Metabolism and Nutrition: Nutrition B - Enzymes

158 Effect of phytase and day length on the extent and location of phytate degradation. M. A. Leslie*[1], M. R. Bedford[2], and E. T. Moran[1], [1]*Auburn University*, *Auburn, Alabama*, [2]*Syngenta Animal Nutrition*, *Chestnut House, Beckhampton, United Kingdom*.

Microbial phytases are widely utilized to reduce inorganic phosphorous supplementation and excretion. The influence of day length and phytase supplementation on the degradation extent and location of phytate (IP6) degradation were investigated. Two hundred forty Ross 708 chicks were placed in four rooms, with 6 cages per room and 10 chicks per cage. All birds were fed a commercial type starter diet from 0 to 20 d. On day 20, 3 cages per room were maintained on a commercial type starter diet, and 3 cages were fed the same diet with 500 FTU of Quantumâ„¢ 2500D phytase. All diets were nutritionally complete with 0.45% aP. At the same time, 2 rooms were maintained on a 24 h lighting program, while 2 rooms were changed to 12 h light: 12 h dark. On day 24, all birds were euthanized, and the contents of the crop, proventriculus and gizzard (pooled), duodenum and jejunum (pooled), ileum, and a sample of excreta were collected, frozen and freeze dried. Samples were analyzed for acid insoluble ash marker content, and the level of water soluble and total IP6 and its degradation products (IP5 to IP2). Phytase supplementation increased feed intake, but had no effect on BW gain, thereby increasing feed conversion. These results are likely due to an increase in feed passage rate. As all diets contained adequate aP, no improvement in feed conversion would be expected. Phytase reduced the level of total IP6 and increased IP4 and IP3 in the crop, while unsupplemented diets showed higher levels of water soluble IP6 and IP5. Similar results were seen in the proventriculus and gizzard samples. Phytase reduced IP6 and increased the level of IP5 to IP3 in all small intestinal samples and the excreta. Solubility of all inositol phosphates was negligible in the small intestine and excreta. Lighting program only significantly reduced IP6 and increased other inositol phosphates in the small intestine, but not in the excreta. The interaction showed short day-length can increase IP6 dephosphorylation by phytase.

Key Words: phytase, phytate, dephosphorylation

159 Dietary phytate and phytase effects on laying hen performance, nutrient digestibility, mucin and VFA concentration. M. E. Persia*[1], E. Onyango[2], P. Jaynes[2], T. Parr[3], and T. J. Applegate[2], [1]*University of Delaware*, *Newark*, [2]*Purdue University*, *West Lafayette, Indiana*, [3]*Syngenta Animal Nutrition*, *Research Triangle Park, North Carolina*.

Two experiments (Exp) determined the effects of phytate and phytase concentration (conc.) on nutrient utilization, mucin conc. in the jejunum and cecal volatile fatty acid (VFA) conc. of laying hens. In both Exp, hens were fed normal and low phytate-P diets (0.22 and 0.16% in Exp 1; 0.21 and 0.13% in Exp 2) with and without phytase supplementation (400 U Quantum phytase/kg) in a 2 x 2 factorial arrangement. Low phytate diets were made using degermed and debranned corn and corn bran in place of corn in a corn-SBM diet. In Exp 1, 28 wk-old hens were fed experimental diets for 17 d prior to sample collection. Phytate or phytase did not affect feed intake, egg production or hen BW gain. Distal jejunal mucin decreased by 28% and cecal propionic acid increased by 17% in hens fed the normal phytate diet ($P<0.05$). In Exp 2, 45 wk-old hens were fed experimental diets for 13 d prior to sample collection. As in Exp 1, egg production was not different among the treatments. Phytase supplementation increased feed intake and reduced BW loss regardless of dietary phytate conc. The low phytate diet reduced feed intake. Ileal P digestibility was increased by 14% with phytase supplementation and reducing phytate content of the diet tended to increase P digestibility. Reducing dietary phytate increased ileal AMEn by 136 kcal/kg. Apparent ileal N digestibility was not affected by dietary treatment, but apparent ileal thr digestibility increased by 4.6 %-units in birds fed the low phytate diets. Distal jejunal mucin production was not affected by diet. Cecal acetic acid was 15% greater in birds fed the normal phytate diet ($P=0.01$). Phytase supplementation decreased cecal butyric acid conc. in birds fed diets containing normal phytate conc. but not in diets with reduced phytate ($P=0.05$). Normal dietary phytate conc. increased cecal total VFA conc. In conclusion, dietary phytate conc. and to a lesser extent supplemental phytase can affect intestinal dynamics in laying hens.

Key Words: laying hens, phytase, phytate

160 Manipulation of dietary calcium, phosphorus, and phytase in broilers. 1. Effects on performance. P. W. Plumstead*[1], A. B. Leytem[2,1], R. O. Maguire[1], E. Oviedo[1], and J. T. Brake[1], [1]*North Carolina State University*, *Raleigh*, [2]*USDA-ARS*, *Kimberly, Idaho*.

To evaluate the effects of dietary phosphorus (P), calcium (Ca), and phytase on broiler performance and P utilization, 2,016 Ross 508 broiler chicks were distributed among 72 floor pens with 14 male and 14 female chicks per pen. Each pen received 906 g per bird of a standard broiler starter feed after which 18 dietary treatments were applied in a randomized complete block design to each of 4 replicate pens from 14 to 42 d of age. A 3 x 3 x 2 factorial treatment structure was used with three levels of available P (AvP) (0.35%, 0.30%, and 0.25%) combined with three levels of Ca (0.80%, 0.69%, and 0.57%) with two levels of phytase (0 and 600 FTU; Quantum™) applied. All diets were pelleted with conditioning temperatures in excess of 80 C. BW of male and female broilers were determined separately while feed intake of mixed sex pens was determined at 0, 14, 28, and 39 d of age. At 39 d average BW gain and feed conversion ratio corrected for mortality (AdjFCR) was 2,413 g and 1.62 g:g across all treatments, respectively. Results showed no evidence of either a two-way or three-way interaction of dietary Ca, AvP, or phytase on the broiler performance. Combinations of AvP and Ca level had no effect on BWG or AdjFCR to 28 or 42 d. However, the stepwise reduction in dietary AvP intake did result in a significant linear increase in mortality to 28 d but not between 28 and 42 d, although effects remained significant for cumulative 42 d mortality. Phytase addition increased female BW gain from 14 to 28 d but only positive numerical effects of phytase were found for male and female BW gain to 42 d. In this study, adjusting the AvP and Ca levels and supplementing phytase had no detrimental impact on performance, although lowering the AvP intake significantly increased early mortality.

Key Words: poultry, broiler, phosphorus

161 Studies of the effects of adding a combination of dietary Ca, 1alpha-OH cholecalciferol, and phytase to a diet deficient in available phosphorus. A. Liem*, G. M. Pesti, and H. M. Edwards Jr., *University of Georgia*, *Athens*.

Previous research has shown that supplemental phytase and 1alpha-OH cholecalciferol (1alpha D_3) increases phytate P utilization. Decreasing Ca level in the diet also increases phytate P utilization. The current study was conducted to see if there is a three way interaction among these 3 factors and generate mathematical models of the results to study in detail the two and three way interactions. The criteria measured were 16 day body weight gain, feed intake, incidence of Ca and P rickets, percent and mg/tibia bone ash, and disappearance of phytate. The study used a 3 dimensional rotatable design with 5 levels of Ca (0.52, 0.6, 0.8, 1.0, 1.08 %), 1alpha D_3 (2.2, 3, 5, 7, 7.8 µg/kg), and phytase (2.27, 2.40, 2.70, 3.00, and 3.12 log of units/ kg). An experiment was conducted with 480 Cobb x Cobb mixed sex 1 day old chickens raised to 16 day. The diet was primarily corn and soybean meal with total P and available P content 0.5% and 0.24% respectively. The p-value in the full models for the 3 way interactions for body weight gain =0.1364, feed intake =0.3535, bone ash % =0.0278, mg bone ash/tibia =0.0909, calcium rickets =0.9394, phosphorus rickets =0.4892, tibial dyschondroplasia =0.5927, and phytate P disappearance =0.0882. Reduced models were used to generate 9 surface response of each criteria measured. The body weight gain response showed significant effects of all three variables, however, the Ca levels are a major effect on body weight gain and on the response to 1alpha D_3 and phytase. The bone ash response indicates that high phytase levels, lower Ca, and higher 1alpha D_3 levels of the diet are needed to obtain maximum bone ash. These results indicate that studies such as this to simulate practical dietary conditions may be conducted to identify the best level of nutrients to add to a diet where complex 3 way interactions exist affecting several criteria.

Key Words: 1 alpha-OH cholecalciferol, phytase, calcium

162 Incorporation of wheat middlings, citric acid, and phytase in a corn soybean meal diet: Effects on phosphorus utilization and growth in the grower and finisher phases. T. O'Connor-Dennie* and J. L. Emmert, *University of Arkansas*, *Fayetteville*.

Previous research has indicated that citric acid (CA) improves phosphorus (P) utilization of chicks in the starter phase, but has no additive effect when combined with wheat middlings (WM), despite high levels of intrinsic phytase activity in WM. One hypothesis for this lack of synergism is the underdevelopment of the GI tract of young broilers. To test this theory an experiment was conducted utilizing broilers from 18 d of age. Birds were placed on a common diet adequate in P from d 0 to d 18, on d 18 chicks were weighed and allotted to experimental diets. Twenty or 15 broilers were allotted to 15 treatments of 5 replications each, for grower (18 to 29 d) and finisher periods (29 to 43 d), respectively. Diets 1 through 4 consisted of a P deficient diet with graded levels of supplemental P (0, 0.04, 0.08, or 0.12% P respectively). Diets 5 through 15 were as diet 1 with phytase (300 or 600 FTU/kg), CA (3%) or WM (10%), alone or in combination. During the grower and finisher periods increasing dietary P, phytase and CA increased bone response variables. Increasing P and phytase levels increased growth, with 600FTU/kg negating all effects of decreasing dietary P. To assess bioavailable P release standard curves were used on data for grower and overall periods. Adjusted bone strength (ABS) (kg/mm2), gain (kg) and percent bone ash were the dependent variables and supplemental P consumption (kg) the independent variable. During the grower period adding phytase released a minimum of 0.06 % P based on ABS and gain values. There was an additive effect of phytase on CA, or CA and WM ($P < 0.001$) using ABS values, CA also had an additive effect on WM ($P < 0.001$). There was no additive effect using gain values. For the finisher phase a similar trend was observed using ABS and gain values. Therefore combining phytase, CA and WM is better than phytase alone for releasing P and negates negative effects of a severely deficient P diet on bone variables.

Key Words: citric acid, phytase, wheat middlings

163 The effect of dietary Ca and P content on the relative performance of Quantum phytase with that of a fungal phytase. M. R. Bedford*, C. L. Wyatt, and T. Parr, *Syngenta Animal Nutrition*, *RTP, North Carolina*.

Six replicate pens of 35 Ross 508 male broiler chicks were used for each of 12 treatments in an experiment to determine the effect of varying dietary Ca and P on the responses to a fungal (FP) or bacterial (Quantum ™ 2500D, QP) phytase. Corn-soy based diets were formulated to provide all nutrients at NRC requirement levels or greater (positive control (PC)), as the PC but with 0.14% and 0.13% less AvP in the starter (0-21d) and finisher (21-42d) respectively (Low P), or as the PC but with 0.15% less Ca in the starter and finisher (Low PCa). To each series of diets was added either 0, 250 or 500 units of QP or 500 units of FP phytase. Gain, intake and FCR data were analysed by ANOVA with main effects of diet CaP, enzyme type/dose and their interaction investigated with means being separated by use of the Lsmeans pdiff procedure ($p<0.05$) There was a clear reduction in gain and intake when the Low P and Lo PCa control diets were fed compared with the PC at both 21 and 42d. At 21, but not 42d, the Low PCa fed birds ate more and weighed more than the Low P fed birds. An interaction between dietary CaP and enzyme for gain and intake at both 21 and 42d of age occured due to the lack of any enzyme effects on the positive control but large responses on the negative control. At 42d of age, the addition of 500 units of QP to the Low P diet resulted in superior gain to that of the FP treatment. In the Low PCa diets no such difference was apparent due to an improvement in FP Low PCa performance relative to the Low P diet, QP performance remained relatively stable regardless of Ca concentration. FCR at 42d of age was improved by addition of phytases to the Low P but not the Low PCa diets. Optimum weight corrected FCR was achieved on the 500 unit dose of QP on the Low P diet. These data suggest that reduction in Ca as well as P is required for optimum functionality of the fungal phytase whereas the E. coli-derived phytase is able to perform equally well over a wide range of dietary Ca levels. Optimal overall performance was achieved on the low P diet supplemented with 500 units of phytase.

Key Words: phytase, calcium, phosphorus

164 Effect of different phytase sources on broiler performance and yield when added to the mixer and pelleted at two temperatures. T. Parr* and C. Wyatt, *Syngenta Animal Nutrition*, *Research Triangle Park, North Carolina*.

A previous study has been published indicating that a non-coated thermo-tolerant phytase (Quantum™) supported broiler performance

and significantly outperformed a coated fungal phytase (CFP) when pelleted at 80C (Parr et al., 2006). A second 49-day trial was conducted to compare performance and carcass yield of broilers fed two different sources of phytase when pelleted at 81 or 87C. A commercial four-phase feeding program consisting of corn/soybean meal/meat-bone meal diets was formulated and fed to 11 replicate pens (17 male broilers/ pen) for each diet. Two similar formulations were used for the Quantum in this study: Phytase D (QPD) and Phytase XT (QPXT). The dietary treatments consisted of a positive control (PC), a negative control (NC: nutrient reduction of 45 kcal/kg ME, 0.13% available P, 0.10% Ca, 0.01% Lys, 0.29% Thr and 0.18% TSAA), NC + 500U/kg CFP, NC + 500U/kg QPD, or NC + 500U/kg QPXT added to the mixer and pelleted. Birds fed QPD and QPXT diets pelleted at 81C were heavier (P<0.01) than CFP, NC and PC-fed birds at both 40 and 49d. At 87C, QPD and QPXT-fed birds weighed more (P<0.01) than CFP and NC-fed birds at 40d, whereas by 49d the QPXT-fed birds had heavier (P<0.01) weights than the other diets. At d40, both feed intake and FCR were improved (P<0.01) in QPXT-fed birds compared to NC and CFP birds at both pellet temperatures. FCR at d49 was not different (P>0.05) between phytase sources at 81C, but at 87C, the QPXT-fed birds were more efficient (P<0.01) than the QPD or CFP-fed birds. Feeding the NC or CFP diets pelleted at both temperatures resulted in significantly less carcass yield compared to QPXT, QPD and PC-fed birds. The difference in carcass yield was found to be correlated to an increase leg quarter % compared to breast yield % with birds fed Quantum having the highest leg %. This study further validates that Quantum can support performance and yield when using the high nutrient reduction in diets pelleted up to 87C compared to the CFP sources.

Key Words: phytase, Quantum, broiler

165 Dietary phytase activities and the efficiency of energy utilisation in chickens. V. Pirgozliev*[1], P. Mares[2], T. Acamovic[1], and M. R. Bedford[3], [1]*ASRC, Scottish Agricultural College*, *Edinburgh, Scotland, United Kingdom*, [2]*Mendel University of Agriculture and Forestry*, *Brno, Czech Republic*, [3]*Syngenta Animal Nutrition Inc.*, *Marlborough, Wiltshire, England, United Kingdom*.

Exogenous phytase is often added to poultry diets to increase mineral availability, growth performance of the birds and reduce environmental pollution. Although it has been hypothesised that dietary phytase may also increase the efficiency of dietary energy utilisation, there is a lack of scientific data supporting this hypothesis. The aim of this experiment was to determine the effect of dietary phytase on performance and efficiency of gross energy retention (EGER) and metabolisable energy retention (EMER) when fed to young broiler chickens. Forty-eight male Ross broilers (from 7 to 17d age) were used and four soya-maize based diets (positive control (PC), negative control (NC), NC + 500, + 12500 FTU (phytase units/kg feed)). The enzyme used was derived from an evolved E. coli phytase (Quantum 2500D: Syngenta Animal Nutrition Inc.). There were six replicates of each diet in a randomised block design. Birds offered the diet containing 12500 FTU performed significantly better (P<0.05) than the NC group and tended (P>0.05) to have better growth performance compared to PC fed birds. The EGER and EMER for the enzyme supplemented diets were significantly higher (P<0.05) compared to the negative control. The result of this study support the hypothesis from previous research that dietary phytase improves the efficiency of energy utilisation and, as a result, improves nutrient utilisation and the performance.

Key Words: phytase, broilers, efficiency of energy retention (EER)

166 Broiler performance on phytase-supplemented defatted rice bran diet during heat stress. M. O. Smith*[1] and O. Puminn[2], [1]*The University of Tennessee*, *Knoxville*, [2]*Kasetsart University*, *Kamphaengsaen, Nakom Pathom, Thailand*.

An experiment was conducted to determine broiler performance and mineral utilization of defatted rice bran diets supplemented with phytase under two different environmental temperatures. Six replicate groups of chicks were assigned to five dietary treatments consisting of a control corn-soybean meal based diet with 25 % cornstarch and four diets containing two levels of defatted rice bran (10 and 25 %) with or without commercial phytase (500 units/kg diet) supplementation. Birds were weighed weekly and feed intake determined. On day 21 birds were transferred to either a thermoneutral (23.9 C) or a heat stress (23.9-35 C, diurnal cycling) environmental chamber. Digesta retention time was determined and a 5-day total excreta collection was done at 35 days. Birds were slaughtered at 49 days, tibias harvested, and intestines collected. Including up to 25 % defatted rice bran in the diets of broilers was not detrimental and feed cost per weight gain of birds fed 25 % defatted rice bran was lower. Percent phosphorus, zinc, and manganese in tibia of birds fed 10 % defatted rice bran was improved by supplemental phytase. The adverse effects of heat stress on bird performance was not improved by phytase supplementation.

Key Words: defatted rice bran, broiler heat stress, phytase

167 Manipulation of dietary calcium, phosphorus, and phytase in broilers. 2. Effects on total and soluble phosphorus excretion. A. B. Leytem*[2,1], P. W. Plumstead[1], R. O. Maguire[1], E. Oviedo[1], and J. T. Brake[1], [1]*North Carolina State University*, *Raleigh*, [2]*USDA-ARS*, *Kimberly, Idaho*.

To address the effects of phosphorus (P), calcium (Ca), and phytase on manure and litter P excretion in broilers, 2,016 Ross 508 broiler chicks were distributed among 72 floor pens with 14 male and 14 female chicks per pen. Each pen received 906 g per bird of a standard broiler starter feed after which 18 dietary treatments were applied in a randomized complete block design to each of 4 replicate pens from 14 to 42 d of age. A 3 x 3 x 2 factorial treatment structure was used with three levels of available P (AvP) (0.35%, 0.30%, and 0.25%) combined with three levels of Ca (0.80%, 0.69%, and 0.57%) with two levels of phytase (0 and 600 FTU; Quantum™) applied. The AvP level of phytase amended diets was held constant by replacing 0.10% of the inorganic P from dicalcium phosphate with 600 FTU of phytase, while Ca and AvP levels of diets were varied by altering proportions of limestone, dicalcium phosphate, and an inert filler. To assess treatment effects on P excretion, fresh litter and manure were collected when the broilers were 39 and 41 d of age, respectively. Litter and manure was analyzed for total and soluble P. Results indicated that the inclusion of phytase at the expense of inorganic P, or reductions in AvP decreased total P excretion. Soluble P in the litter and manure decreased with decreased AvP or with increased dietary Ca levels. Manure soluble P decreased with phytase addition. The ratio of Ca:AvP in the diets was negatively correlated with the solubility of P in both litter and manure. The ratio of litter soluble P:total P increased with phytase additions at all ratios of Ca:AvP. This study indicates that while feeding reduced AvP diets with phytase decreased litter total P, the ratio of Ca:AvP in the diet was primarily responsible for effects on soluble P. This is important from an environmental perspective as the amount of soluble P in litter and manure is related to potential off site P losses following land application.

Key Words: poultry, broiler, phosphorus

168 Effects of varied levels of dietary nonphytate P and Ca on P excretion and relationship between plasma inorganic P and urinary excretion of P in broilers. M. K. Manangi* and C. N. Coon, *University of Arkansas*, *Fayetteville*.

Two 5-d bioassays were conducted to evaluate the relationship between dietary NPP and plasma inorganic P (iP) levels in relation to nonphytate P (NPP) retention using normal birds and urinary P excretion using colostomized birds when the birds were supplemented with varied levels of NPP and Ca. For Experiment (Expt) 1, 40-d old Cobb-500 male broilers chicks were placed in individual metabolic cages and offered corn soybean test diets consisting of 8 levels of NPP (0.08, 0.13, 0.18, 0.23, 0.28, 0.33, 0.38, and 0.45%) combined with a fixed level of Ca (0.5%) and phytate P (0.17%). Reagent grade $CaHPO_4.2H_2O$ was added to the basal diet as additional NPP source and 2% acid insoluble ash was used as a marker. Ten broiler chicks were fed each of the 8 test diets for the 80 experimental units. On day 5 of the Expt, blood samples were collected from 5 birds for each treatment group. Another group of 40-d Cobb-500 broiler chicks previously colostomized at 3-4 wks of age were fed the 8 experimental diets in order to collect excreta and urine samples separately. Expt 2 was conducted the same as Expt 1 using 50-d old birds, however Ca was maintained at 0.9% for all diets. Expt 2 was identical to Expt 1 with the exception of dietary Ca levels. Segmented line regression methodology was used to determine the break point estimates for plasma iP, urinary P and Ca excretion, and NPP retention. The estimates at the break points for plasma iP and feed NPP content (X), urinary P excretion and X, urinary Ca excretion and X, NPP retention and X for Expt 1 were 8.13mg/dL and 0.26%, 6.02mg/d and 0.28%, 4.12mg/d and 0.30%, and 78.36% and 0.29%, respectively, and for Expt 2, these estimates were 7.51mg/dL and 0.27%, 1.93mg/d and 0.21%, 11.16mg/d and 0.30%, and 82.21% and 0.25%, respectively. Increasing dietary NPP increased plasma iP concentration and increased % NPP retention until the broilers reach a point of physiological threshold for P. The excess P beyond physiological threshold is eliminated as reflected by decreased efficiency in % NPP retention.

Key Words: colostomized, urinary P and Ca, NPP retention

169 Apparent ileal digestibility and total tract nutrient retention of chickens receiving a cocktail of carbohydrases and protease or phytase individually or in combination. O. A. Olukosi*[1], A. J. Cowieson[2], and O. Adeola[1], [1]*Purdue University*, *West Lafayette, Indiana*, [2]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, United Kingdom*.

The effect of adding a cocktail of xylanase, amylase and protease (XAP) or Escherichia coli-derived phytase (ECP) individually or in combination on ileal nutrient digestibility and total tract nutrient retention of chicks receiving corn-soybean meal-based diet was investigated. Six hundred d-old chicks were used for the 21-d study and were allocated to 5 dietary treatments in a randomized complete block design. The treatments were: positive control with supplemental inorganic P (PC), negative control (NC) marginal in P and energy; NC plus XAP added at 0.2 g/kg to supply 650; 1,650; and 4,000 units of xylanase, amylase and protease, respectively per kg feed; NC plus ECP added at 1,000 FTU/kg; and NC plus XAP added at 0.2 g/kg and ECP added at 1,000 FTU/kg. Ileal digestibility of DM was higher ($P < 0.05$) in PC compared with NC, phytase improved ($P < 0.05$) ileal DM digestibility above the NC diet; but XAP alone or combined with ECP did not improve DM digestibility. Ileal nitrogen digestibility was improved ($P < 0.05$) above the NC by the addition of XAP or phytase individually. Ileal P digestibility was highest ($P < 0.001$) in diet with ECP and lowest in NC diet. Ileal ME was higher ($P < 0.01$) in PC than NC, but there were no effects of the enzymes individually or in combination on ileal ME. Total tract DM retention was lower in NC ($P < 0.01$) than PC but was improved ($P < 0.05$) above the NC by the addition of the enzymes individually and in combination. Total tract P retention was highest ($P < 0.01$) in diet with ECP and lowest in NC. Total tract N retention was significantly improved ($P < 0.01$) above the NC diet by the addition of XAP and ECP individually and in combination. Both enzymes alone and in combination improved ($P < 0.01$) total tract DM retention whereas only ECP improved ($P < 0.05$) ileal DM digestibility. In conclusion, XAP and ECP individually and in combination improved ileal digestibility and total tract nutrient retention of N and P in chickens fed corn-soybean meal-based diet that is marginally deficient in energy and phosphorus.

Key Words: carbohydrases, digestibility, phytase

170 Performance parameters and egg ω3 fatty acids content in laying hens fed flaxseed diets without or with enzyme supplementation. W. Jia*[1], B. A. Slominski[1], W. Guenter[1], A. Humphreys[2], and O. Jones[3], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Maple Leaf Animal Nutrition*, *Winnipeg, MB, Canada*, [3]*Canadian Bio-systems Inc.*, *Calgary, Canada*.

A 2×2 factorial experiment was conducted to evaluate the effects of diet type [flaxseed (150 g/kg diet)] or Linpro® [flaxseed : peas, 1:1 wt/wt (150 g/kg diet)] and enzyme addition (none or 0.2 g/kg diet) on egg production parameters, egg ω-3 fatty acids content and nutrient digestibility in Hy-Line CV-20 laying hens. The enzyme supplement contained cellulase, pectinase, xylanase, glucanase, mannanase, and galactanase activities. Each of the four treatments was randomly assigned and replicated six times with 18 hens per cage unit for a total of 108 birds per treatment from 39 to 63 weeks. The experiment was divided into two phases of three 28 days periods each. Performance data from each phase were combined and analyzed statistically by mixed procedure as repeated measurements. All diets were pelleted and crumbled. Phase I and Phase II diets contained 19% and 18% CP, respectively. Hens consuming the Linpro diets had overall higher egg production (84.7%; $P<0.0001$), lower feed consumption (98.5g/hen/day; $P=0.02$), and therefore better feed efficiency (1.95g feed/g egg; $P<0.001$) than those fed the flaxseed diets (79.4%, 100.1g and 2.09, respectively). Enzyme supplementation significantly increased ($P<0.01$) egg production (from 78.0 to 80.9%) and improved ($P<0.001$) feed efficiency (from 2.15 to 2.03) in hens fed the flaxseed diet. There was no significant effect of enzyme addition on egg production (84.7 vs 84.6%) and feed efficiency (1.97 vs 1.93) in hens fed the Linpro diet. Neither diet type nor enzyme supplementation affected the egg size which averaged 60.3g for the entire trial. Hens fed the Linpro diets produced eggs with superior shell quality ($P<0.0001$) and egg specific gravity higher than that from birds consuming the flaxseed diets (1.0793 vs 1.0755). Enzyme supplementation significantly increased ($P<0.01$) the specific gravity of the eggs produced by hens fed the flaxseed diet in Phase I (1.0800 vs 1.0773) but not in Phase II of the experiment. Both diet type and enzyme supplementation significantly affected ω-3 fatty acids deposition in the egg. Eggs produced by hens fed the flaxseed diets had higher ($P<0.0001$) ω-3 content (562 mg/60g egg,) and lower ω-6 to ω-3 ratio (1.30) than those from hens consuming the Linpro diet (427 mg/60g egg and 1.71, respectively). Enzyme supplementation increased the

egg ω-3 content for the flaxseed diet (from 546 to 578 mg/60g egg; P=0.02) and for the Linpro diet (from 415 to 438 mg/60g egg; P=0.07). As well, an overall decrease (P=0.01) in ω-6 to ω-3 ratio (from 1.53 to 1.47) was noted. Enzyme addition increased (P=0.02) the NSP digestibility from 17.2 to 24.6%. There was no significant effect of enzyme addition on total tract fat digestibility. Overall, hens fed the Linpro diets had higher (P=0.02) fat digestibility than those fed the flaxseed diets (95.6 vs 89.9%). It could be concluded from this study that both dietary ingredient (i.e., Linpro) and diet processing along with enzyme supplementation had positive effects on feed utilization and the production of ω-3-enriched eggs.

Key Words: laying hens, flaxseed, ω-3 eggs

171 Energy releasing effect of an alpha amylase - beta glucanase blend in all vegetable corn soy diets for broiler. A. G. Bertechini*[1], S. L. Vieira[2], J. C. Carvalho[1], J. A. G. Brito[1], and G. O. Figueiredo[1], [1]*UFL*, *Lavras, MG, Brazil*, [2]*UFRGS*, *Porto ALegre, RS, Brazil*.

Enzyme inclusion in broiler feeds has been increasing. Theoretically, enzyme blends can show a larger spectrum to improve nutrient utilization from low digestible substrates. In this study, 960 Cobb X Cobb 500 broiler chicks were placed in 32 floor pens. All birds were fed corn-soybean meal all vegetable diets allocated to 4 different treatments having energy and nutrients to meet or exceed NRC (1994). A Positive Control was formulated with ME levels as usual in commercial integrations from 1 to 7, 8 to 21, 22 to 35 and 35 to 42 days (2,950; 3,050; 3,150 and 3,200 kcal/kg). A Negative Control was formulated with 3% reduction in ME. This was accomplished by exchanging soy fat from the the Positive Control formulation by an inert. The other two treatments were produced through the supplementation of the Negative Control with 300 and 400 grams of Ronozyme A (200 kilo-Novo alpha-amylase units and 350 fungal beta-glucanase units per gram). Eight replicates of each treatment were used in a Completely Randomized Design. In parallel, a metabolism assay was conducted with broilers placed in steel cages, 10 birds per cage, 6 replicates per treatment. Birds with 24 days of age received the grower feed for 4 days of adaptation and 3 days of total excreta collection. Body weight, feed intake and feed conversion were significantly improved for birds of Positive Control when compared to the Negative Control. The enzyme blend added to the Negative Control demonstrated a complete recovery in performance, similar to the Positive Control. However, differences between the two enzyme levels were not seen. Results from the metabolism assay showed consistency in formulated versus analyzed ME's. Improvements in analyzed ME values of 2,06 and 4,36% were observed after inclusion of 300 and 400 grams of the enzyme blend, respectively. Viscosity of excreta samples colected at 42 days and the yield of carcasses and commercial cuts were not affected by the treatments.

Key Words: broiler, enzyme, amylase

Physiology, Endocrinology, and Reproduction: Physiology

172 Can a novel lighting program for turkey breeder hens delay the expression of photorefractoriness and boost late-season egg production? J. A. Proudman*[1] and T. D. Siopes[2], [1]*USDA-ARS*, *Beltsville, Maryland*, [2]*University of North Carolina*, *Raleigh*.

Turkey breeder hens are commonly photostimulated to lay using a day length of at least 14 h of light (14L:10D), which results in a rapid onset and high peak of egg production. Some lighting programs then increase day length further as the reproductive season progresses. Long day length leads to photorefractoriness (PR) and an end to the breeding season in many hens. We have previously shown that a 12h photoperiod will not induce PR, but it also will not reliably stimulate maximum egg production. In this study, we photostimulated hens with a 16L:8D photoperiod for 8 wk to achieve maximum peak production and then reduced day length to 12L to reduce PR. After 7 more wk, we increased day length to 18L to boost late-season production in hens that remained photosensitive. Control hens received 16L:8D until 15 wk and then 18L:6D until the experiment was terminated at 34 wk. Results showed that hens receiving the experimental photoperiod had a lower incidence of PR than controls over 34 wk of production (10% vs 27%), and that egg production was significantly higher in the experimental group between 17 and 34 wk of lay. However, overall egg production did not differ between groups because 10% of the treated hens ceased laying during the 12 h light treatment period. These hens remained photosensitive and resumed lay when returned to a longer photoperiod (18L). We conclude that a reduction in photoperiod to 12L after 8 wk of conventional photostimulation will reduce PR, extend photosensitivity, and permit a subsequent boost in late-season egg production. Additional studies are needed to achieve a lighting program that will extend photosensitivity while maintaining egg production in all hens.

Key Words: turkey, photorefractoriness, photoperiod

173 Can typical poor egg production by turkeys during the summer be accounted for by insufficient lighting and reduced photoperiodic drive? T. D. Siopes*, *North Carolina State University*, *Raleigh*.

This experiment tested the hypothesis that typical poor egg production during the summer is a consequence of insufficient lighting and reduced photoperiodic drive. Large White turkey breeder hens were photostimulated at 30 wk of age with incandescent light on April 12 for summer (off-season) egg production and continued for 28 wk. The lighting treatments were given in a 2 x 2 factorial arrangement with day length and light intensity as main effects. Day length used was 15L:9D and 18L:6D whereas the intensities were 567 ± 67 and 22 ± 2 lux. All the treatments were within a light controlled building and there were 8 replicate pens of 5 hens for each treatment. Data were collected, by pen, for onset and the rate of lay; BW and feed consumption at 4 wk intervals; EW at 4 wk intervals including the weight of the first 14 eggs laid; livability; and, plasma thyroid hormones for 8 wk post-lighting. The rate of egg production through 28 wk of photostimulation was better in the hens receiving 18 than 15 h of light per day (14 eggs/hen difference) but was similar between the two intensity treatments. The lower number of eggs in the 15 h group was associated with a greater number of photorefractory hens than in the 18 h of light per day group