased gut viscosity (GV) and decreased nutrient digestion. Pelleting and glucanase supplementation are common practices utilized before feeding broilers barley based diets; however, the interaction of these practices is complex. Thermal processing and glucanase supplementation have been shown to have opposing effects on GV; and if glucanase is added at the mixer, then glucanase thermal stability becomes a concern. The objective of this study was to evaluate the effects of pelleting and glucanase supplementation in barley based diets (45% of diet formulation) on broiler performance and GV. The study utilized a randomized complete block design with 8 replications of 10 straight-run Cobb 500 broilers. Dietary treatments included 12 different diets: positive and negative control diets that differed by 150kcal/kg, various glucanase doses to generate a range of activities (125 – 2000U/kg of feed), and 2 different glucanase enzymes (Glucanase A and B). Treatments were fed as mash and as ground pellets (80°C conditioning). Statistical analyses utilized main effects of diet formulation, glucanase dose, and degree of processing. Broilers fed ground pellets had a greater pen feed intake, live weight gain (LWG), and GV (P < 0.05). For Glucanase A, an interaction between glucanase dose and degree of processing occurred for ending bird weight, LWG, and GV (P < 0.1). Glucanase A supplementation decreased GV and increased weight gain for ground pelleted diets, but not mash diets. For ground pellets, Glucanase A dosed at 1000 U/kg of feed was superior to the negative control and indistinguishable from the positive control for ending bird weight and LWG (P < 0.05). This effect was not observed for Glucanase B, perhaps in part due to a 50% decrease in activity post pelleting. Evaluations of glucanase should go beyond in vitro activity and include live bird performance using feed that has undergone pelleting.

Key Words: glucanase, feed manufacture, viscosity, broiler performance


Although dietary inclusion of corn distillers dried grains with solubles (DDGS) in turkey diets may be cost effective, it increases the amount of non-starch polysaccharides, such as water-insoluble arabinoxylans, which compromises nutrient digestibility but may also serve as fermentation substrate for commensal microflora. This study evaluated the effect of DDGS inclusion level in corn-SBM diets supplemented with endo-xylanase from T. reesei, α-amylase from B. licheniformis, and serine protease from B. subtilis, (XAP, Danisco Animal Nutrition) and a combination of spores from 3 defined Bacillus subtilis strains (DFM, Danisco Animal Nutrition) on growth performance and nutrient digestibility in turkey pouls. A 3 × 2 experiment was designed with 3 DDGS inclusion levels (0%, 6%, and 12%) and supplemented with or without XAP+DFM. All diets were formulated to have the same nutrient content and pelleted. The treatments were randomly assigned among 6 replicate pens of 8 pouls and fed ad-libitum for 28 d. Feed intake and body weight (BW) were recorded weekly. Fecal samples were collected 22–24 d and ileal content was collected on 28 d for nutrient digestibility analysis. There were no significant DDGS X XAP+DFM interaction...
effects on growth performance or nutrient digestibility. As dietary DDGS level increased, weekly BW decreased and FCR increased linearly, and digestibility of P, crude fat (CF), crude protein (CP) decreased (P < 0.005). Dietary supplementation of XAP+DFM had no effect on BW, but marginally improved FCR (P < 0.10) and significantly reduced fecal moisture by 4.2% (P < 0.05). XAP+DFM significantly increased ileal digestibility of CF and CP (P < 0.05), but had no effect on AMEn or ANR at 22–24 d. This experiment confirms that growth performance of pouls will decrease as dietary inclusion levels of DDGS increases if the formula is not compensated for inferior protein, fat and P digestibility. Although, dietary supplementation of XAP+DFM had no effect on the BW, if improved nutrients digestibility.

Key Words: DDGS, XAP, DFM, nutrient digestibility, turkey poult

106 Evaluation of inclusion level of wheat distillers dried grains with solubles with and/or without protease and β-mannase on performance and water intake of turkey hens. E. Y. Opoku*, H. L. Classen, R. A. Agivale, and T. A. Scott, University of Saskatchewan, Saskatoon, SK, Canada.

It is becoming increasingly common to use higher levels of wheat distillers dried grains with solubles (wDDGS) in poultry diets. The objective was to determine the effect of level of inclusion of wDDGS with or without enzyme supplementation on performance and rate of water intake on turkey hens (0–72 d). Two diets (0 or 30% WDDGS) were formulated to meet the nutrient requirement of the Hybrid Converter turkey. Diets were then mixed to obtain different levels of inclusion of 0, 15 or 30% wDDGS. The 30% diet was divided into 3 fractions and 2 fractions supplemented with either protease (P+; 0.126g/kg) or β-mannase (M+; 0.05g/kg). All diets were fed ad libitum as mash. All 700 bd turkey hens were randomly allocated into groups of 35 birds per replicate with 4 replicates floor pens per treatment, in a completely randomized design. Water intake per pen was recorded beginning at 7d. There was no effect of dietary treatment on feed intake. Body weight of turkey hens (28–52d grower) was significantly higher for 30%P+ as compared with 0 or 15% diets; but was not different than 30% or 30%M+ diets. Feed:gain (P < 0.01; 28–52d), and total feed:gain ratio (P < 0.05; 0–72d) was significantly improved for birds fed 30% regardless of enzyme treatment compared with 0% and 15% levels. Water intake tended to be higher (P = 0.08) between 7 and 28d for 30%P+ diets. Similarly, water intake of birds fed 30%P+ was higher (P < 0.05; 28–52d) and total water intake (P = 0.06; 7–72d) tended to be higher than other treatments. Similarly water:gain ratio (52–72d) was higher (P < 0.05) for 30%P+. To our knowledge, this experiment is the first to report the impact of WDDGS on water intake. As high as 30% WDDGS can be substituted in turkey hen diets. No impact of protease or β-mannase was found on performance of turkey hens fed 30% WDDGS.

Key Words: wheat, distillers dried grains with solubles, water intake, turkey, enzymes

107 Effects of housing differences and phytase supplementation on growth performance, behavior, blood mineral and immune characteristics of broiler chickens fed a low available phosphorus diet. C. Raginski*1, A. J. Madisen1, K. Novak1, E. Davis1, and D. Petri2. 1University of Saskatchewan, Department of Animal & Poultry Science, Saskatoon, SK, Canada. 2Irish Animal Nutrition, DuPont Industrial Biosciences, Marlborough, Wiltshire, United Kingdom.

Animal behavior and immune characteristics are often discussed to impact animal performance. However, these measures are rarely determined in nutrition related studies. To demonstrate the interplay of animal behavior, growth performance and animal physiology with nutrition, a 21 d study using day-old Ross 308 chicks was conducted with a 2 x 2 factorial setup of treatments with 20 birds per replicate comparing broilers reared in battery cages (BC, n = 24) versus floor pens (FP, n = 8) fed a low available P mash basal diet (0.56% tP, 0.18% aP) without (CTL, n = 18) or with supplementation of 0.05% of a Butantiaea derived Phytase (PHY, n = 18). Feed intake was lower (P = 0.01) when birds were housed in BC compared with birds housed in FP, and when birds were fed CTL compared with those fed PHY. Body weight gain and feed:gain ratio of birds was improved (P < 0.05) when birds were fed PHY compared with birds fed CTL; however, the magnitude of this response was greater when birds were housed in FP compared with BC (diet x housing interaction, P < 0.01). Time spent feed pecking was greater (P = 0.09) in birds fed CTL compared with those fed PHY. Floor pecking was observed in FP only (P < 0.05), whereas birds housed in BC did not exhibit this behavior. Blood Ca was greater (P < 0.001) and blood P was lower (P < 0.01) when birds were fed CTL compared with birds fed PHY. Blood Ca:P ratio was 2.5:1 in CTL versus 1:1 in birds fed PHY. Bone ash was lower (P < 0.001) in birds fed CTL compared with PHY. Liver weights were greater (P < 0.01) in birds fed PHY compared with CTL and when birds were housed in FP compared with BC. Gene expression of liver interleukin-6 was lower (P = 0.09) in birds fed PHY compared with those fed CTL and when birds were housed in FP compared with BC. These results indicate that broiler growth performance response to phytase supplementation is dependent upon housing environment. Furthermore, both phytase addition to the diet and housing environment affected broiler behavior and physiological responses measured in this study.

Key Words: phosphorus, behavior, phytase, housing, gene expression

108 In vivo efficacy of an evolved Escherichia coli phytase versus a Citrobacter braakii phytase in broilers from 1 to 21 days of age. G. A. Gomes*1, T. T. Santos1, C. L. Walk1, V. Ribeiro Jr.2, G. B. S. Pessoa2, H. S. Rostagno2, and L. F. T. Albino2, 1AB Vista Feed Ingredients, Marlborough, Wiltshire, United Kingdom. 2Universidade Federal de Viçosa, Viçosa, MG, Brazil.

The main goal of phytases is to replace P sources in poultry feed by improving P availability of vegetable sources and reducing P excretion and feed costs. Suppliers have been working to improve enzymological characteristics, making phytases more efficacious in displacing P sources. The objective of this study was to test 2 commercially available phytases (genetically modified Escherichia coli [EC] and a synthetically created phytase mimicking a Citrobacter braakii [CB]) on in vivo efficacy. 1,680 Cobb 500 male broilers were randomly allotted to 8 experimental diets with 10 replicates of 21 birds each. Diets were fed in mash form, and formulated to contain 3,050 kcal/kg AMEn, 220 g/kg CP, 12.2 g/kg of digestible lysine, 9.0 g/kg Ca. Four of these diets were formulated to contain graded levels of avP (4.5, 3.6, 2.7 and 1.8 g/kg) with intermediate levels of avP obtained by mixing the highest and lowest avP diets in appropriate proportions. Both phytases were dosed at 500 and 1,000 U/kg on top of the lowest avP diet, and feed was analyzed to assure the proper dosage prior the commencement of the trial. Birds had ad libitum access to feed and water. Performance was measured and at the end of the trial the left tibia was collected to measure fat free bone weight (TW) and bone ash (AW) content (4 birds per rep). Data was analyzed by ANOVA, means compared using t-test, and a log regression performed to determine the P equivalency of both phytases. Log
regressions confirmed that P was limiting broiler performance since R² varied between 0.95 and 0.98. Significant differences (P < 0.01) were detected in BWG, FI, FCR, TW and AW. EC phytase resulted in 14, 9, 6, 20 and 38% better BWG, FI, FCR, TW and AW, respectively. Using the average of BWG, FI, TW and AW of log regressions it was seen that EC phytase showed a P equivalency of 0.14% and 0.21% for 500 and 1,000 U/kg, while CB showed 0.08% and 0.12%, respectively. Both phytases were efficacious on hydrolyzing Phytate P, however EC phytase was on average 80% more efficacious at the same dosage when compared with CB phytase.

Key Words: tibia-ash, performance, phytase, broiler, 6-phytase

109 Evaluation of a Citrobacter braakii phytase and inorganic phosphate sources in the diets of broiler chickens. F. N. Frust, N. E. Ward, and O. Adeola. DSM Nutritional Products, Kaiseraugst, Switzerland. DSM Nutritional Products Inc., Parsippany, NJ. Department of Animal Sciences, Purdue University, West Lafayette, IN.

Two 21-d studies were conducted with broilers to evaluate the efficacy of a bacterial 6-phytase from C. braakii and compare 3 inorganic phosphate (Pi) sources commonly used in diets. The 3 sources were phosphates of monocalcium (MCP), dicalcium (DCP), tricalcium (TCP). In each study, 384 4-d-old male birds (Ross 708) were blocked based on initial BW and randomly allotted 8 diets with 6 replicate cages of 8 birds each. Access to experimental diets and water from d 4 to d 25 post-hatch was free. In the 1st study, the 8 diets were: 1) a low-P negative control (NC) corn-soybean meal basal diet formulated to contain CP, Ca, total P, and non-phytate P (nPP) at 218, 9.0, 4.5, and 2.0 g/kg, respectively; 2) NC plus 0.75 g Pi from KH₂PO₄/kg; 3) NC plus 1.5 g Pi from KH₂PO₄/kg; 4) NC plus 0.75 g Pi from MCP/kg; 5) NC plus 0.75 g Pi from DCP/kg; 6) NC plus 0.75 g Pi from TCP/kg; 7) NC plus phytase at 500 FYT/kg; 8) NC plus phytase at 1,000 FYT/kg. Feeding the low-P NC diet reduced (P < 0.01) BWG, FI, and tibia ash. Supplementing the NC with Pi or phytase linearly improved (P < 0.01) BWG, FI, and tibia ash. Supplementing the NC with 0.75 g/kg Pi from MCP, DCP, or TCP were equipotent in improving BWG and FI, however, percent tibia ash was higher (P < 0.05) in birds fed MCP than either DCP or TCP. The 2nd study was similar to the 1st except that Ca, total P, and nPP in the NC were reduced to 7.0, 4.2, and 1.8 g/kg, respectively; and Pi from MCP, DCP, and TCP were reduced to 0.6 g/kg. Similar to observations in the first study, the low-P NC diet reduced (P < 0.01) BWG, FI, and tibia ash; and supplementing the NC with Pi or phytase linearly improved (P < 0.01) BWG, FI, and tibia ash. Furthermore, supplementing the NC with 0.75 g Pi from MCP, DCP, or TCP per kg diet were equipotent in improving BWG, FI, and tibia ash. Results from both studies showed that the phytase was efficacious in releasing phytate P for growth and bone mineralization in chickens compensating, at least, the spared Pi, and that Pi sources commonly used in formulating diets of chickens may be different in their potential to supply P.

Key Words: broiler chicken, bone ash, phosphate source, phosphorus, phytase

110 Effects of inositol or phytase, alone or in combination, in diets deficient, adequate or in excess of dietary phosphate. M. R. Bedford and S. V. Rama Rao. AB Vista Feed Ingredients Ltd., Marlborough, United Kingdom. Project Directorate on Poultry, Rajendranagar, Hyderabad, India.

This objective of study was to determine if inositol production from phytase when high levels of phosphate are used explains the extra-phosphoric effects of phytase. 2700 commercial broilers were randomly allocated to 12 diets with 9 pens per diet and 25 birds per pen, and fed from day of age to 42d of age in a 2 phase feeding program (0–21, 22–42d). The diets were corn-soy based and supplied all nutrients at or above requirements levels, with the exception of phosphorus which was supplied at requirement level (0.48% and 0.38% avP in the starter and grower respectively), in excess (+0.12% avP) or in deficiency (−0.16% avP) with Ca levels held constant at 0.98% and 0.78% in the starter and grower respectively. Into each of these 3 dietary phosphorus regimens, Quantum Blue phytase was added at 0 or 1500 FTU/kg feed in factorial combination with inositol at 0 or 3 kg/tonne. Feed and water were available on an ad libitum basis. Birds were weighed and feed intake recorded and FCR calculated on a weekly basis. Data were analyzed by ANOVA using JMP ver 10. An ANOVA was conducted and a full factorial model investigating the main effects and interactions between nutrient density, phytase level and inositol level was employed. Where significant, means were separated by t-tests with α set at 0.05. There were no interactions. Differences in weight gain and intake were noted between the deficient and adequate P diets as early as 2 weeks of age and continued to the end of the trial, with only the phytase restoring performance. No differences in gain and intake were noted between the adequate and excess P diets. FCR was optimized in the deficient P + inositol diet during wk 1 compared with all other diets but this effect was quickly lost and from 3 weeks of age onwards FCR was improved by both inositol but moreso phytase addition, regardless of P level, with no further benefit noted on their combination. These data suggest that high dosages of phytase can improve FCR but not gain of birds fed P adequate diets, supporting the extra-phosphoric effect hypothesis. It also suggests that inositol provision is possibly part of this extra-phosphoric effect.

Key Words: phytase, inositol, extra-phosphoric effect


An experiment was conducted to determine relative bioavailability values (RBV) of calcium (Ca) in canola meal-based diets in the absence or presence of phytase. Two hundred and 10 male broiler chicks (Ross 308 genetics) were housed in battery cages (5 chicks/cage) and provided experimental diets from 2 to 16 post-hatch. Seven dietary treatments (6 replicate cages/diet) consisted of graded Ca concentrations (0.08, 0.16, or 0.24%) and phytase inclusion (0 or 1500 FTU/kg of diet; Quantum Blue, AB Vista, Marlborough, UK) in a 3 × 2 factorial design, plus a Ca-free diet (0.01% Ca) without phytase. All diets contained soy protein isolate and graded Ca concentrations were provided solely by canola meal in Ca-containing diets; the Ca-free diet replaced canola meal with corn. All diets were formulated to contain 0.30% available phosphorus (P). Excreta were collected from d 14 to 16 post-hatch. Tibias were extracted at d 16 post-hatch for determination of bone measurements (length, height, and width), fracturability (using reference force indentation methodology; BioDent, Santa Barbara, CA), bone breaking strength, and mineral content (bone ash, and Ca and P concentration in bone ash). Chick weight and feed disappearance were recorded weekly to calculate growth performance. Body weight gain (P < 0.001), bone length (P < 0.001), and total tibia ash (P < 0.001) increased linearly with increasing Ca concentration. Responses in body weight gain (d 2 to 9 post-hatch) and bone length to increasing dietary Ca concentration resulted RBV of 109.4% and 106.6%, respectively, due to phytase inclusion. Over the entire experimental period, a RBV of 102.6% was observed for body weight gain due to graded dietary Ca in the presence of phytase. Using
total tibia ash as the response variable, a RBV of 113.6% was determined for inclusion of phytase. In conclusion, the presence of phytase improved bioavailability of Ca in broilers fed canola meal-based diets.

**Key Words:** calcium, broiler, bioavailability, canola meal, ash

112  Efficacy of elevated levels of a *Citrobacter braakii* phytase in turkey poult diets. E. Esteve-Garcia¹, J. Broz², F. Fru³, and N. E. Ward*, ¹Department of Animal Nutrition, IRTA, Centre Mas de Bover, Constanti, Spain, ²Animal Nutrition and Health R&D, DSM Nutritional Products Ltd., Basel, Switzerland, ³Technical Marketing Development, DSM Nutritional Products Inc., Parsippany NJ.

The efficacy of elevated levels of Ronozyme HiPhos was assessed for turkey poult fed a low-P corn/SBM-based diet with an estimated 0.25% phytate. 180 d-old female turkeys (BUT 9) were divided into 60 replicate groups of 3 poults to equalize weights. Dietary treatments included a negative control (NC) with 0.27% non-phytate P. Treatments 2, 3 and 4, resp., were composed of the NC with 1,000, 2,000, or 4,000 FYT/kg feed of a *Citrobacter braakii* bacterial 6-phytase (Ronozyme HiPhos) expressed in *Aspergillus oryzae*. Treatment 5 was a positive control (PC) without phytase but with 0.10% additional non-phytate P as dicalcium phosphate. Ca was formulated to be 1.2% across diets. Chemical analyses confirmed several nutritional targets, including total P, Ca and phytase. Each treatment was replicated 12 times in a completely randomized block design. The 21-d live performance, bone mineralization, and blood concentration were ascertained, and 25-d apparent retention of Ca and P gauged phytase efficacy. As dietary phytase increased, tibia ash and body weight increased ($P < 0.05$) linearly, while F/G, Ca and P retention increased ($P < 0.05$) curvilinearly. Blood P and Ca mirrored retention measurements. Poults fed 2,000 and 4,000 FYT phytase/kg feed experienced significantly higher tibia ash and Ca and P retentions than PC. The 4,000 FYT phytase/kg improved ($P < 0.05$) body weight, F/G and tibia ash relative to PC. Elevated dietary phytase levels – sometimes called super doses – of Ronozyme HiPhos boosted live performance and measurements of mineral nutrition in turkey poults.

**Table 1.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Phytase, FYT/kg feed</th>
<th>BW, g</th>
<th>F/G</th>
<th>Tibia ash, %</th>
<th>Ca retention, %</th>
<th>P retention, %</th>
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<tbody>
<tr>
<td>T1 (NC)</td>
<td>0</td>
<td>368c</td>
<td>1.709a</td>
<td>37.2d</td>
<td>56.4bc</td>
<td>58.2c</td>
</tr>
<tr>
<td>T2</td>
<td>NC + 1,000</td>
<td>464b</td>
<td>1.485bc</td>
<td>44.6c</td>
<td>59.1ab</td>
<td>72.8b</td>
</tr>
<tr>
<td>T3</td>
<td>NC + 2,000</td>
<td>458b</td>
<td>1.492bc</td>
<td>47.7b</td>
<td>62.8a</td>
<td>76.2ab</td>
</tr>
<tr>
<td>T4</td>
<td>NC + 4,000</td>
<td>515a</td>
<td>1.419a</td>
<td>49.8ab</td>
<td>64.2a</td>
<td>78.7a</td>
</tr>
<tr>
<td>T5 (PC)</td>
<td>0</td>
<td>438b</td>
<td>1.541b</td>
<td>43.8c</td>
<td>55.4c</td>
<td>60.7c</td>
</tr>
</tbody>
</table>

*a–dDifferent superscripts within a column differ ($P < 0.05$).

**Key Words:** phytase, elevated level, poult, phytate