Dietary manipulation early in life has been shown to affect the development of broiler chickens later in life. The goal of this study was to evaluate the effect of feeding a zinc (Zn) deficient diet during the first 96 h post-hatch and dietary supplementation of different levels and sources of Zn on the growth performance, tissue and excreta Zn content using a RCB with a 2 × 5 factorial arrangements of treatments. Four hundred twenty (1 d old) male broiler chickens were divided into 2 groups. One group was fed a corn-soybean basal diet containing 25 mg of Zn/kg. The second group was fed the basal diet supplemented with 40 mg of Zn/kg. Both diets were fed for 96 h. At d 5, chicks from each group were randomly assigned to the dietary treatments consisting of the basal diet alone or the basal diet supplemented with 8 or 40 mg/kg Zn as zinc oxide or Zn proteinate. There were no significant interactive effects between 2 factors. Early Zn imprinting decreased (P < 0.05) feed intake and increased (P < 0.05) gain to feed ratio in 21 d growing period. Chicks fed low Zn diet in first 96 h had lower (P < 0.05) Zn content in the tibia ash and excreta samples and higher (P < 0.05) Zn content in the pancreas tissue compared with those fed diets containing recommended level of Zn. Chicks fed the diet supplemented with 8 mg of Zn as Bioplex Zn had higher (P < 0.01) Zn content in tibia ash compared with chicks fed a diet supplemented with 8 mg of Zn as Zn oxide. Chicks fed a diet supplemented with 40 mg of Zn as Bioplex Zn had higher (P < 0.01) Zn content in the pancreas tissue compared with chicks fed diet supplemented with 40 mg of Zn as Zn oxide. Results from this study suggested that Zn imprinting in the early life of chicks may increase Zn absorption permanently and the bioavailability of Bioplex Zn is higher than that of Zn oxide based on tissue Zn concentrations.

Key Words: imprinting, excreta, proteinate, bioavailability, zinc

Metabolism and Nutrition—Vitamins and Minerals

Effects of early imprinting and replacing inorganic Zn with different levels of Zn proteinate in broiler diets on growth performance and tissue zinc status of broiler chicks. S. Mwangi*1, T. Ao2, J. Timmons1, M. Paul2, L. Macalintal2, A. Pescatore2, A. Cantor2, and M. Ford2, 1University of Maryland Eastern Shore, Princess Anne, MD, 2Alltech-University of Kentucky Nutrition Research Alliance, Lexington, KY.

The minerals in organic form are molecules of high bioavailability with better utilization by birds in relation to inorganic sources. The purpose of this study was to evaluate the use of different levels of organic minerals copper (Cu), iron (Fe), manganese (Mn), selenium (Se), and zinc (Zn) in the diet of broiler chickens on performance and carcass yield in summer season (January to March), with environmental temperature ranged from 17 to 35°C, and relative humidity of the air from 43 to 95%. In total, 1,080 Cobb-500 male chicks were used in a completely randomized design with 6 treatments and 6 replicates of 30 birds each from 1 to 42 d of age. The treatments were as follows: T1: control (inorganic minerals Cu, Fe, Mn, Se, and Zn according to Rostagno et al., 2011), T2: organic minerals, T3: reduction of 1/3 from T2, T4: reduction of 2/3 from T2, T5: increase of 1/3 from T2, and T6: increase of 2/3 from T2. The levels of organic minerals (T2) in the diets were as follows: Pre-starter (Cu 12.5, Fe 62.5, Mn 88.0, Zn 81.3, and Se 0.375 mg/kg), Starter (Cu 11.0, Fe 55.0, Mn 77.0, Zn 71.5, and Se 0.330 mg/kg), Grower (Cu 10.0, Fe 50.0, Mn 70.0, Zn 65.0, and Se 0.300 mg/kg), and Withdrawal (Cu 7.5, Fe 37.5, Mn 53.0, Zn 48.8, and Se 0.225 mg/kg). Performance characteristics evaluated were feed intake (FI), weight gain (WG), body weight (BW), feed conversion (FC) and productive efficiency index (PEI). At 42 d, 20% of the flock were selected for evaluation of carcass yield and commercial cuts: wing, breast, thigh and drumstick. Data were analyzed by ANOVA using Proc GLM of SAS (2004). The comparison among treatments was performed by regression and between the sources of minerals (organic and inorganic) was used contrast. For performance characteristics, only the FI showed a positive quadratic effect (y = 249.24x^2 − 543.27x + 4541.2; P < 0.05), with lower consumption for the treatment T2. There was no difference among diets for carcass yield and commercial cuts. Organic minerals can be used at lower levels than current recommendations for inorganic minerals without affecting the performance and carcass yield of broilers in summer season.

Key Words: bird, microelements, mineral availability, nutrition, season

Comparisons of selenium sources and time of supplementation on performance, lipid peroxides, and tissue selenium concentration in broilers. A. G. Bertechini1, B. R. F. Nogueira1, H. Mazzuco2, and H. V. Ribeiro2, 1Federal University of Lavras, Lavras, MG, Brazil, 2EMBRAPA, Concordia, SC, Brazil.

Scientific research confirm that yeast selenium (Y-Se) increase tissue Se deposition and enhance meat quality however, the limitation for the use of this source is it prohibitive cost, 20 times more expensive than the inorganic source, sodium selenite (S-Se – 45.6% of Se) commonly used in animal feeds. In the present study, Y-Se (2,000 ppm of Se) was used in combination or not with S-Se in a corn-soybean meal diet (0.095 ppm of analyzed Se). A total of 1,200 broilers (Ross 308) were randomly allocated to 6 treatment groups (8 replicate/25 birds). The treatments were different periods of birds age Se supplementation (0.300 ppm) of inorganic and or organic source: S-Se (1–42 d), Y-Se (1–42 d), S-Se (1–14d) + Y-Se (15–42 d), S-Se (1–21 d) + Y-Se (22–42 d), S-Se (1–28 d) + Y-Se (29–42 d), S-Se (1–35 d) + Y-Se (36–42 d). Liver and breast Se concentration, tissue chemical composition, breast TB-reactive substances (TBARS) and carcass yield were obtained from 2 birds/experimental unit at 42 d of age. Data were subject to ANOVA and significant differences among treatment means obtained by Tukey test at P < 0.05. No differences (P > 0.05) in growth performance and yield, hepatic Se concentration, meat quality attributes such as visual color quality of breast muscle, pH, water holding capacity and muscle shear force. Breast muscle Se content was 1.067 mg/kg (weight basis) in the treatment where Y-Se supplemented the broiler diets during the last 7 d of the experimental period, and not different (P > 0.05) of a deposition of 1.130 mg/kg (weight basis) when Y-Se was used during 1–42 d. Lower breast muscle Se concentration (0.693 mg/kg, P < 0.01) was observed in the treatment where S-Se supplemented the diets during the entire experimental period (1–42 d). These results show that there is no need to include Y-Se from day one to achieve significant Se contents in breast meat besides to reduce the feed cost.

Key Words: breast yield, feed cost, TBARS

Comparison of selenium sources and time of supplementation on performance, lipid peroxides, and tissue selenium concentration in broilers. V. A. Silva1, A. G. Bertechini1, B. R. F. Nogueira1, H. Mazzuco2, and H. V. Ribeiro2, 1Federal University of Lavras, Lavras, MG, Brazil, 2EMBRAPA, Concordia, SC, Brazil.

The results showed a positive quadratic effect (y = 249.24x^2 − 543.27x + 4541.2; P < 0.05), with lower consumption for the treatment T2. There were no significant interactive effects between 2 factors. Early Zn imprinting decreased (P < 0.05) gain to feed ratio in 21 d growing period. Chicks fed low Zn diet in first 96 h had lower (P < 0.05) Zn content in the tibia ash and excreta samples and higher (P < 0.05) Zn content in the pancreas tissue compared with those fed diets containing recommended level of Zn. Chicks fed the diet supplemented with 8 mg of Zn as Bioplex Zn had higher (P < 0.01) Zn content in tibia ash compared with chicks fed a diet supplemented with 8 mg of Zn as Zn oxide. Chicks fed a diet supplemented with 40 mg of Zn as Bioplex Zn had higher (P < 0.01) Zn content in the pancreas tissue compared with chicks fed diet supplemented with 40 mg of Zn as Zn oxide. Results from this study suggested that Zn imprinting in the early life of chicks may increase Zn absorption permanently and the bioavailability of Bioplex Zn is higher than that of Zn oxide based on tissue Zn concentrations.

Key Words: imprinting, excreta, proteinate, bioavailability, zinc...

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462P  Effect of dietary nonphytate phosphorus (nPP), calcium (Ca), and phytase use in broilers to 44 d of age: Performance. E. F. Cardoso*,1, R. Angel2, W. Li2, S.-W. Kim2, J. R. Timmons3, and N. E. Ward4, 1Department of Animal Science, University Federal de Viçosa, Viçosa, MG, Brazil, 2Department of Animal Science, University of Maryland, College Park, MD, 3Department of Agriculture, Food & Resource Science, University of Maryland Eastern Shore, Princess Anne, MD, 4DSM Nutritional Products, Parsippany, NJ.

Several studies have been done at the University of Maryland to determine Ca and nPP requirements. The current trial was done to test these requirements, with or without phytase, in floor pens. Broilers were allocated at hatch (H) and fed one of 7 treatments (Trt) (51 b/pen; 8 pens/Trt) in a 4 phase feeding program (H-10, 11–18, 19–31, and 32–44d of age). Trts were: 1. PC, Positive control: Ca/nPP of [1.00/0.48, 1.00/0.48, 0.85/0.40, and 0.80/0.37%], 2. BWG, Ca/nPP to maximize BWG [1.05/0.55, 0.85/0.38, 0.65/0.27, and 0.55/0.22%], 3. Bone, Ca/nPP to maximize bone ash from H-18d and BWG from 19 to 44d [1.10/0.63, 0.95/0.42, 0.65/0.27, and 0.55/0.22%], 4. NC, Negative control as Trt 3 minus 0.19% Ca and nPP, 5, 6, and 7 were NC + 1000, 2000, 3000 FYT Ronozyme HiPhos/kg, respectively. Data were analyzed as completely randomized block design using JMP GLM procedure with regressions run on NC and phytase Trt. Trt means were separated by Tukey’s test when model was significant (P < 0.05). At 44d, the birds fed NC Trt had lower (P < 0.05) TA (mg/g BW) vs. those fed the PC Trt (1.006 and 1.284 mg/g BW, respectively). Birds fed Trts 2, 3, 5, 6, and 7 had lower (P < 0.05) TA vs. those fed the PC Trt and greater (P < 0.05) TA than those fed the NC Trt. No differences were seen between TA of birds fed phytase Trts. Birds fed to bone needs until 18d, then to BWG needs until 44d (Trt 3) had similar (P < 0.05) TA as compared with those fed the BWG Trt (Trt 2), suggesting that feeding higher concentrations of Ca and nPP from H-18d may not be necessary. This needs to be confirmed in a processing study with greater sampling.

Key Words: calcium, phosphorus, bones, phytase

464P  Effect of dietary supplementation with vitamin C and soybean and sunflower oils in performance and quality of eggs of European quails (Coturnix coturnix coturnix). C. G. Q. Roriz1, F. L. Silva1, L. S. Fonseca1, L. H. N. Ribeiro1, C. A. Silva Junior1, J. B. Lopes2, and L. S. Murata*1, 1University of Brasilia, Brasilia, Federal District, Brazil, 2Federal University of Teresina, Teresina, Piauí, Brazil.

The aim of this study was to evaluate the performance and egg quality of European quails (Coturnix coturnix coturnix) fed diet with soybean or sunflower oil supplemented with vitamin C. The experimental period was of 70 d (d), divided into 5 cycles of 14 d each. The average maximum and minimum temperatures were 24 and 20°C, respectively. Two hundred and forty quails averaging 115 d of age were distributed in a completely randomized design in a 2 x 4 factorial arrangement with 2 oil sources (soybean and sunflower) and 4 levels of vitamin C (0, 100, 200, and 400 ppm), with 6 replicates per treatment with 5 quails each. At the end of each cycle data was collected from feed intake (FI) (g/hen/d), egg production (%), feed conversion (FC) (kg feed/kg egg). On the same day, 3 eggs of each repetition were collected for analyzes of egg weight (g) and relative weight of yolk, albumen and shell (%). This data was analyzed through the SAS using the PROG GLM. Sunflower oil showed significant effects (P < 0.05) in FI and FC, which was better than soybean oil. However, different oils sources showed no differences (P > 0.05) in other parameters studied. No significant differences (P > 0.05) were identified in any of the studied variables when diets were supplemented with different levels of vitamin C, it is suggested that the results obtained are due to the mild temperatures during the experimental period. Sunflower oil can improve important performance traits of European quails. Further studies with vitamin C in conditions of heat stress are hence suggested.

Key Words: ascorbic acid, egg production, feed conversion, polyunsaturated fatty acids, vegetal oil
oil; OxCAN) as an oxidative challenge or virgin canola oil (CAN). Egg traits were recorded at 31 and 39 wk of age. Eggs from 41 and 43 wk of age were incubated to determine chick quality and early growth traits. Embryo growth at 5, 10, and 15 d of incubation was measured in eggs from 42 and 44 wk of age. Egg production, egg weight, egg composition, embryo weight, progeny BW and FCR data were analyzed as a 2-way ANOVA. Egg composition, chick BW and chick length were analyzed by 2-way ANCOVA, with egg weight as a covariate. Egg production, egg, yolk, and albumen weight, albumen height, and egg specific gravity were not affected by maternal dietary oil or antioxidant treatment. Feeding hens CAN increased egg weight by 2.4% compared with that of hens fed OxCAN (P < 0.0001). Neither dietary oil nor antioxidant treatment affected embryo weight at 5, 10 and 15 d of incubation once egg weight was accounted for with covariate analysis. Dietary oil and antioxidant treatments did not affect chick activity or hock, beak, or navel condition at hatch. The CV of chick BW was 9.6 in EE chicks compared with a mean of 12.6 in CON and E+SEL chicks. Covariate analysis indicated that chick weight was affected by dietary antioxidants at 41 and 43 wk, and by dietary oil at 43 wk. The EE diet hens had 1.2 g heavier chicks than those of CON hens at 41 wk of age (P = 0.02). At 43 wk of age, chicks from EE hens were 2.2% g heavier, on average, than chicks CON or E+SEL hens (P = 0.001). Chick BW differences persisted to the final measurement at 7 d of age (P = 0.06). The 7 d FCR did not differ among treatments. Maternal EE treatment can increase chick size.

Key Words: broiler breeder, maternal nutrition, vitamin E, EconomassE, chick quality

466P Different metabolites of vitamin D₃ in the diet of broiler chicken during the starter phase. A. F. Q. G. Guerra, Guerra, A. E. Murakami,1 P. T. M. Pinto,2 C. Eyng*,2 and C. R. A. Duarte1,1 Universidade Estadual de Maringá, Maringá, Paraná, Brazil,2 Universidade Federal da Grande Dourados, Dourados, Mato Grosso do Sul, Brazil.

Vitamin D is required by the chicken for calcium and phosphorus metabolism and bone development. To be useful to body, vitamin D₃ ingested must be metabolized into 25-hydroxycholecalciferol in the liver and subsequently into its active metabolite 1,25-dihydroxycholecalciferol [1,25(OH)₂D₃] in the kidneys. The aim of this study was to verify the effect of levels of vitamin D₃ and 1,25(OH)₂D₃ on performance, bone quality and serum parameters in the starter phase (1 to 21 d). A total of 1,344 1-d-old male Cobb chicks were used, distributed in a completely randomized factorial design 2 × 4 × 2 (metabolites of vitamin D₃: D₃ and 1,25(OH)₂D₃; and 4 levels: 200, 950, 1,700, and 2,400 IU/kg feed) with 6 replications and 28 birds each. The levels of metabolites of vitamin D₃ were added to the diet in replacement for the inert component. The vitamin supplement contained no vitamin D₃. Diets were based on corn-soybean. Birds and feed were weighed weekly throughout the experimental period to assess performance (weight gain, feed intake and feed:gain). For bone quality (bone resistance, ash, phosphorus and calcium), the left legs were collected at 7 and 21 d, and were collected serum for analyzed calcium and phosphorus at 21 d. All data were analyzed by the GLM and differences among means were separated using a Tukey’s multiple range tests procedure of SAEG. There were no interaction (P > 0.05) between metabolites of vitamin D₃ and levels. There was a quadratic effect (P < 0.05) on the feed intake and weight gain, which was best at 1772.39 and 1760.14 IU, respectively. Among the metabolites, the vitamin D₃ showed better results (P < 0.05) on weight gain at 21 d, compared with 1,25(OH)₂D₃. Vitamin D₃ addition linearly increased (P < 0.05) bone ash at 7 and 21 d, calcium at 7 d, phosphorus at 21 d and serum calcium percentage at 21 d and had a quadratic effect (P < 0.05) on bone resistance at 21 d, which was best in 1586.42 IU. The others parameters were not affected (P > 0.05) by vitamin D₃. The level of vitamin D₃ for better weight gain was 1760.14 IU/kg feed and bone quality was 1586.42 IU/kg feed.

Key Words: bone quality, calcium, calcitriol, cholecalciferol, phosphorous

467P Influence of 25-hydroxy vitamin D₃ source on growth and bone development of young broilers. J. B. Hess*,1 K. S. Macklin1, J. T. Krehling1, and O. Gutierrez2,3 Auburn University, Auburn, AL, 1Huvepharma Inc., Peachtree City, GA.

This trial compared 2 commercially available 25-hydroxy vitamin D₃ (25-OH-D₃) products [(X) BioD, Huvepharma Inc., Peachtree City, GA; (Y) HyD, DSM Nutritional Products, Basel, SUI] when fed to young broiler chickens. Diets were fed to 10 pens of 10 male broiler chicks (Aviagen 708) in Petersime brooder batteries. Each 25-OH-D₃ product was fed at levels of 125, 250, 500, and 1,000 ppm (0.25, 0.5, 1, and 2 lb/ton). The control diet contained 50 IU vit. D₃/Kg (Z). At 21 d of age, birds and feed were weighed for BW and FCR. Five birds per group were euthanized and left tibia were removed for ashing (overnight in a 600°F muffle furnace). Bone ash wt (BA) were determined and analyzed using the GLM procedure of SAS. BW and FCR were analyzed using ANOVA. Egg production, egg weight, egg composition, chick BW and chick length were analyzed by 2-way ANCOVA, with egg weight as a covariate. To evaluate the effect of the injection of vitamin D (cholecalciferol) on hatchability, embryonic mortality (early, mid, or late), weight loss and weight of chicks hatched, an experiment was conducted with 600 fertile eggs (Cobb), from broiler breeder hens at 43 weeks. They were distributed in a completely randomized design with 5 treatments: control (eggs not injected), eggs injected with only 100 µL of olive oil, and eggs injected with 1.2 µg of vitamin D (48 IU)/100 µL of olive oil; 2.4 µg of vitamin D (96 IU)/100 µL of olive oil and 3.6 µg of vitamin D (144 IU)/100 µL olive oil for a total of 120 eggs per treatment. The eggs were weighed individually twice to calculate weight loss once before incubation and another during transfer into the hatchery (d 19 of incubation). On d 8 of incubation, they were injected the different concentrations of D vitamin in the yolk sac and after the injection the hole was closed with a label. At hatch, chicks were weighed individually and the eggs that failed to hatch were recorded to calculate the weight of the chicks and hatchability. Data was analyzed using the General Linear Model (GLM) procedure of SAS. In the case of a significance effect, the comparison of means was performed using 5% probability of Tukey’s test.

Key Words: vitamin D₃, body weight, bone ash


To evaluate the effect of the injection of vitamin D (cholecalciferol) on hatchability, embryonic mortality (early, mid, or late), weight loss and weight of chicks hatched, an experiment was conducted with 600 fertile eggs (Cobb), from broiler breeder hens at 43 weeks. They were distributed in a completely randomized design with 5 treatments: control (eggs not injected), eggs injected with only 100 µL of olive oil, and eggs injected with 1.2 µg of vitamin D (48 IU)/100 µL of olive oil; 2.4 µg of vitamin D (96 IU)/100 µL of olive oil and 3.6 µg of vitamin D (144 IU)/100 µL olive oil for a total of 120 eggs per treatment. The eggs were weighed individually twice to calculate weight loss once before incubation and another during transfer into the hatchery (d 19 of incubation). On d 8 of incubation, they were injected the different concentrations of vitamin D in the yolk sac and after the injection the hole was closed with a label. At hatch, chicks were weighed individually and the eggs that failed to hatch were recorded to calculate the weight of the chicks and hatchability. Data was analyzed using the General Linear Model (GLM) procedure of SAS. In the case of a significance effect, the comparison of means was performed using 5% probability of Tukey’s test.
For hatchability the Chi-squared test analysis was performed. There was significant effect among treatments for mass loss and weight of chicks hatched ($P < 0.05$). Eggs injected with 3.6 $\mu$g of vitamin D (144 IU)/100 $\mu$L olive oil and eggs injected only with 100 mL of olive oil, being 12.786% and 12.139% respectively, showed the highest percentage of weight loss when compared with the control and other treatments. The lower weight of chicken hatch (46,908g) was observed with highest percentage of vitamin D inoculated in ovo (3.6 $\mu$g of vitamin D (144 IU)/100 $\mu$L olive oil). Because the highest concentration (144 IU) of injected vitamin D increased the weight loss of eggs and affected the weight of chicks hatched, it can be concluded that vitamin D injection in fertile eggs during incubation can influence the embryo’s development.

**Key Words:** broiler chicken, in ovo, calciferol, embryonic development, bird