

treatments and were intermediate for the LCPPH. From 12 to 13 wk FI was significantly higher for CON and LCPPH, compared to LCP pens. Feed conversion and mortality were not affected by treatment. Processing and cut-up of toms at 13 wks resulted in no treatment differences in the weight of the breast, legs, neck, skin, wings, thighs, back, abdominal fat pad or yield as a percent of the last BW, due to treatment. LCP diets did result in poor performance during wk 12-13, indicating phytase supplementation benefited the LCPPH birds with similar and intermediate BWG to the CON ($P=0.05$).

Key Words: Turkey, Phytase, Growth efficiency

202 Turkey toms fed low calcium, phosphorus diets supplemented with phytase 2. Impact on litter mass, phosphorus, bone mineral density and feed costs. P. H. Patterson^{*1}, R. M. Hulet¹, R. J. Mitchell², and T. L. Cravener¹, ¹The Pennsylvania State University, University Park, ²Mitchell Consulting Service, Tega Cay, South Carolina.

A turkey study was conducted to measure the affects of feeding diets formulated to contain lower levels of calcium (Ca) and total phosphorus (tP) (15 and 15%, respectively) than controls (CON) from 6-9 wk, 29 and 23% lower from 9-12 wk and 45 and 33% lower from 12-13 wk with and without phytase supplementation. Toms (BUTA-T2) were raised in 24 floor pens (0.212 m²/bird) with 8 replicate pens per diet treatment (CON, Low Ca and tP (LCP), Low Ca, and tP with phytase (LCPPH)). The CON feeding program (calculated analysis) included a pre-starter (0-3 wk: 28.4% crude protein (CP), 1.45% Ca, 1.03% tP), starter (3-6 wk: 27.4% CP, 1.41% Ca, 1.01% tP) grower-I (6-9 wk: 24.5% CP, 1.48% Ca, 1.00% tP) grower-II (9-12 wk: 22.5% CP, 1.37% Ca, 0.92% tP) and finisher (12-13 wk: 18.9% CP, 1.18% Ca, 0.79% tP). All birds were fed the same commercial diet from 0-6 wk, which contained 0.06% phytase. The CON diets did not include phytase after 6 wk. Bone mineral density measurements of humerus and femur from LCP or LCPPH birds were the same as the CON at 6, 9, 12, or 13 wk ($P=0.05$). Dietary treatments did not influence wing or thigh mass when birds were processed at 13 wk ($P=0.05$). Litter mass was not significantly impacted by dietary treatments at the conclusion of the study ($P=0.05$). However, litter phosphorus (LP) was 26 and 24% less on a dry matter and as is basis, respectively for the LCPPH treatment at 9 wk compared to the CON ($P=0.05$). The LCP treatment LP was intermediate and not different from the others. At the end of 13 wk LP on an as is basis was 17% less for the LCPPH and LCP treatments compared to the CON (45.7^b, 44.8^b, 54.7^ag/kg, respectively, $P<0.05$). Feed costs for the LCP and LCPPH diets during the grower-I, II and finisher phases averaged \$2.56, \$3.76 and \$4.82/ton savings compared to the CON. Total feed costs per bird were similarly less for the LCP and LCPPH compared to the CON (\$5.57^b, \$5.62^b and \$5.74^a, respectively, $P=0.05$). These findings suggest the negative effects of LCP diets can be averted with greater dietary phosphorus levels in the 12-13 wk finisher phase.

Key Words: Turkey, Phosphorus, Bone mineral density

203 Effect of feeding time on the reproductive performance of Pharaoh quail and Pekin duck. M. Petek^{*}, University of Uludag, Bursa, Turkey.

Whether feeding early or late during the day can be used as a means to improve the fertility, hatchability, and embryonic mortality in quail and duck is unknown. Therefore, three feeding periods were used to measure the impact of feeding

time on reproductive performance of Pharaoh quail (*Coturnix coturnix* Pharaoh) and Pekin Duck (*Anas platyrhynchos*). Male and female quail and duck breeders were housed in colony cages and free-range housing systems, respectively. They were fed ad libitum between 0900 to 1300 h or 1300 to 1700 h or 24 h (control) daily. Eggs (736 quail and 272 duck) were used to determine reproductive performance. Eggs were incubated in a commercial setter and hatcher. The setter was operated at 38.0±1.0°C dry bulb and 29.0±0.5°C wet bulb temperatures. The hatcher was operated at 37.0 ±1.0°C dry bulb and 31.0±0.5°C wet bulb temperatures. Eggs in the setter were turned 15 times per day. Three days after removing the chicks from the hatcher all unhatched eggs were classified as infertile, early dead, late dead, or dead pipped. Hatchability was calculated as the number of chicks hatched per fertile or total eggs. The fertility results were reported as apparent fertility on clear egg basis. All traits were analysed with Chi-square test using SPSS® computer software (version 10.00). Hatchability of total eggs was significantly increased in duck and significantly decreased in quail due to limited time of feeding. Results indicated that feeding between 1300 to 1700 h reduced apparent fertility when compared with the effects of feeding between 1300 to 1700 h. Different feeding times affected the total embryonic mortality. Further investigations are needed to determine the optimum length of feeding time for each bird species.

Key Words: Feeding time, Hatchability, Quail

204 Comparative histology of duck bills following different bill trimming practices. H. W. Cheng^{*1}, L. Gustafson², E. A. Pajor³, and J. A. Mench², ¹USDA-ARS, West Lafayette, Indiana, ²University of California, Davis, ³Purdue University, West Lafayette, Indiana.

Various histological staining methods have been developed to examine trauma-induced pathological changes. Each method is chosen in a tissue-dependent manner. The aims of this study were to investigate trimming-induced bill morphological changes and to test suitable staining methods for detecting traumatic neuromas. One hundred ninety-two day old Pekin ducklings were randomly assigned into 12 floor pens (3.66 X 0.91 m). The pens were divided into three groups, i. e., control, hot blade trimmed with cautery (HT), and tip-seared (TS). Six bills were randomly collected from each group when the ducks were 3 and 6 wk of age, respectively. Following fixation and decalcification, the bills were embedded in paraffin wax, and sectioned longitudinally. Alternate sections were stained with haematoxylin and eosin and Masson's trichrome for connective tissues, and for the nerve fibers, Bielschowsky's silver impregnation, Bodlan's and Holm's staining were used. Compared to the controls, although both bill trims caused connective tissue proliferation in the bill stumps, HT caused more thickness of tissue scars than those induced by TS. There were nerve fibers in the bill stumps trimmed by TS but not in the bills trimmed by HT. No neuromas were found in the bill stumps following either practice. These characteristics of neuronal reactions were more clearly seen following Holm's staining than others. These results indicate 1) trauma-induced pathological changes are dependent on the type of lesion; 2) in Pekin ducks, TS caused less morphological changes than HT, which suggests that TS may be more humane than HT; and 3) different histological methods should be used to examine different tissues, such as connective tissue vs. neuronal tissue. A further study is needed to examine the correlations between these morphological changes and pain sensations (acute and chronic) following the different bill trimming practices.

Nutrition: Enzymes

205 Effect of β -Mannanase (Hemicell®) on performance and body weight uniformity in broiler chickens provided with corn-soybean meal diets and economic ramifications. M. Jackson^{*1}, D. Anderson¹, H. Hsiao¹, F. Jin¹, and G. Mathis², ¹ChemGen Corp, Gaithersburg, Maryland, ²Southern Poultry Research, Athens, Georgia.

The enzyme B-mannanase has been shown to improve growth, feed conversion and body weight uniformity in broilers. The value of uniformity is difficult to

quantify and is dependent on carcass value within various weight categories as well as other factors. A 42-day trial was conducted in floor pens with male Cobb X Cobb broilers provided with corn-soybean meal based diets in the absence of antibiotics. Treatments consisted of a control, control + B-mannanase 0-42 days, and control + B-mannanase 0-17 days of age. There were 45 birds/pen and 8 replications per treatment. At 0, 17, and 42 days of age, all birds were individually weighed to determine body weight uniformity (%CV) on a pen

basis. Addition of B-mannanase from 0-42 days and 0-17 days increased final weights by 4.7% ($P < 0.05$) and 1.0% (NS), and improved weight adjusted feed conversion by 6 points ($P < 0.05$) and 1.4 points (NS) respectively. Enzyme addition from 0-42 days significantly decreased 42 day body weight CV from 9.77% to 8.20%, while addition to 17d decreased CV to 9.31% (NS). A practical economic analysis was performed using individual body weights from this experiment. The following dressed carcass values were used: 1. weights falling within $\pm 8\%$ of the population mean, \$0.88/kg 2. below this range, \$0.66/kg 3. above this range, \$1.00/kg. An \$8.50/ton value of enzyme addition was calculated not accounting for improvements in growth or feed conversion. Results of this study suggest that B-mannanase improves broiler uniformity which can result in substantial economic benefits.

Key Words: B-mannanase, Uniformity, Economics

206 Use of vegpro to improve soybean meal digestibility in layers. A. E. Sefton^{*1} and S. Leeson², ¹Alltech, Inc., Guelph, ON, Canada, ²University of Guelph, Guelph, ON, Canada.

Plant protein supplements, particularly soybean meal, have low energy digestibility when fed to poultry as compared to when fed to swine and so there should be potential for increased digestibility. Vegpro[®] (Nicholasville, KY) is an enzyme combination specifically designed to enhance the digestibility of plant protein supplements, and has been found to improve the digestibility of plant protein supplements by 7% for energy, protein and amino acids. This long-term layer trial was undertaken to test the efficacy of Vegpro when fed to layers. Four treatment groups with 80, individually housed, 19 week old Shaver Whites were used. The test rations were formulated the same nutrient specifications as the control (C) treatment except that the ingredient profile of the soybean meal was raised by 7% (L), 10.5% (M) and 14% (H) for metabolizable energy, crude protein, and amino acids. The rations followed the Shaver White recommendations. This report covers the first 9, 28 day periods. There were no differences among treatments until the 8th period when feed consumption of treatment H was less than treatment L ($P < 0.05$), there were no other differences in feed intake. This difference mirrored the lower egg production of treatment H in the 9th period then it was lower than treatment C and M. There were no other differences in egg production, mortality, feed intake, egg weight, shell deformation or albumen height. These results support the ability of Vegpro to improve digestibility of soybean energy, protein and amino acids by at least 7% in layers.

Key Words: Enzymes, Digestibility, Layers

207 Broiler responses to a feed enzyme in diets differing in amino acid levels. M. L. West^{*1}, A. Corzo¹, W. A. Dozier², M. E. Blair³, and M. T. Kidd¹, ¹Mississippi State University, Mississippi State, ²USDA-ARS, Poultry Research Unit, Mississippi State, Mississippi, ³Adisseo USA, Inc., Alpharetta, Georgia.

Diets varying in amino acid density, with and without a feed enzyme (Rovabio[™]), were fed to 576 Ross x Hubbard male broilers (12 chicks/pen randomly allotted to 48 pens) from 1 to 41 d of age. Diets were based on corn, soybean meal, and poultry meal, and were fed from 1 to 14, 15 to 32, and 33 to 41 d. A control diet (100%) exceeding NRC (1994) amino acid recommendations and mimicking industry amino acid levels was increased to 105% and 110% in terms of amino acid density. The combination of three amino acid density diets (100, 105, and 110%) with and without the feed enzyme (0 and 0.022%) resulted in a 3 x 2 factorial design (8 replications/treatment). The floor pens contained built-up litter, nipple drinkers, and a tube feeder in a tunnel ventilated house. Pen BW gain, feed conversion, and mortality were obtained in all periods. At 41 d, eight broilers per pen were randomly selected for processing. The enzyme treatment did not affect ($P > 0.05$) BW gain or feed conversion. However, 41 d mortality was reduced ($P < 0.05$) when the feed enzyme was added. Increasing amino acid density to 110% decreased feed conversion at 41 d compared to birds fed 100 and 105% amino acid density. Although each increase in amino acid density decreased ($P < 0.05$) abdominal fat, other differences ($P < 0.05$) in carcass parameters were not observed. In conclusion, increasing amino acid density resulted in lower feed conversion and abdominal fat, and the dietary addition of Rovabio[™] reduced overall mortality.

Key Words: Amino acid, Enzyme, Growth

208 The effect of Avizyme 1502[®] on turkey poult performance from 0-56 days. C. Troche^{*1}, X. Sun¹, A. McElroy¹, J. Remus², and C. Novak¹, ¹Virginia Tech, Blacksburg, ²Danisco Animal Nutrition, Carol Stream, Illinois.

Enzyme supplementation has been shown to improve production parameters and nutrient availability in wheat/barley based diets. However, due to the high accessibility of high quality feedstuffs in the USA, these enzyme additives have not been utilized thus the push to look at alternatives. A study was designed to determine the effects of enzyme supplementation on turkey poults fed a commercially based diet which included; corn, soybean meal, meat and bone meal and ground wheat as protein sources. Day old BUTA turkey poults ($n=3850$) were randomly divided into 35 pens and fed one of 5 dietary treatments for 56 days. Performance parameters (feed intake (FI), body weight (BW), body wt. gain (BWG), feed conversion (FCR) and mortality) were evaluated along with determination ileal digestibility of protein and energy on 21, 42 and 56d. Dietary treatments consisted of: a positive control (PC), a negative control (NC) (corn matrix adjustment of 140 kcals - increase), and NC diets containing graded levels of Avizyme 1502[®] (250g/MT, 500g/MT or 750g/MT). Significant differences in mortality were not observed during the trial. Effect of enzyme supplementation on BWG and FI remained significant through 21 ($P=0.031$ and $P=0.0058$, respectively) and 42d ($P=0.0004$ and $P=0.0003$, respectively), but became negligible on 56d. FCR was significantly affected by diet on 42d ($P=0.0158$). Day 21 FI (0.768, 0.7753 and 0.7428 kg/bird) showed a quadratic effect ($P=0.0118$) with increase of enzyme supplementation. Enzyme supplementation had a significant ($P < 0.05$) age by treatment interaction on both energy and protein digestibilities. A quadratic response on both energy and protein digestibility was determined for 42d ($P=0.003$), with absence of a similar response at 21d and 56d. Ultimately, Avizyme 1502[®] has a positive impact on performance to 42 days of age, but the reason for this improvement is not reflected in an increase in digestibility of feedstuffs when turkey poults are feed a commercially based starter program.

Key Words: Avizyme 1502[®], Turkey poults, Ileal digestibility

209 The effects of non-starch polysaccharide enzyme inclusion and dietary energy restriction on performance of organically-reared broiler chickens. N. P. Buchanan^{*}, L. B. Merritt, G. E. Seidel, and J. S. Moritz, West Virginia University, Morgantown.

Feed constitutes a substantial cost in organic production. Organic poultry have access to pasture; a nutrient source that has potential to curtail feed costs. Incorporating a non-starch polysaccharide (NSP) enzyme may enable broilers to better utilize nutrients found in pasture. Past research has demonstrated that feed restriction encourages broilers to forage. The objective of the current study was to evaluate the extent that broilers may utilize pasture to meet energy needs for growth. Seven hundred and five day-old Ross 308x344 broilers were reared from 0-to-3-weeks in floor pens and fed a corn/soybean based diet that was certified organic and met NRC recommendations. On day 21, 300 broilers were randomly selected and moved into houses with access to pasture for 5 weeks. Experimental grower diets were corn/soybean based, certified organic, and consisted of two different energy levels (3200 or 2976 kcal/kg) arranged in a factorial structure with two different enzyme inclusions (including or excluding NSP enzyme). In addition, 300 broilers were fed similar diets and not given pasture access. The study was repeated in spring and summer months. A split-plot design was utilized. Access was designated as the main plot with enzyme, energy, and season representing subplots. An energy x enzyme x access effect ($P=0.0064$) was observed for live weight gain (LWG). Broilers not given pasture access had higher LWG compared to broilers given pasture access. In addition, consumption of normal energy diets improved LWG compared to low energy diets, regardless of pasture access. However, enzyme inclusion increased gain only when broilers were given access to pasture. An enzyme x season effect was also observed with broilers given the enzyme in spring exhibiting a higher LWG ($P=0.001$). Feed efficiency improved ($P=0.0009$) for broilers reared in spring months compared to summer months. These results demonstrate that diet incorporation of a NSP enzyme may allow organically-reared broilers to better utilize pasture to meet nutrient needs, especially in spring months.

Key Words: Enzyme utilization, Organic production, Broilers

210 0-to-6 week broiler performance effects of 3-nitro replacement in the diet. A. Parsons^{*1}, A. McElroy¹, T. Sefton², and C. Novak¹, ¹*Virginia Tech, Blacksburg*, ²*Alltech, Inc., Guelph, ON, Canada*.

The use of arsenic as an ingredient in 3-Nitro has increased consumer concern. The objective of the current study was to assess the ability of Bio-MOS[®] to replace 3-Nitro in a conventional broiler diet as determined by performance parameters. Treatments consisted of a corn-soybean meal basal diet supplemented with AGP+3-Nitro+Coban (3-Nitro) or AGP+ Bio-MOS[®]+Coban (Bio-MOS[®]). Each of the diets were fed to fourteen replicate pens of 45 straight-run Cobb broilers (0.8sq ft/chick) during the (1-14d) starter period, (14-28d) grower period, (28-35d) finisher period and (35-49d) withdrawal period. All diets were formulated to meet or exceed NRC recommendations for each respective growth period and fed in a mash form. There were no significant differences in live weight gain (LWG) (p=0.39), feed intake (FI) (p=0.07) or feed conversion (FC) (p=0.34) for broilers fed either the 3-Nitro or Bio-MOS[®] diets during the starter period. Broilers fed the Bio-MOS[®] containing diet had higher (p=0.0001) LWG during the grower, 0.917 and 0.856 kg respectively, and 1-49 d periods (p=0.003), 3.093 and 3.001 kg, respectively, compared to broilers fed diets containing 3-Nitro. Broilers fed the Bio-MOS[®] containing diet also had greater FI for the grower (p=0.002), finisher (p=0.04) and overall 1-49d (p=0.005) periods. Feed conversion of Bio-MOS[®] fed birds improved significantly when compared to 3-Nitro fed broilers during the grower, 1.457 and 1.848 kg/kg (p=0.0008) and 1-28 d, 1.426 and 1.445 kg/kg (p=0.049). There was no significant difference in mortality between diets. These findings conclude that replacing 3-Nitro with Bio-MOS[®] in a commercial corn-soybean meal broiler diet is not only feasible but beneficial to overall performance, most notably during the grower period (14-28d).

Key Words: Broiler performance, 3-Nitro, Bio-MOS

211 Evaluation of corn nutrient profile, starch digestibility and exogenous enzyme responsiveness for samples harvested during 2003 and 2004. S. Dalsgaard^{*1}, J. C. Remus², M. Hruby³, and E. E. M. Pierson², ¹*Danisco Innovations, Brabrand, Denmark*, ²*Danisco Animal Nutrition, St. Louis, Missouri*, ³*Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom*.

Globally, corn is the most frequently used cereal grain in poultry feeds. This relatively economical source of energy and other nutrients is assumed to be also highly digestible and uniform ingredient. However, both scientific and commercial experience suggests that corn can be less uniform source of nutrients for poultry due to the nutrient level variations but also due to differences in nutrient digestibility, namely starch digestibility.

Five-hundred fifty-eight corn samples, 221 harvested in 2003 and 337 in 2004, were collected from 31 countries to evaluate nutrient characteristics including dry matter, starch, crude protein, oil and starch in vitro digestibility (dry matter basis). Additionally, the responsiveness of corn to the multi-enzyme (Xylanase, Amylase and Protease) feed system (Avizyme[®] 1500, 0.1% inclusion, Danisco Animal Nutrition) was determined as part of the Avicheck[™]Corn service to predict energy improvement value (EIV) of a specific corn sample when supplemented poultry feeds. There were no differences in average nutrient levels, average starch digestibility or the average enzyme response between two harvest years. However, nutrient levels varied between: 77.8 - 92% (dry matter), 64 - 75% (starch), 6.7 - 12% (crude protein), 2.4 - 7.9% (oil) and starch digestibility (56.7 - 84%). Average EIV for both harvest years combined was 145 kcal/kg corn (65.8 kcal/lb). Globally, corn samples from Canada and Brazil showed the highest energy improvement values (~150 - 155 kcal/kg or 68 - 70.3 kcal/lb) while samples from Thailand and Indonesia had the lowest average EIV (~130 - 135 kcal/kg, 59 - 61 kcal/lb) due to the enzyme supplementation. Samples from Brazil, France and Thailand had the most variable EIV results. The results on this large dataset of corn samples confirm a wide variability in nutrient content and starch digestibility. The results also justify a need for a customer specific approach when incorporating feed enzymes in corn-based poultry feeds to achieve maximal profit.

Key Words: Corn, nutrient levels, Starch digestibility, Avizyme 1500

212 Effects of simultaneous supplementation of alpha-galactosidase and citric acid on nutrient digestibility and growth performance of broiler chicks. T. Ao^{*}, A. Cantor, A. Pescatore, M. Ford, and J. Pierce, *Alltech-University of Kentucky Nutrition Research Alliance, Lexington*.

A study was conducted to investigate the effects of dietary supplementation of alpha-galactosidase and citric acid on nutrient digestibility and growth performance of broilers fed corn-soybean meal based diets with different energy levels. Treatments consisted of feeding diets with two energy levels (2,740 or 3,100 kcal AME/kg), two levels of alpha-galactosidase (0 or 1724 units/kg) and two levels of citric acid (0 or 1.5%) in a 2 x 2 x 2 factorial arrangement of treatments. A total of 576 male broiler chicks, 1 day of age, were uniformly distributed by weight to provide six replicate groups of twelve caged chicks for each of the eight treatments. Excreta samples were collected from each replicate for 24 hours on Day 18 to measure nutrient digestibility and AME_n of the diets. Alpha-galactosidase significantly (P < 0.05) increased reducing sugar concentration in the crop content and improved the AME_n of the diets. Citric acid significantly decreased the pH of the crop content, increased the activity of alpha-galactosidase and decreased the AME_n of the diets. The reduction of AME_n due to the supplementation of citric acid occurred only when citric acid was added to the diets without alpha-galactosidase, but not to the diets supplemented with the enzyme. Chicks fed citric acid had significantly lower gain to feed ratio than did chicks fed both alpha-galactosidase and citric acid. Alpha-galactosidase significantly improved the AME_n of the lower energy basal diets by 12%, while citric acid significantly reduced the AME_n of the lower energy basal diets by 6.9%. The AME_n of the higher energy basal diets were unaffected by either enzyme or acid supplementation. These results suggest that alpha-galactosidase can be used to correct the depression in nutrient digestibility and growth performance of broiler chicks caused by citric acid supplementation of low energy diets.

Key Words: α -galactosidase, Citric acid, Broilers

213 Phytase, carbohydrase and protease have an additive effect on the performance of broilers fed on nutritionally marginal diets. A. Cowieson¹, E. Pierson^{*2}, T. D'Alfonso², and O. Adeola³, ¹*Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom*, ²*Danisco Animal Nutrition, St Louis, Missouri*, ³*Purdue University, West Lafayette, Indiana*.

The effects of carbohydrases, proteases, and phytases in the diets of broiler chickens has been studied and reviewed over the last several decades and it is clear that the use of these enzymes, under appropriate conditions, can be an effective nutritional strategy to improve the profitability of poultry production. However, the suggested modes of action of these enzymes may overlap and so it is not clear whether they can be used in combination for a fully additive response. A 28-d trial was conducted with 1,152 broiler chickens (8 treatments with 12 replicate pens of 12 chicks). The birds were fed on a corn/soy-based negative control (NC) diet that was formulated to be 220kcal/kg, 0.16% and 0.15% lower in metabolizable energy, available P and Ca respectively than the positive control diet (PC), which was fed for comparison. The NC diet was supplemented with phytase (Phyzyme[®] XP, Danisco Animal Nutrition), a cocktail of xylanase, amylase and protease (XAP; Avizyme[®] 1505, Danisco Animal Nutrition) or a combination of phytase and XAP at two concentrations of each enzyme (100 and 200 ppm). Growth performance, ileal digestible energy (IDE), and the digestibility coefficients of N, Ca, P and DM were calculated. Individually and in combination, both phytase and XAP improved (P<0.05) gain-to-feed ratio compared with NC particularly at the highest inclusion concentration. Bodyweight gain followed a similar trend, with an improvement of approximately 6% with either enzyme individually and 12% improvement with a combination of phytase and XAP. A 165 kcal/kg reduction in IDE was noted between the NC and PC diets and a combination of phytase and XAP improved IDE by over 100 kcal/kg. It can be concluded that the use of phytase and XAP individually in a corn/soybean meal-based diet is effective in improving nutrient digestibility and performance of broilers. Furthermore, there may be an additive effect of phytase and XAP on broiler performance, giving a cost-effective nutritional strategy for the profitable production of poultry products.

Key Words: Enzyme, Combination, Broiler

214 Influence of phyzyme XP™ on commercial leghorns fed corn-soy diets. G. Wu*, Z. Liu, M. M. Bryant, and D. A. Roland, *Auburn University, Auburn, Alabama.*

The objective of this experiment was to determine the influence of Phyzyme® on performance and profits of commercial Leghorns fed con-soy diets. Seven diets were fed to Hy-line W-36 hens (n = 840, 8 replicates of 15 hens per treatment) during Phase 1 (from wk 21 to 33). The treatments consisted of a control diet containing 0.38% nonphytate phosphorus (NPP) and a 2 × 3 factorial arrangement with two dietary NPP levels (0.11 and 0.26%) and three phytase sources (no phytase, Natuphos®, Phyzyme®). Results showed that dietary NPP levels had significant effects on feed intake, egg production, egg weight, egg mass, egg specific gravity, and NPP intake. The addition of Phyzyme® significantly increased egg production and egg mass of hens fed the deficient-phosphorus diet (0.11% NPP) to levels that were similar to hens fed the control diet (0.38% NPP). Although feed intake of hens fed the diets supplemented with Phyzyme® or Natuphos® was significantly less than that of hens fed the control diet, there were no significant differences in egg mass and egg production between the control diet and the diets supplemented with Phyzyme® or Natuphos®. Feed conversion and egg specific gravity of hens fed the diets supplemented with Phyzyme® were significantly better than those of hens fed the control diet. Phyzyme® supplementation had no effect on egg weight, egg specific gravity, body weight, and mortality. There were no significant differences in feed intake, egg production, egg weight, egg mass, feed conversion, egg specific gravity, mortality, and body weight between the diets supplemented with Natuphos® and the diets supplemented with Phyzyme®. In conclusion, the addition of Phyzyme® had positive influences on performance and profits of commercial Leghorns fed corn-soy diets.

Key Words: Phyzyme®, Hens, Phytase

215 Effect of microbial phytase supplementation on nutrient digestibility of corn and soybean meal-based broiler diets. N. K. Sakomura¹, F. Santos¹, M. Hruba², E. M. Pierson³, J. C. Remus³, and J. S. Sands^{*2}, ¹*Universidade Estadual Paulista, Jaboticabal, São Paulo, Brazil*, ²*Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom*, ³*Danisco Animal Nutrition, St. Louis, Missouri.*

A study was conducted to evaluate the effect of variable phytase levels in corn-based diets reduced progressively in nutrients (P, Ca, ME, crude protein (CP), amino acids (AA)) on ileal digestibility of energy and nutrients in broilers. Using a CRD, a total of 630 male broiler chicks (Cobb) were assigned to seven treatments with six replicates of 15 chicks each. Diets treatments consisted of a Positive control (PC), 3 negative control diets with progressive reduction of nutrients (NC1, NC2 and NC3) and 3 levels of phytase (500, 750, and 1000 FTU/kg of Phyzyme® XP 5000G, Danisco Animal Nutrition) for each NC treatment. Diets were fed between 14 and 21 days of age. Digestibility of nutrients was determined by ileal digesta collection. A source of acid-insoluble ash (AIA) was added at 1% to the diets as an indigestible marker. At 21 days all birds were humanely slaughtered and the contents of the terminal ileum collected. The nutrient reductions in the NC diets resulted in significantly (P<0.05) lower ileal digestible energy (IDE) compared to the PC diet. Phytase supplementation (500 and 750 FTU/kg) of the NC diets improved (P<0.05) IDE by 8% on average. CP digestibility was not influenced by the reduction in nutrient levels in the NC diets. However, phytase supplementation increased the digestibility of CP (avg. 5%) and most AA (2-5%). For minerals, the digestibility coefficients of NC1 were inferior to the PC and phytase supplemented diets. Ileal digestibility of P, Zn, Cu, Mg and Na were improved (P<0.05) with 500 or 750 FTU/kg of supplemental phytase. These results confirm previously published reports on improved energy and nutrient digestibility in broilers fed diets containing microbial phytase.

Key Words: Phytase, Ileal digestibility, Broiler

216 Influence of dietary supplementation of organic minerals and phytase on mineral concentration in manure of replacement pullets. A. Mañón, A. Cantor*, A. Pescatore, M. Ford, H. Gillespie, and M. Daley, *Alltech-University of Kentucky Nutrition Research Alliance, Lexington.*

The effect of dietary supplementation of organic minerals (proteinates) and phytase on manure mineral concentration and growth performance was evaluated in a study using 1152 Hy-Line W-36 pullets, 2 wk of age. Corn-soybean meal starter, grower and finisher basal diets were fed with 1) no trace mineral supplement, 2) an inorganic trace mineral supplement or 3) an organic trace mineral supplement and with or without phytase in a 3 X 2 factorial arrangement of treatments. The levels of minerals (mg/kg diet) provided by the inorganic trace mineral supplement were: Cu (5), I (0.35), Fe (80), Mn (60) and Se (0.3) in the starter diets and Cu (4), I (0.35), Fe (60), Mn (30), Zn (35) and Se (0.3) in the grower and finisher diets. Mineral levels (mg/kg diet) provided by the organic trace mineral supplement were: Cu (1.8), I (3), Fe (9.6), Mn (16), and Se (0.2) in the starter diets and only half of these levels in the grower and finisher diets. Calcium and available phosphorus were both decreased by 0.1% in phytase supplemented diets. Twelve replicate groups of 16 pullets were assigned to each of the six treatments. The pullets were housed in cages in an environmental control building and experimental diets were fed from Weeks 3 through 18. Excreta samples were collected for 48 hr during Week 14 from eight replicates per treatment and analyzed for minerals content using induced coupled plasma spectrophotometry. Feeding the diets with organic minerals compared with those containing the inorganic trace mineral supplement significantly (P < 0.05) reduced manure concentrations of Cu (27 vs. 35 mg/kg dry matter), Fe (694 vs. 1068 mg/kg) and Zn (154 vs. 279 mg/kg). Compared with diets without enzyme supplementation, phytase decreased the levels of total P (28 vs. 33 g/kg), Ca (43 vs. 47 g/kg) and Fe (694 vs. 1068 mg/kg) in the dried manure. Growth performance was not affected by dietary treatments. The results indicate that both organic minerals and phytase can be used to significantly lower mineral concentrations in pullet manure.

Key Words: Trace minerals, Organic, Manure

217 Holo-analysis of the effects of genetic, managemental, chronological and dietary variables on the efficacy of a pronutrient mannanoligosaccharide in turkeys. G. Rosen*, *Pronutrient Services Ltd., London, England.*

All available negatively-controlled turkey test data sets from 16 publications on a yeast mannanoligosaccharide, Bio-Mos® (BM) Alltech Inc., have been holo-analysed by multiple regression of start-to-finish feed intake (FDI_{eff}), liveweight gain (LWG_{eff}), feed conversion ratio (FCR_{eff}) and mortality (MORT_{eff}) effects on 13 independent variables, control performance, year, duration, dosage, discontinuous dosage, hen, cage, pellet, antibiotic, anticoccidial, disease, high (>10%) control mortality and non-USA. Average responses are FDI_{eff} = -243g (-1.45%), LWG_{eff} = 57.0g (0.85%) and FCR_{eff} = -0.0156 (-0.75%), using 0.5 - 4.0gBM/kg feed (mean 1.06) in 21 - 140 (74.2) day tests on 12,723 turkeys in 33 tests in France (4), Poland (3) and USA (26), in which 24/33 tests manifest mean MORT_{eff} = 1.29% (14.9%). Respective coefficients of variation of these effects are 451, 451, 705 and 426% with beneficial response frequencies of 52% for LWG_{eff} and FCR_{eff} (jointly 33%) and 52% for MORT_{eff}. Outlier-free (2.5 x RMSE) models (p in .05/p out .10) gave no significant BM dosage terms; significant negative FDI, FCR and MORT control performance terms; enhanced FDI_{eff} with duration; reduced LWG_{eff} and FCR_{eff} with year; and better MORT_{eff} with disease and antibiotic. Less stringent models (p in .25/p out .34) for 30 FDI, 27 LWG, 30 FCR and 22 MORT outlier-free (1.5 x RMSE) tests indicate reduced FDI_{eff} with control FDI, hen, cage, pellet and high mortality; increased FDI_{eff} with duration; better FCR_{eff} with less efficient birds and anticoccidial; reduced FCR_{eff} with antibiotic; reduced MORT_{eff} in cage, pellet, USA test and control mortality; increased MORT_{eff} with disease and antibiotic; and reduced LWG_{eff} and FCR_{eff} and increased MORT_{eff} with year. Topics for future research when further data suffice include dose-response functions; discontinuous dosage effects; specific disease influences; BM interactions with other pronutrients (e. g. exogenous enzymes, microbials, etc.) and/or limiting nutrients; and comparisons with other oligosaccharides.

Key Words: Holo-analysis, Mannanoligosaccharide, Turkeys

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, 63µg/kg), or 1, 25(OH)₂ vitamin D₃ (low 1µg/kg, high 5µg/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*