An experiment was conducted to investigate the effects of Zn, Cu, and Mn sources [sulfates vs. metal methionine hydroxy analog chelates (Mintrex)] on eggshell breaking strength and tibia minerals deposition in laying hens. A total of 1050 35-36 wk old hens were randomly divided into 7 treatments by egg production with 10 replicates of 3 cages each (5 birds per cage). The treatments consisted of: 0-0-0 ppm supplemental Zn-Cu-Mn, T1; 20-4-15 ppm (T2), 40-8-30 ppm (T3), and 80-16-60 ppm (T4) of Zn-Cu-Mn as sulfates; 20-4-15 ppm (T5), 40-8-30 ppm (T6), and 80-16-60 ppm (T7) of Zn-Cu-Mn as chelates. The data were analyzed using 1-way ANOVA. All hens were fed the basal diet for 4 wks as depletion period, and then the experimental diet for 12 wk (experimental period). Overall results indicated a significant treatment effect (P < 0.05) for eggshell breaking strength, and tibia Zn. Hens fed 20-4-15 ppm of chelated trace minerals had higher (P < 0.05) breaking strength compared with hens fed sulfates at similar levels and were comparable to (P > 0.05) hens fed sulfates at 80-16-60 ppm of Zn-Cu-Mn. The highest tibia Zn concentration was observed in hens fed diets containing 40-8-30 ppm Zn-Cu-Mn (T6) and was significantly better compared with all other treatment groups (P < 0.05). Tibia Zn in hens fed 20 ppm of chelated Zn (T5, 20-4-15 of Zn-Cu-Mn) was comparable to 40 and 80 ppm of Zn as sulfates. In summary, the results indicated that the supplemental chelated trace minerals would allow reduction of dietary levels of trace minerals from 20-4-15 to 40-8-30 ppm of Zn-Cu-Mn, respectively, compared with 80-16-60 ppm of Zn-Cu-Mn as sulfates depending on the variable (egg shell breaking strength or tibia trace mineral concentration).

Key Words: chelated minerals, laying hen, breaking strength

Comparison of dl-selenomethionine with other sources of selenium on performance, glutathione peroxidase activity and tissue selenium concentration in young broilers. F. Yan*, B. Wuel­ling, and M. Vazquez-Anon, Novus International Inc., St. Charles, MO.

A battery study was conducted to evaluate the effect of different sources of selenium (Se) on growth performance, glutathione peroxidase (GPx) activity and tissue Se deposition of young broilers. A semi-purified diet containing corn starch, dextrose, and torula yeast was formulated to meet requirement of broilers for all nutrients except Se. The Se level was formulated to be 0.11 ppm but analyzed to be 0.23 ppm. The study consisted of 9 treatments - negative control with no added Se; 0.30 ppm added Se provided by sodium selenite (SS), dl-selenomethionine (dl-SeMet; Mintrex Se, Novus International, Inc.); 2 commercial selenized yeast products, methylselenocysteine (MeSeCys), or combination of SS and SeMet with each providing 0.15 ppm added Se; and 0.15 ppm added Se from SS or dl-SeMet. Each of the 9 test diets was fed to 8 replicate pens of 8 male broilers. Body weight, FCR, feed intake, and mortality were measured on d 6, 13, 20 and 27. Plasma and liver GPx activity was determined on d 7, 14, 21, and 28. Liver and breast Se concentration was analyzed on d 28. On d 35, breast muscle, liver, kidney, and skin/fat samples were taken for Se determination. Data were subject to one-way ANOVA with statements of significance based on P < 0.05. Despite the use of a semi-purified diet, growth performance of the birds was close to breeder’s objectives guideline. Growth performance and GPx activity were not significantly affected by dietary treatments throughout the trial. On d 28, dl-SeMet increased the concentration of Se in both liver and breast whereas selenized yeast, MeSeCys, and SS significantly increased liver Se concentration only. On d 35, breast muscle, liver, kidney, and skin/fat Se concentration was increased significantly only by dl-SeMet. In summary, dl-SeMet was more available for deposition in liver, breast muscle, kidney, and skin/fat than selenized yeast, SS, or MeSeCys when added to provide 0.15 or 0.30 ppm Se in young broiler diets.

Key Words: broiler, selenomethionine, selenized yeast, sodium selenite

Criteria of response and Ca concentration affect estimates of phytase equivalence to monocalcium phosphate. W. Li*, R. Angel1, M. Proszkowiec-Weglarz1, S.-W. Kim1, E. Jiménez-Moreno1, and P. W. Plumstead2, 1University of Maryland, College Park, MD, 2Danisco Animal Nutrition, DuPont Industrial Biosciences, Marlborough, United Kingdom.

Differences exist in the methodology used to estimate the amount of inorganic P that can be replaced by phytase. Traditionally, phytase efficacy has been assessed by regressing graded concentrations of inorganic P added to a P-deficient diet and determining the amount of added phytase required to give the equivalent response. The objective of this study was to assess if the criteria of response used (Tibia ash or ileal P digestibility), or dietary Ca level, affected estimates of the amount of inorganic P that can be replaced by phytase. Eight experimental diets were fed to 780 Ross 708 broilers from 11 to 21 d of age (8/pen, 10 pens/diet). Diets A-C contained 0.7% Ca, with 0.0, 0.08 and 0.19% added P from MCP in diets A-C, respectively. Diets F-H contained the same nPP as diets A-C but with 0.8% Ca. A 6-phytase from Butiauxella spp. was added at 2 doses to the same basal diet as A to create diets D and E. At 21 d, the distal ileal content was collected for apparent P digestibility determinations, and right tibia from all birds collected to determine bone ash. Ileal P digestibility was 37.0% to 39.5% in diet A and F with a reduced response in P digestibility to incremental amounts of added P from MCP when Ca was increased from 0.7 to 0.8% (P < 0.05). The response in tibia ash to added MCP was not affected by diet Ca. P digestibility was respectively increased (P < 0.05) to 48.1% and 49.9% for diet A plus 108, and 190 FTU analyzed phytase/kg feed. Regressing tibia ash to added MCP resulted in P equivalency from 190 FTU phytase of 0.75 g/kg total P from MCP. When P equivalence of phytase was calculated based on the change in ileal digested P in diets with or without 190 FTU phytase, this was 0.52 g and 0.41 g digestible P/kg at 0.7% and 0.8% Ca, respectively. Method of calculation and Ca concentrations have a profound impact on phytase efficacy values determined.

Key Words: phytase efficacy, calcium concentration, methodology, broiler

The effect of available phosphorus on calcium appetite in broil­ers. S. J. Wilkinson*1, E. J. Bradbury1, M.R. Bedford2, and A. J. Cowie­son1, 1University of Sydney, Poultry Research Foundation, Camden, NSW, Australia, 2AB Vista Feed Ingredients, Marlborough, United Kingdom.

The majority of phosphorus (P) in corn-soy poultry diets is bound to phytate and due to poor solubility in the small intestine is poorly

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digested by broilers. The poor intestinal solubility of phytate is associated predominately with relatively high lumen cation concentrations (notably calcium; Ca). It has recently been reported that providing a diet with a low Ca concentration concurrent with a separate source of Ca can increase phytate-P availability, improving bird performance. The objective of this study was to evaluate the effect of available P (avP) on the Ca specific appetite of broilers, bird performance and nutrient digestibility. Seven-day old Ross 308 male broilers were randomly allocated to 8 treatment groups (6 birds per cage and 6 replicate cages per treatment) in a 2 × 4 factorial design that included 2 Ca (5.0 g/kg) and 4 available P (2.5, 3.5, 4.5 and 5.5 g/kg) concentrations. All groups were offered a separate source of Ca (as limestone) in a second feeder. Daily feed intake, separate Ca source intake and weekly body weight were recorded. Ileal digesta and right tibias were collected from all birds on d35 and pooled for each replicate. Feeding birds diets with 2.5 g/kg avP resulted in reduced feed intake when compared with the other groups (P < 0.05). Increasing avP concentration from 2.5 to 5.5 g/kg resulted in a commensurate rise in Ca intake (P < 0.05). Birds fed 5.0 g/kg Ca consumed more of the separate Ca source and total Ca than those fed 10.0 g/kg Ca diets (P < 0.05). There was no effect of diet on body weight gain and feed efficiency. Feeding birds diets with 10.0 g/kg Ca reduced the apparent ileal digestibility of P (P < 0.05) but was improved with increasing avP concentration (P < 0.05). Tibia ash was significantly increased in birds fed 10 g/kg Ca diets and was reduced in birds fed 2.5 g/kg avP compared with birds from the higher avP groups. These data demonstrate that both dietary Ca and avP concentrations influence the Ca specific appetite of broilers and that birds did not appear to converge on a similar digestible Ca to digestible P ratio.

Key Words: calcium, phosphorus, digestibility, broiler

140 Effect of 25-hydroxycholecalciferol on growth performance, bone growth and mineralization, and mineral utilization of broiler chicks fed low dietary Ca and P. H. M. Salim*1,2, M. Radfar1, R. Adhikari1, A. Rogiewicz1, B. J. Turner3, B. Slominski1, and W. K. Kim1, 1Department of Animal Science, University of Manitoba, Winnipeg, MB, Canada, 2Department of Livestock Services, Khamar Bari, Dhaka, Bangladesh, 3Animal Nutrition & Health-North America, DSM Nutritional Products Inc., Parsippany, NJ.

25-Hydroxycholecalciferol (25-OH-D3) is a metabolite of vitamin D3 which is required by the chicken for proper Ca and P metabolism and bone development. An experiment was conducted to investigate the effect of 25-OH-D3 on growth performance, bone growth and mineralization, and apparent mineral utilization of broiler chicks fed low dietary Ca and P. A total of 250 1-d-old male broiler chicks were randomly allotted to 5 dietary treatments with 10 replicate battery cages per treatment (5 birds/pair). Five dietary treatments were: a corn-soybean meal based diet with adequate Ca and available P (avP) (1% and 0.5%) plus 200 IU/kg 25-OH-D3 as positive control (PC); low Ca and avP (0.5% and 0.25%) plus 25-OH-D3 200 IU/kg as negative control (NC); low Ca and avP plus 2,760 IU/kg 25-OH-D3 (T1); low Ca and avP plus 5,000 IU/kg 25-OH-D3 (T2); and low Ca and avP plus 10,000 IU/kg 25-OH-D3 (T3). Results showed that body weight gain was significantly (P < 0.05) increased in PC, T1 and T2 groups compared with NC and T3 groups, but feed intake was significantly lower in NC than PC and T2 groups of broiler chicks. In addition, feed conversion was significantly (P < 0.05) improved in NC and T1 than PC; however, dietary supplementation of 25-OH-D3 did not affect livability of broiler chicks. The bone mineral density (BMD) and the bone mineral content (BMC) from both femur and tibia of broiler chicks were significantly (P < 0.05) higher in PC, T2 and T3 compared with NC and T1 treatments; however, bone area from both femur and tibia of broiler chicks was significantly improved in only T2 among the treatment groups. The apparent Ca utilization was significantly lower in PC compared with NC, T2 and T3, but a significant (P < 0.05) improvement of apparent P utilization was found in T1, T2 and T3 groups compared with NC and PC. It is concluded that dietary supplementation of 25-OH-D3 improves growth performance, BMD, BMC and area of the bone, and apparent mineral utilization of broiler chicks fed low Ca and P.

Key Words: 25-hydroxycholecalciferol, performance, bone mineralization, Ca and P utilization, broiler chick


A study was conducted to examine the effect of different isoforms and levels of vitamin D on mineral utilization, egg quality and bone mineralization in laying hens. A total of 42 Bovan White laying hens at 37 wk of age were randomly assigned to 7 dietary treatments and kept in metabolism cages for 6 weeks. Wheat and soybean based basal diet containing 3,000 IU/kg vitamin D3 as control, basal diet with 3,000 IU/kg 25-OH-D3 (T1), 9,000 IU/kg 25-OH-D3 (T2), 3,000 IU/kg vitamin D3 (T3), 9,000 IU/kg vitamin D2 (T4), 3,000 IU/kg of vitamin D2 (T5) and 9,000 IU/kg of vitamin D3 (T6) were used for the study. Egg production and egg quality parameters [egg weight (EW), specific gravity (SG), shell thickness (ST), and Haugh Unit (HU)] were measured weekly. Fecal samples were collected to measure Ca and P utilization at wk 2 and 6. At the end of wk 6 all birds were sacrificed and the left tibia and femur were collected to measure bone mineral density (BMD), Bone mineral content (BMC) and bone area using dual-energy x-ray absorptiometry. There were no significant differences in BMD, BMC and bone area between the treatments. There were no significant differences in BW, SG, ST and egg production between the treatments. Egg weight from T3 and T5 were higher (P < 0.05) than T6. Feed intake was lower (P < 0.05) in T1 and T6 compared with T3 and T5. Apparent total tract digestibility (ATTD) of Ca was higher (P < 0.05) in T1 and T3 at wk 2 and in T4 at wk 6 whereas control group had lower (P < 0.05) Ca ATTD at both weeks. ATTD of P was higher (P < 0.05) in T5 and T6 at wk 2 and in T5 at wk 6. Calcium utilization increases with increasing levels of vitamin D3 and 25-OH-D3 whereas vitamin D2 increases P utilization in the presence of vitamin D3 in laying hen diet. Ca and P utilization can be improved by increasing the combined isoforms of vitamin D in diets; however, they do not have effects on egg production and egg quality parameters of laying hens.

Key Words: bone mineralization, Ca and P utilization, laying hen, vitamin D