

218 Adsorption in comparison to enzymatic degradation - which is the best method for deactivating mycotoxins in animal feed? G. Schatzmayr^{*1}, D. Schatzmayr¹, S. Nitsch¹, and E. Binder², ¹*Biomin GmbH, Herzogenburg, Austria*, ²*Erber AG, Herzogenburg, Austria*.

In spite of all efforts to prevent formation of mycotoxins significant contaminations still occur. Contaminated grain or feed ingredients may encounter livestock health problems or poor animal performance because they can have chronic and acute effects on animals. By now, the worldwide most applied method to protect animals against mycotoxin-related diseases and to avoid carryover of mycotoxins into animal products is the use of non-nutritive sorbents in the diet which are supposed to tightly bind and immobilize mycotoxins in the gastrointestinal tract, resulting in a major reduction of toxin bio-availability. HSCAS, the most extensively studied adsorbent, was demonstrated to be very effective with regard to preventing aflatoxicosis, however, its efficacy against zearalenone and ochratoxin A was limited and in the case of trichothecenes it was practically zero. The objective of this study was to evaluate binder and a microbio-

logical for detoxification *in vitro* and *in vivo*. The *in vitro* experiments showed that natural binders bound ochratoxin up to 80% at pH 3 whereas the binding at pH 6.5 was very poor. In contrast to that many of the processed binders could deactivate OTA to a very high extend independently from the pH-value. Two of these organoclays were tested separately in experiments with broiler chickens. The addition of ochratoxin A to the diet of broilers led to impaired performance parameters. Surprisingly the application of organoclays further decreased the production efficiency factor (EEF). In contrast to that the use of a OTA-cleaving yeast (Biomin[®]MTV) resulted in an improvement of EEF. The experiments revealed that adsorbents are not useful for deactivating ochratoxin A in animal feed. Organoclays which showed very good binding capabilities *in vitro* did not work in *in vivo* experiments. The reason for this might be the binding of vitamins and other essential nutrients due to an alteration of the binding properties of processed minerals from specific to unspecific binding. In contrast to binders the addition of a new yeast strain (Biomin[®]MTV) to the diet led to a detoxification of ochratoxin A.

Key Words: Mycotoxins, Detoxification, (Biomin[®]MTV)

Nutrition: Vitamins and Minerals

219 Factors affecting bone mineral density of brown and white laying hens. K. L. Nadeau^{*}, C. M. Riczu, and D. R. Korver, *University of Alberta, Edmonton, AB, Canada*.

Lohman Brown (LB) and White (LW) pullets were grown according to breeder guidelines. The birds were housed in individual cages at 18 wk of age, and daily egg production and weekly feed intake were recorded. Bone mineral density (BMD) of the shank was measured by quantitative computed tomography (QCT) at 39, 43, 47, 51, 56, and 59 wk of age. The QCT procedure had no impact on any production trait measured ($P > 0.05$). From 39 to 59 wk, the LB birds had a smaller total BMD, but larger total and trabecular cross-sectional areas. At 59 wk the LB also had a larger cortical area. The LW had a larger cortical BMD from 47 to 59 wk. At all ages, BW was related to total, trabecular, and cortical area ($P < 0.0001$, $r = 0.66$ to 0.82). Larger birds had greater bone cross-sectional area in order to support a larger body weight. All relationships of feed intake and BMD could be explained by differences in BW; larger birds had greater area and feed intake. At 39 wk, total and cortical area, and trabecular density were correlated with feed intake ($P = 0.006$ to 0.05 , $r = 0.26$ to 0.35). At 43 wk, total area and feed intake were related ($P = 0.01$, $r = 0.32$), as well, cortical area was correlated with feed intake ($P = 0.0002$, $r = 0.46$). At 47 wk, cortical area was correlated with feed intake ($P = 0.007$, $r = 0.34$). Much of the variability in BMD of laying hens was due to factors other than feed intake. Between 39 and 51 wk, trabecular area was correlated with total egg production ($P = 0.005$ to 0.02 , $r = 0.30$ to 0.36). At 43 and 47 wk, total area was correlated with shell weight ($P = 0.008$ to 0.04 , $r = 0.27$ to 0.33). Shell weight was also correlated with trabecular area at 43 wk ($P = 0.03$, $r = 0.27$), and cortical area at 43 and 47 wk of age ($P = 0.0006$ to 0.003 , $r = 0.39$ to 0.42). Hens with greater bone areas, and therefore Ca reserves, are more likely to produce large numbers of well-calcified eggs. This study showed the pattern of changes in the relationship among body weight, feed intake, and BMD over time in laying hens. Most differences in the various relationships identified could be explained in terms of the body weight of the birds.

Key Words: Bone mineral density, Laying hens, Egg traits

220 Effect of vitamins A, D and vitamin D metabolites on experimentally-induced tibial dyschondroplasia. N. C. Rath^{*1}, G. R. Huff¹, W. E. Huff¹, R. L. Horst², P. B. Pillai³, and J. L. Emmert³, ¹*USDA, ARS, PPSR, Fayetteville, Arkansas*, ²*USDA, ARS, NADC, Ames, Iowa*, ³*University of Arkansas, Fayetteville*.

Tibial dyschondroplasia (TD) is a disease of growth plate cartilage in fast growing broilers and turkeys where parts of the growth plate fail to form bone leading to bone fragility and lameness. The etiology of naturally occurring TD is not known; therefore, it has not been possible to identify remedies that can prevent

TD. Because experimentally-induced disease models are often useful to screen for the factors with preventive and therapeutic efficacies, we have been interested in employing such a strategy to determine the factors that may protect against TD or reduce its incidence and severity. Vitamin A, D, and vitamin D metabolites are important in skeletogenesis including cartilage morphogenesis, calcification, and eventually bone formation. A study was conducted to determine if broilers maintained with some of these factors may be protected against TD induced by thiram. Two sets of birds (twenty five per group) were fed diets supplemented with or without vitamin A (16,000 IU/kg), vitamin D₃ (4,000 IU/kg), 25(OH)₂ D₃ (HYD, 63 µg/kg), or 1, 25(OH)₂ vitamin D₃ (low 1 µg/kg, high 5 µg/kg) from day of hatch until age d7 when feed was withdrawn for 12h. For each treatment group one set of birds were given the diets containing either 100ppm thiram (experimental) or no thiram (control) for 48h after which the chickens were returned to their respective diets without thiram until the day of necropsy on d15. Blood profiles, including differential counts and selective blood chemistry parameters, were measured and scored for TD index (incidence X severity). There were selective changes in blood parameters due to vitamin A or D treatment but thiram increased most stress indices including blood heterophil, triglyceride, and iron levels. However, none of the treatments were able to reduce the TD indices as determined by morphological and histological scoring. It was concluded that supplementation of these feed factors may not protect the birds against the occurrence of TD at least when induced by thiram.

Key Words: Thiram, Tibial dyschondroplasia, Vitamin

221 Effect of 25-OH vitamin D₃ on broiler breeder production, hatchability and chick innate immune function. J. L. Saunders-Blades^{*} and D. R. Korver, *University of Alberta, Edmonton, AB, Canada*.

The effect of maternal dietary 25-OH vitamin D₃ (25-OH-D₃) on broiler breeder egg production, hatchability and early innate immune function of chicks was studied. In Experiment 1, eggs ($n = 3,199$) from commercial hens were assessed for hatchability and initial chick quality. All hens were fed 3,000 IU vitamin D₃ (D₃), half of the hens also received 34.5 µg/L 25-OH-D₃ in the drinking water. Eggs from the 25-OH-D₃-fed hens had reduced early embryo mortality (4.37 vs 6.22 %, 25-OH-D₃ and D₃, respectively). A larger egg size resulted in greater chick BW for the D₃ chicks (38.2 vs 37.7 g, D₃ and 25-OH-D₃, respectively). In Experiment 2, 98 Ross 308 broiler breeder hens were placed in 4 floor pens and fed diets supplemented with either 69 µg of 25-OH-D₃ or 2,760 IU D₃ per kg feed (2 pens/treatment) starting at 23 wk. Hens were assessed for BW, egg production and quality. From 29 to 31 wk, hens were artificially inseminated and fertile eggs were incubated and hatched. Chick peripheral immune cell phagocytosis of *E. coli* and heterophil oxidative burst over 20 minutes were measured by flow cytometry at d 1 and 4 post-hatch. Total whole blood killing of *E. coli*

was assessed at d 4 post-hatch by growth of non-killed *E. coli*. Egg production (25 to 36 wk), hen BW and chick hatch BW were not affected by diet. Eggs from 25-OH-D₃-fed hens had thicker shells at 29 wk and greater albumen height, specific gravity and shell weight as a % of egg weight at 36 wk. The 25-OH-D₃ chicks had a greater average fluorescence/phagocytosing cell, suggesting a greater number of *E. coli* were ingested. Total killing of *E. coli* was greater in the 25-OH-D₃ chicks (88.3 vs 80.8 %, 25-OH-D₃ and D₃, respectively). Heterophil oxidative burst from 0 to 15 minutes was not different at 1 or 4 d post-hatch. At 1 d post-hatch, heterophils from the D₃ chicks had a stronger oxidative burst after 20 minutes than the 25-OH-D₃ chicks. Overall, broiler breeder 25-OH-D₃ supplementation improved egg quality, hatchability and in vitro chick innate immune response toward *E. coli*.

Key Words: 25-hydroxy vitamin D₃, Broiler breeders, Innate immunity

222 Inorganic versus organic mineral premix comparison in broilers.

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An experiment was conducted to determine the relative availability of inorganic and organic premix sources of Cu, Fe, Mn, and Zn in a corn-SBM diet fed to male broilers chicks from 0-28d. Diets were formulated to provide 23% CP and 3,200 kcal ME₁₆/kg diet. Dietary basal levels of Cu, Fe, Mn, and Zn were determined by analysis of individual ingredients yielding 13.1, 314.1, 33.9, and 42.0 mg/kg diet, respectively. The basal (B) diet was supplemented with the NRC (1994) requirement of each mineral from either inorganic (IN) or organic (OR) sources (Bioplex™ Minerals). Two hundred eighty-eight day old chicks (Ross 308) were assigned to one of the three diets (16 replicate pens of six chicks per diet). Plasma, pancreas, liver, and tibia samples were collected on d 14 and 28 for mineral analysis, along with performance and hematocrit data. Excreta were collected on d 25-27 for total and water soluble mineral analysis. Performance and hematocrit data were not different (P>0.05) for any treatment on either sample day. Pancreatic Mn at 14d was different (P<0.01) between all treatments, pancreatic Zn was lower (P<0.01) for the B compared to supplemented diets, and pancreatic Cu was 22% higher (P<0.05) for chicks fed OR compared to B. Pancreatic Mn and Zn at 28d were higher (P<0.01) for supplemented diets, and pancreatic Fe was lower for chicks fed supplemented diets compared to B. Hepatic Mn at 14d was higher (P<0.01) for OR than B diets and hepatic Zn was higher (P<0.05) for both supplemented diets. Tibia Mn at 14d was higher (P<0.05) for OR than B diet and tibia Zn was higher for supplemented diets. The soluble mineral levels in excreta were higher (P<0.01) in supplemented diets demonstrating a level but not source effect. These data suggest that organic Mn has a tendency to be better utilized during early development as indicated by higher hepatic (13%), pancreatic (17%), and tibia (9%) Mn in broilers fed the OR diet compared to IN. However, supplemental Fe seems to reduce concentration of Fe in pancreas and bone regardless of source.

Key Words: Broiler, Organic minerals, Tissue content

223 Effects of vitamin E and arginine on cardiopulmonary function in broilers.

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Pulmonary hypertension (PH) is characterized by elevated production of free radicals and reductions in pulmonary artery relaxation. Supplemental Vitamin E (VE) reduces oxidative stress and Arginine (Arg) supplementation improves pulmonary capacitance, but its effects on reducing PH have not been consistent. This experiment's goal was to evaluate the effect of Arg, VE, and its combination on cardiopulmonary response to an Epinephrine challenge (Epi). 100 one d-old male broilers were fed a commercial corn-soybean meal based diet (1.2% Arg and 40 IU VE/kg). Birds were provided tap water (CTL), water with 0.3% Arg (HArg), water with 400 IU VE/L (HVE), or a combination of both compounds (AR-VE). At d 18, temperature was reduced to 16°C to amplify the incidence of PH. BW and hematocrit were recorded weekly throughout the experiment. From d 28 to d 42, pulmonary arterial pressure (PAP), mean arterial pressure, and heart rate were measured in clinically healthy anesthetized birds (n= 6 / treatment). After cannulation birds were allowed to recover for 10 min (basal), an i. v. injection of Epi was applied (1 mg/kg BW), and a second dose was applied 20 min later. These parameters were continually recorded and ana-

lyzed by a repeated measures ANOVA. Right/Total ventricular weight ratio (RV/TV) was recorded at the end of the experiment. BW in AR-VE birds (2156±89 g) was lower than in VE birds (2337±46.7 g) at wk 5. HVE birds had lower hematocrit (40±2.4%) values than CTL birds (46.37±2.8%) at wk 6. RV/TV was higher in AR-VE (0.22±0.01) than in VE birds (0.22 ±0.01). PAP peaked (P < 0.01) within 30 s after Epi in all treatments (23.9±1.1, 31.0±1.4 mmHg, basal and peak, respectively), and returned to basal levels within 60 s and 90 s after peak in the CTL, HArg and HVE groups, but it took more than 5 min for the AR-VE group to return to basal levels. In the second challenge, PAP peaked within 30 s for all treatments, HArg group returned to basal values within 90 s but it took 150 s for the other groups to return to basal levels. These results suggest that VE may not improve the effects of Arg on pulmonary arterial relaxation capacity.

Key Words: Vitamin E, Arginine, Pulmonary hypertension

224 Maternal selenium nutrition: Effects on egg and chick selenium status.

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Selenium (Se) is an integral part of more than 20 selenoproteins in the animal body, which play important roles in regulation of various physiological processes. Growth, development, reproduction and immunity all require optimal Se status for maximal efficiency. In poultry, Se is transferred from feed to the egg, and can affect embryonic and postnatal development of chicks. The aim of the present work was to study effect of breeder dietary supplementation with Sel-Plex[®] selenised yeast (Alltech Inc., USA), on Se level in tissues of chicks during postnatal development. Domestic chickens of the Hubbard-ISA broiler breeder strain were maintained from 39 weeks of age on either a control diet containing 0.027 ppm Se, or supplemented with an additional 0.4 ppm Se in the form of Sel-Plex[®]. After 7 weeks on these diets, eggs were collected for analysis of the Se contents of the yolk and albumen and were placed in a commercial incubator. Six chicks from each parental diet group were taken at 1, 7, 14 and 21 days post-hatch for tissue Se analyses. Growing chickens were fed a commercial low Se diet. Eggs from breeders receiving the high Se diet had increased Se concentration in egg yolk (from 85.3±5.1 to 515.6±14.7 ng/g, P<0.01) and albumin (from 29.8±3.1 to 248.7±15.1 ng/g, P<0.01). At hatch, the concentrations of Se in the liver, breast muscle and whole blood of the chicks of the high-Se parents were 672.5±39.4; 241.3±11.4 and 259.2±12.3 ng/g respectively, 5.4-, 4.3- and 7.7-fold higher (P<0.01) than the values in the chicks of the low-Se parents. The post-hatch changes in Se concentrations followed a similar pattern in all three tissues analysed. Se concentration in the chicken liver was significantly (P<0.05) elevated at 3 wks post-hatch as a result of maternal Se nutrition. This maternal effect was also significant (P<0.05) 4 wks post-hatch in the breast muscle and plasma.

Key Words: Selenium, Chick, Egg

225 Selenium-enriched eggs as a source of dietary selenium for humans.

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Selenium (Se) deficiency is widespread across the globe. Production of animal-derived products enriched with Se is one means of improving human Se status. In particular Se-enriched egg production has been of great interest for the last few years. The aim of the present work was to evaluate Se-enriched eggs as a source of Se for human consumption. Student volunteers were stratified by age and sex and then randomly allocated to groups designated to consume either two Se-enriched or two commercial table eggs per day for eight weeks in a double-blind trial. Sixty volunteers successfully finished the trial. Eggs consumed in the control group contained 7-9 mg Se/egg and experimental eggs were enriched with selenium (28-32 mg Se/egg) by adding Sel-Plex[®] (Alltech Inc., Nicholasville, KY) to diets fed to the hens at 0.5 mg/kg. Blood was collected before the beginning and at the end of experimental period and Se was determined in plasma. The level of Se in plasma of volunteers living in the Kiev area of Ukraine (0.055-0.081 mg/ml) was on the low side of the physiological range. Consumption of commercially available eggs for 8 weeks only slightly

increased Se in plasma, which reached physiological level (0.075-0.085 mg/ml). In contrast, consumption of two Se-enriched eggs daily, which together delivered the daily requirement of 55-65 mg Se, for 8 weeks was associated with an increase in Se concentration in plasma ($P < 0.05$). Plasma Se reached 0.09-0.14 mg/ml, indicating improved Se status of volunteers. Total cholesterol level did not differ either between the treatments or from the beginning to the end of the study. It is possible to produce eggs simultaneously enriched with several antioxidants including selenium, vitamin E and carotenoids. Indeed Se-enriched eggs are on the supermarket shelves in more than 25 countries worldwide and could substantially improve Se status of people.

Key Words: Selenium, Egg, Nutrition

226 The available phosphorus and calcium requirements of chicks fed corn and peanut meal based diets with and without added phytase. G. Pesti*, R. Bakalli, and J. Driver, *The University of Georgia, Athens.*

Two experiments were conducted with 368 Cobb x Cobb d-old starting broiler chicks each in battery brooders to determine the requirements for available Phosphorus (aP, Experiment 1) and Calcium (Ca, Experiment 2) when corn and peanut meal based diets were fed with and without added Phytase. In each experiment there were 4 replicates of 8 birds each per treatment in battery brooders for 18 days. Body Gain (BG), Feed Intake (FI), Feed Conversion Ratio (FCR), P Rickets (PR) incidence and score, Ca Rickets (CaR) incidence and score, Tibial Dyschondroplasia (TD) incidence and score, TD3 incidence, and Tibia Ash (TA) were measured.

Experiment 1 (6 x 2 factorial) had six aP levels (0.20, 0.27, 0.34, 0.41, 0.48 and 0.55%) and two added Phytase levels (0, and 1000 FTU). Requirements for BG were 0.306 ± 0.009 and $0.267 \pm 0.001\%$ aP with 0 and 1000 FTR Phytase, respectively. Requirements for TA were 0.354 ± 0.008 and $0.291 \pm 0.004\%$ aP with 0 and 1000 FTR Phytase, respectively. Requirements for PR incidence were 0.301 ± 0.001 and $0.263 \pm 0.001\%$ aP with 0 and 1000 FTR Phytase, respectively. There were no FCR responses to added aP or Phytase.

Experiment 2 (6 x 2 factorial) had six levels of Ca (0.60, 0.66, 0.72, 0.78, 0.84 and 0.90%) without and with added Phytase (1000 FTU). Levels of aP were 0.45% (treatments without Phytase) and 0.41% (treatments with added Phytase). Requirements for maximum BG were 0.761 ± 0.029 and $0.757 \pm 0.390\%$ Ca with 0 and 1000 FTU Phytase, respectively. Requirements for maximum tibia ash were 0.928 ± 0.018 and $0.927 \pm 0.022\%$ Ca with 0 and 1000 FTR Phytase, respectively. Requirements for minimum TD incidence were 1.031 ± 0.196 and $0.854 \pm 0.097\%$ Ca with 0 and 1000 FTR Phytase, respectively. There were no FCR responses to added Ca or Phytase. Supplemental phytase lowered aP requirements about 0.05% based on tibia ash, the most sensitive indicator, but did not affect dietary Ca requirements.

Key Words: Calcium phosphorus, Peanut meal, Broilers

227 Effects of dietary calcium on the egg production, feed intake and egg quality of laying hens fed corn and peanut meal based diets. G. Pesti*, R. Bakalli, and J. Driver, *University of Georgia, Athens.*

A 16 week experiment was conducted to determine the effects of different Calcium (Ca) levels and protein sources (corn and peanut meal, PNM vs. corn and soybean meal, SBM) on the egg production (HDEP), feed efficiency (FE, kg/doz.), egg weight (EW, g) and egg specific gravity (ESG, g/cm³) in Hyline W-36 laying hens. Hens were housed 2 per cage with 4 cages per replicate and 5 replicates per treatment. The experiment had three phases: 20-24, 25-29 and 30-36 weeks. Five constant levels of Ca (2.5, 3.0, 3.5, 4.0, or 4.5% during all 3 phases) and one series of increasing Ca levels (2.5, 3.0, 3.5% Ca in Phases 1, 2 & 3 respectively) were fed with 0.40% available phosphorus (aP). One PNM and one SBM based series of diets was fed based in breeder recommendations of Ca & aP (4.6% Ca + 0.52% aP, 4.15% Ca + 0.46% aP, and 3.75% Ca + 0.42% aP in Phases 1, 2, and 3).

There were no significant differences in egg production due to Ca or protein source. PNM-fed hens peaked higher (95.7 vs 95.0%), and SBM-fed hens averaged higher (89.2 vs 88.5%). There was a significant age by protein source effect on egg weight. PNM-fed hens laid larger eggs in Phase 1 (48.5 vs 48.1 g)

but SBM-fed hens laid larger eggs in Phase 3 (59.4 vs 58.3g). FE was improved by the highest Ca level, particularly during Phase 3 (1.47 ± 0.04^{ab} , for 4.0% Ca vs 1.37 ± 0.04^c for 4.5% Ca). The diet with the highest Ca level also had the most added fat, to keep the diets iso-caloric. FE was not affected by protein source. ESG was sensitive to Ca level, especially during Phase 1, accounting for a significant age by Ca level interaction. Increases from 3 to 4.5 % Ca were 1.082 to 1.090 in Phase 1 and 1.083 to 1.086 in Phase 3.

Requirements for Ca in corn-peanut meal based diets are 3.5% for HDEP and EW and 4.5% for ESG. There were no significant differences between corn-peanut and corn-soybean meal in HDEP ($P > 0.8317$), EW ($P > 0.7135$), feed intake ($P > 0.4215$), FE ($P > 0.6236$), or ESG ($P > 0.2194$).

Key Words: Leghorn, Peanut meal, Calcium

228 Caged laying hen trials using dietary *Bacillus subtilis* C-3102 spores (Calsporin®) demonstrate improvements in egg shell thickness. D. M. Hooge*¹, M. Kato², and K. Nishimura³, ¹*Hooge Consulting Service, Inc., Eagle Mountain, Utah*, ²*Calpis Company Ltd, Tokyo, Japan*, ³*Quality Technology International, Inc., Elgin, Illinois.*

Supplementing poultry diets with *Bacillus subtilis* C-3102 spores (*Bs*) in direct-fed microbial Calsporin® helps to maintain normal intestinal microflora and support live performance. The proposed mode of action is that *Bs* spores vegetate and use oxygen, creating a more anaerobic condition which promotes proliferation of lactic acid producing bacteria (e. g., Lactobacilli). Besides inhibiting certain pathogens (*E. coli*, Salmonella), this condition appears to increase utilization of calcium. U. S. Patent 6,660,294 (Dec. 9, 2003) was awarded to this "Poultry Eggshell Strengthening Composition", and trials cited in the patent application showed +5.2% average shell thickness improvement. In present Exp. 1, 30 Hy-Line W-36 hens (59 wk) in each of 2 treatment groups were fed diets with either 0% (CON) or 0.003% *Bs* spores (Calsporin®, 0.05% level), and microbes in fresh feces and shell thickness (ShT; 3 values/egg) were determined. Based on 4 samplings over 1 month, after 1-wk adjustment period, shell thickness was 0.297 mm in CON vs 0.306 mm in *Bs* group (+3.0%; $P = 0.027$). Lactobacilli / total anaerobes (cfu Log₁₀/g feces) increased from 44.4% in CON to 56.4% in *Bs* group. In Exp. 2, Hy-Line W-36 hens (43 wk) in a commercial flock were fed diets containing flax and soy oils (CON vs *Bs*) for omega-3 eggs. Based on 4 weekly egg samplings "before" and 5 samplings "during" *Bs* feeding (60 eggs/sampling), ShT was 0.317 mm "before" and 0.323 mm "during" treatment (+1.9%; $P = 0.034$) despite advancing age of hens. In Exp. 3, Lohmann hens (49 wk) in a commercial flock were fed diets "before" (3 wk) and "during" *Bs* addition (8 wk) resulting in respective ShT values of 0.339 mm vs 0.345 mm (+1.8%; $P = 0.098$; 60 eggs/sampling), in spite of age progression, and fecal lactobacilli / total anaerobes increased from 34.7% to 69.3% (50% was desired threshold level). The *Bs* increased ShT of eggs.

Key Words: Bacillus subtilis, Calsporin, Shell thickness

229 Phosphorus bioavailability of two phosphorus sources for broiler prestarter diets. A. Garcia*, A. Batal, and N. Dale, *University of Georgia, Athens.*

Defluorinated tricalcium phosphate (TP) and dicalcium phosphate (DP) are two of the main sources of inorganic phosphate used by the poultry feed industry. It is commonly believed that defluorinated phosphate is slightly less biologically available than either dicalcium or monocalcium phosphate. The objective of this study was to determine whether this effect might be more pronounced in very young chicks, and if so, might preclude the use of TP in broiler pre-starter diets. To this end, an experiment was conducted to determine whether the bioavailability of TP (relative to that of DP) was markedly lower for broiler chickens during the first 15 d of life. Test diets based on corn-soybean meal were formulated to be isocaloric and isonitrogenous, and contained 0.13% non-phytin phosphorus (NPP). Six treatments were used, employing inorganic phosphorus from different sources. In the first three treatments, potassium phosphate (PP) was used as a standard, and was added to the diet to meet 0.24, 0.32, and 0.40% NPP. For treatments 4 and 5, TP and DP, respectively, were added to the diet to achieve 0.32% NPP, and in treatment 6 the same amount of NPP from raw rock phosphate (RP) was added as a negative control. Measurements

taken were body weight gain (BWG), gain to feed ratio (GF) and percent of foot ash (FA) at 4, 8, and 15 d of age. A significant linear response ($P < 0.05$) was observed in growth performance and FA in birds receiving graded levels of PP at all ages, confirming the sensitivity of the procedure. No significant differences were found in FA percent between groups receiving TP or DP at all ages (13.5 vs 13.3% at 4 and 8 d, and 14.5 vs 14.3% at 15 d, respectively). As expected, the group receiving the RP had significantly reduced BWG, GF and FA percent (11.5, 10.5 and 12.9% at 4, 8 and 15 d, respectively), confirming the ability of the assay to detect low phosphorus availability. Results of this research did not demonstrate evidence of a reduced bioavailability of TP for chicks at 4, 8 or 15 d of age, suggesting this ingredient can successfully be employed in pre-starter diets for broilers.

Key Words: Phosphorus availability, Defluorinated phosphate, Dicalcium phosphate

230 Effects of dietary nonphytate phosphorus level on roaster performance and phosphorus excretion. M. E. Persia^{*1}, R. Angel², and W. W. Saylor¹, ¹University of Delaware, Newark, ²University of Maryland, College Park.

Reducing supplemental nonphytate phosphorus (nPP) fed to growing poultry can reduce environmental impact and diet costs in concentrated poultry regions. An experiment was performed to determine the effects of reduced dietary nPP on leg bone mineralization and associated losses during commercial processing, as well as bird performance and P excretion, which will be presented here. Five levels of dietary Ca and P were fed to 12 replicate pens of 47 male commercial broiler chicks from hatch until d 57. Calcium and P levels were formulated to result in differences in leg bone mineralization without affecting final body weight to avoid confounding effects during processing. Roasters were fed the same diets for the pre-starter and starter phases after which Ca and P levels were reduced in grower, finisher and two withdrawal phases resulting in a control treatment and four treatments of varying but moderate Ca and P. Total P and Ca intakes for the five treatments were as follows: control, 46 and 65; moderate high, 38 and 48; moderate low, 35 and 44; low high, 37 and 46 and low low, 34 and 39 g/bird, respectively. Unfortunately, ventilation failure in one wing of the house resulted in increased mortality so performance and litter data from only six replicate groups will be discussed. No differences were noted in bird weight gain, feed efficiency or dry litter weight for any dietary treatment. The reductions of dietary Ca and P resulted in 28 to 48% reductions in litter P

between the control-fed birds and the groups fed moderate levels of Ca and P. There were 12 to 28% reductions in litter P resulting from reductions in dietary Ca and P among the moderate treatments. Percent P retention was increased with decreasing dietary Ca and P. Feeding reduced amounts of Ca and P, especially in later phases, reduces Ca and P intake and P excretion, without reducing roaster performance.

Key Words: Roaster, Litter phosphorus, Performance

231 Mintrex™ Zn organic trace mineral (zinc bis[2-hydroxy-4-methylthiobutyrate]) can travel intact to the small intestine, and is equivalent to Alimet® feed supplement as a methionine source. J. Richards^{*}, C. Atwell, J. Hume, and J. Dibner, *Novus International, Inc., St. Louis, Missouri.*

Organic trace minerals should travel intact through the upper gastrointestinal tract (GIT) and deliver their minerals in protected form to the small intestine for absorption. Mintrex™ Zn Organic Trace Mineral is a chelate of two 2-hydroxy-4(methylthio) butanoic acid (HMTBa) ligands per atom of zinc. We tested whether Mintrex Zn can pass intact through the upper GIT and whether the HMTBa in Mintrex Zn is a source of methionine activity. Broilers were gavaged with equimolar amounts of 14C-HMTBa in the form of Mintrex Zn (zinc bis(2-hydroxy-4-methylthiobutyrate)) or Alimet® (HMTBa) and rested 1-4 hours. Tissues (duodenum, jejunum, liver, leg muscle and pancreas) were collected, homogenized, and the protein fraction was precipitated and pelleted. Pellet and supernatant fractions were scintillation counted and corrected by 14C-Mintrex and 14C-HMTBa standards. Pellet counts represent HMTBa that was absorbed, converted to l-methionine and incorporated into protein. Total (pellet + supernatant) counts represent total tissue uptake of HMTBa. Previous work has shown that free HMTBa is absorbed mainly in the upper GIT. Total duodenal counts were greater for Mintrex than for HMTBa at all time points, indicating that Mintrex can travel intact through the acidic upper GIT to the small intestine for absorption. Total counts in other tissues were not different between sources. Likewise, Mintrex provided more methionine activity to the duodenum than did HMTBa; but when compared in the other tissues and across all tissues there was no difference in the methionine activity provided by the two sources. Furthermore, the kinetics of incorporation into protein were generally similar between sources. Thus, Mintrex Zn and Alimet are equivalent sources of methionine activity.

Key Words: Mintrex, Zinc, Methionine

Reproduction Symposium: Optimizing Reproductive Output From Female Broiler Breeders

232 Reviewing our course: Development of the modern broiler. J. H. van Middelkoop^{*}, *Spelderholt Institute, The Netherlands.*

In the older days selection for growth rate was mass selection without any pedigree. Hatching egg production was obtained by using a good producing strain or cross. Since selection circumstances were not uniform and breeders were used its entire lifetime natural selection was included in breeding for the next generation. Pretty soon primary breeders did improve both uniformity of selection circumstances and selection procedure. This allowed breeders to increase progress of the selected traits. However the better the geneticist can distinguish the best birds for the selection traits the more they need to watch for unwanted genetic drift. Genetic changes in breeding are a cumulating effect of each selection per generation. This is valid for both wanted and unwanted traits. Primary breeders tend to standardize and to minimize phenotypic variation in the flock to be selected due to the environment as much as possible. However the lesser variation in selection environment the larger the risk that selected birds cannot adapt in other environments. This reality refers to the risk of shifts in unnoticed traits, or even worse in unnoticed shifts. Changes in traits can remain unnoticed or deviate from anticipation when the environment in commercial operations differ from the selection environment – a potential result of executing selection in pure line while crosses are sold as final product. Examples are sensitivity to ascites and leg problems.

The high selection pressure executed for a few highly heritable broiler traits implies a big risk of losing genetic variation needed for genetic driven egg performance in commercial environments. Selection environment of broiler breeder hens is total different from commercial rearing practice. Primary broiler breeders try to set the best rearing conditions for selection of broiler traits. In contrary the opposite is done with regard to create the best environment for hatching egg selection. This increased the risk of ending up with breeder hens with poor reproductive traits or difficult to manage. Special attention will be paid to the reason why and when restricting broiler breeders started in commercial operations and how this in turn unconsciously made primary breeders selecting broiler breeders which has to be restricted. It was not a decision but it just happened.

233 Is chick quality a price we have to pay for yield? M. J. Wineland^{*}, *North Carolina State University, Raleigh.*

The broiler of 2005 is vastly different from that what many of us knew when we were youngsters. The improvements due to nutrition and genetics have developed a broiler that attains a heavier weight, at a younger market age, and converts feed much more efficiently. Twenty years ago breeder managers had the responsibility of producing hatching eggs, today their goal is still the same but they must attempt to reach their goal with the high yielding bird that is known