53 Influence of NSP enzyme (Rovabio) on energy sparing and growth performance of broilers fed corn-based diets containing corn distillers dried grain with solubles. B. S. Lumpkins*,1, G. F. Mathis1, S. K. Rao2, and D. R. McIntyre1,1Southern Poultry Research Inc., Athens, GA, 2Foster Farms, Delhi, CA, 3Adisseo, Alpharetta, GA.

The study was conducted to investigate the effects of a multi-enzyme complex (Rovabio Excel) containing carbohydrase activities on the performance of broiler chickens. Test diets were formulated to include 12% corn distillers dried grain with solubles (DDGS). In total, 1200 Cobb 500 broiler males were randomly assigned to 8 replicate pens of 50 birds per treatment and grown to 45 d of age using one of 3 different dietary regimens. Birds in Treatment 1 received industry standard broiler feeds that served as the positive control (PC) program. Treatment 2 diets were adjusted to reduce Metabolizable Energy (ME) by 132 kcal/kg and were designated as the negative control (NC) group. Feeds in Treatment 3 were the same as NC but with the addition of a NSP enzyme, Rovabio (ROV). A 5 feed program was used to provide: starter (1–13d), grow 1 (13–21d), grow 2 (21–32d), finisher (32–39d) and withdrawal (39–45d), respectively. Birds were weighed at 0, 21, 35 and 45d; feed conversion ration (FCR), feed intake and mortality were also determined at each weigh day. Calorie reduction in the NC treatment significantly reduced weight gain compared with the PC treatment at 45d (2.45 vs. 2.51 kg). FCR in the NC birds was higher than the PC (1.78 vs. 1.75). Adding the NSP enzyme (Rovabio) to the NC feeds restored both weight gain and feed conversion (2.54 kg and 1.75, respectively). No differences in mortality were observed.

Key Words: NSP-enzymes, DDGS, broiler

54 Effects of low oligosaccharide soybean meal and α-galactosidase supplementation on growth and meat yield responses of broilers during a 40 day production period. K. R. Perryman* and W. A. Dozier III, Auburn University, Auburn, AL.

This study examined the interactive effects of soybean meal (SBM) source and α-galactosidase supplementation on growth performance, meat yield, and physiological variables during a 40-d production period. Twelve hundred (25 per pen; 0.09 m² per bird) Ross × Ross 708 male chicks were randomly distributed to 48 floor pens (12 replicates per treatment). Birds were fed diets containing 2 SBM sources [conventional soybean meal (CSBM) or low oligosaccharide soybean meal (LOSBM)] and 2 concentrations of α-galactosidase (0 or 12,000 units/kg SBM) in a 2 × 2 factorial arrangement. In diet formulation, determined AMEn values were used for each SBM source from a previous energy balance assay. Overall, diets containing LOSBM had a 64% reduction in added fat due to its higher AMEn compared with diets formulated with CSBM. Dietary treatments were fed from 1 to 13, 14 to 28, and 29 to 40 d of age during starter, grower, and finisher periods respectively. Body weight gain, feed intake, feed conversion ratio (FCR), mortality, carcass yield, abdominal fat yield, breast meat yield, plasma glucose, plasma triglycerides, plasma free fatty acids, and intestinal viscosity were assessed. Broilers fed diets containing LOSBM increased (P < 0.001) BW gain from 1 to 13 d of age and decreased (P ≤ 0.012) FCR from 1 to 13 and 1 to 40 d of age. α-Galactosidase supplementation reduced (P ≤ 0.033) BW gain from 1 to 28 and 1 to 40 d of age and decreased (P = 0.039) feed intake from 1 to 40 d of age. Processing characteristics were unaffected by SBM source or enzyme addition with the exception of carcass yield being increased (P < 0.044) with broilers fed the LOSBM treatment, and lower (P < 0.012) breast yield was observed with birds fed diets with α-galactosidase. No differences (P > 0.05) were measured for physiological variables between treatments. These results indicated that LOSBM does not adversely affect growth performance and meat yield, but reduces fat supplementation due to its higher AMEn.

Key Words: α-galactosidase, broilers, oligosaccharide, soybean meal


The use of distillers dried grains with solubles (DDGS) in poultry diets may be cost effective alternative for supplying energy and protein. However, the use of high levels of DDGS in broiler diets may be limiting due to negative effects on performance and carcass characteristics. The use of enzymes may overcome the nutritional challenges associated with feeding high levels of DDGS to broilers. An experiment was conducted to evaluate the use of 2 sources of DDGS and the effect of enzyme supplementation on performance and carcass characteristics of birds fed diets with high levels of DDGS inclusion. One thousand four hundred-40 1-d-old male Heritage broilers were randomly assigned to the 9 dietary treatments; 1) 0% DDGS(control); 2) a diet containing DDGS1; 3) a diet containing DDGS2; 4) a negative control diet (reduced in energy and protein) with DDGS1; 5) a negative control diet with DDGS2; 6) as diet 4 + enzyme 1; 7) as diet 5 + enzyme 1; 8) as diet 4 + enzyme 2; 9) as diet 5 + enzyme 2. The diets contained 9% DDGS during the starter period (0 to 21 d) and then 12% DDGS there after (15 to 49 d). Eight replicate pens containing 20 chicks were fed each experimental diet. The diets were formulated on a digestible amino acid basis for all periods. There was no difference in broiler performance for chicks that were fed DDGS1 or DDGS2. However the birds fed the diets containing 9% DDGS from either source were not (P < 0.05) as efficient (gain:feed) as the birds fed the control diet (with no DDGS inclusion) from 0 to 21 d of age. The supplementation of the enzymes to the 9% DDGS diets improved (P < 0.05) feed efficiency as compared with the 9% DDGS diets un-supplemented with enzyme from 0 to 21 d. Performance from 22 to 49 d and carcass characteristic data are currently being collected. Careful consideration should be given when 9% DDGS is fed to broilers for starter period (0 to 21 d) due to negative effects on feed efficiency. The supplementation of enzymes to broiler diets with high DDGS inclusions level (9%) may overcome the negative effects of DDGS.

Key Words: DDGS, broilers, enzymes, performance, carcass characteristics

56 Influence of exogenous celluloses, hemicelluloses, protease and α-amylase enzymes preparation at ensiling (ZADO-complex) in the diets on broiler performance and slaughter traits from 1 to 42 days of age. H. M. Saffaa*, Animal Production Department, Faculty of Agriculture, Cairo University, Giza, Egypt.

A total of 480 Cobb-500 broiler chicks at one-day old was used to study the effect of exogenous celluloses, hemicelluloses, protease and α-amylase enzymes preparation at ensiling (ZADO-complex) on the productive performance and slaughter traits. Chicks were divided randomly into 4 treatments (diets supplemented with 0, 2, 4 and 6% with...

Effect of dietary protein level and protease supplementation on performance and gut health was evaluated in 2 studies. For study 1, 288 broilers were used to examine effect of normal crude protein (CP) vs. high CP (22% vs. 30%) without or with protease (CIBENZA DP100, Novus International Inc.) supplementation in a 2 × 2 factorial arrangement. Each test diet was fed to 9 replicate pens of 8 birds from 0 to 28 d. All diets contained 20% rye and 25% wheat, high CP diets had 14% poultry meal, and all birds were given a cocci challenge (10⁹ immunizing dose) on d 7. In the absence of protease, increasing dietary CP increased ileal Clostridium perfringens (C.p) by 2 logs (2.35 vs 2.824c, T6, 2.892ab. Feed intake (kg/bird) (P < 0.05) T1, 2.836c, T2, 2.846bc, T3, 2.860abc, T4, 2.900c, T5, 2.824c, T6, 2.892ab. Feed intake (kg/bird) (P < 0.001); T1, 4.859c, T2, 5.047a, T3, 5.049b, T4, 4.999b, T5, 5.053a, T6, 5.010a. Feed conversion (P < 0.002); T1, 1.737a, T2, 1.797a, T3, 1.789bc, T4, 1.747a, T5, 1.814c, T6, 2.008b). Results indicated that body weight and body weight gain were decreased in response to dietary 6% ZADO-complex comparing to the other treatments (P = 0.0112 and 0.0097, respectively). Moreover, feed intake and feed conversion were improved and mortality rate was decreased in response to dietary 4 and 6% of ZADO-complex comparing to 0 and 2%. Feed conversion ratio was 1.95, 1.90, 1.76 and 1.68 for birds fed diet supplemented with 0, 2, 4 and 6% ZADO-complex, respectively. In addition, birds fed diet supplemented with 6% ZADO-complex recorded higher dressing, internal organs and immune organs relative weights at 6 weeks of age than other treatments (P ≤ 0.05). It could be recommended from this study to supplement 4% or more of ZADO-complex to broiler diet from 0 to 42 d of age for improving the productivity and slaughter traits.

Key Words: ZADO-complex, broiler performance, slaughter traits

58 New model for examining the energy release of exogenous enzymes in laying hen rations. G. R. Murugesan* and M. E. Persia, Iowa State University, Ames.

A 12-wk experiment was conducted with 90 Hy-line W-36 laying hens to investigate energy release of an exogenous enzyme cocktail (EE) with special attention to productive, maintenance and storage energy. The experiment was arranged as a 2 × 3 factorial design, with ad-libitum and feed restriction (90g/hen/day) groups and 3 dietary treatments (positive control; PC, negative control; NC, and NC with EE; NEE). The experiment unit (EU) was an individually housed hen (192 in2) resulting in 15 EU randomized in a complete block design for each of the 6 treatments. The PC was formulated to meet or exceed industry based requirements with 3150 kcal/kg, the NC diets were similar to the PC with the exception of a 100kcal/kg reduction in ME. Hens were secured from a local commercial facility at 22 weeks of age and were allowed to transition to the experimental facilities for 2 weeks before experimental diets were provided. Egg production and mortality data were collected daily, feed intake was measured weekly and hen body weight was determined monthly. Statistical analysis was carried out using ANOVA with protected LS means used to separate means. There were no interactions throughout the experiment, but feed restriction resulted in significant reductions in feed intake, egg production, ending body weight, feed conversion ratio and fat pad. Hens fed the NEE diet resulted in a slight, but significant increase in feed intake and feed conversion ratio in comparison to the PC fed birds. The reduction in energy between the PC and NC fed birds (100 kcal/kg) did not change productive energy (egg production and egg weights) or maintenance energy (body weight), but did result in a significant reduction in energy storage (reduced fat pad). The NEE diet resulted in no change in the productive or maintenance energy but significantly increased the energy storage (fat pad) and returned energy storage to the level of the PC fed birds. These results suggest that although productive and maintenance energy were minimally affected, in this experiment the EE did liberate energy from the diet that was stored as fat in the fat pad of the hens.

Key Words: protease, broiler, protein, gut health
Key Words: broiler, enzymes, phytase, carbohydrase, protease

60 Effect of xylanase on performance of starter broilers fed diets containing maize harvested in different regions. H. V. Masey O’Neill1 and N. Liu2,1 AB Vista Feed Ingredients, Marlborough, Wiltshire, UK, 2 Henan University of Science and Technology, Luoyang, China.

Maize composition and physical characteristics vary with geography, agronomic inputs, environment and variety. It is thought that this may affect the nutritional value and response to dietary enzyme addition. The objective of this study was to investigate the effect of a commercially available xylanase on the growth performance of starter broilers fed diets containing maize of one variety, harvested in different regions in China. Samples of the maize were harvested in 2010 from 5 geographically diverse regions: Heilongjiang, Henan, Sichuan, Xinjiang and Zhejiang. Each test maize was fed individually in a mash diet as follows. Diets were formulated as (g/kg) test maize 608.3; SBM 324.1; poultry fat 25.2; salt 4.6; met 2.6; lys 1.6; thr 0.5; limestone 9.7, dicaf 18.4; vit/min 5.0; CP 210 and ME (kCal/kg) 3085. Each maize diet was fed with or without xylanase at 16,000U/kg. The diets were fed to 720 Arbor Acres broilers with 6 replicates, each containing 12 birds, per treatment, from 0 to 18 d of age. Data was analyzed as a 5 (test maize) x 2 (□− xylanase) factorial design. Pen was the experimental unit. The results showed that there was no effect of harvest region on the FI, BWG or FCR of the broilers over the 18 d period (P = 0.959, 0.926, 0.819 respectively). There was a significant improvement in all parameters with the addition of xylanase (Fi P = 0.011; BWG and FCR P < 0.001 in each case). There was no interaction between harvest region and xylanase addition (Fi P = 0.629; BWG P = 0.482; and FCR P = 0.736). The broilers performed well according to the breed guidelines, with slightly increased FI, increased BWG and similar FCR before the addition of xylanase. When FCR and BWG were analyzed with FI as a covariate, xylanase addition remained significant suggesting that the improvement in BWG and FCR was driven by an increase in digestibility and nutrient availability.

Key Words: broiler, maize, performance, xylanase

61 Interaction of heat-resistant β-mannanase feed enzymes with broiler chickens infected with Eimerian parasites. D. M. Anderson*1, H.-Y. Hsiao1, K. Schuster1, T. Holder1, J. Engel1, S. FitzCoy1, and L. Liu1,1 ChemGen Corp., Gaithersburg, MD, 2 Internet/Schering Plough, Millsboro, DE, 3 Allen Family Foods, Seafood, DE.

A β-mannanase feed enzyme (Hemicell HT) has been developed with intrinsic heat, acid and protease resistance (Hsiao et al. JAM, Denver, July 15, 2010). This enzyme was further improved providing a half-life in solution of 15 min at 96.5°C while still retaining full activity at 40°C. In 2 separate cage experiments birds were infected with Eimeria sp both with and without heat tolerant β-mannanase in the diets. The heat tolerant β-mannanases were heated at 75°C to inactivate other enzyme activities in the preparations before use. In one experiment using Ross 708 broilers (8 per cage and 8 replicate cages per treatment) were infected with either E. tenella or E. maxima at d 2 through the feed and water. Total feces were collected from each cage during d 8–10, blended, and the oocysts per gram feces were counted. In a second cage experiment with Cobb × Cobb broilers (6 per cage and 6 replicate cages per treatment) birds were infected by gavage at d 13 with a mixture of E. acervulina, E. maxima, and E. tenella. On d 18–20 total feces were collected from each cage and oocysts per gram feces were also measured. In this case an additional control with Salinomycin medicated feed was used, as well as comparison of 4 mannanase types including enzymes of bacterial and fungal origin. In both experiments with either the Ross 708 or Cobb × Cobb broilers, the average oocyst counts from the first replication cycle were reduced in the birds that received the heat resistant mannanase containing feed. Among the β-mannanase enzymes tested, the best growth parameters were observed with the most heat resistant version fed to the infected birds.

Key Words: β-mannanase, feed enzyme, heat resistant, Eimeria sp., infection

62 Energy contribution of digestible starch, fat, and protein in response to combinations of exogenous xylanase, amylase, and protease in corn-based broiler diets. L. F. Romero*1, P. W. Plummer1, and V. Ravindran2,1 Danisco Animal Nutrition, Marlborough, UK, 2 Massey University, Palmerston North, New Zealand.

The contribution of substrates on the energy responses to exogenous enzymes in poultry diets is not entirely understood. One study with 21-d-old Ross-308 males was performed to evaluate starch, fat, and protein digestibility effects of xylanase and amylase without (XA) or with protease (XAP) in 2 broiler diets using a 3 × 2 factorial design with 6 replicate cages of 5 birds per treatment. Diets were based on corn and soybean meal (CS) or CS with 10% DDGS and 5% canola meal (mixed diet), and were fed from 0 to 12 d of age. At 12 d, 3 different enzyme treatments were applied to each diet: a negative control with 500 FTU/kg phytase (NC); NC with XA, or NC with XAP (Axtra XAP, Danisco Animal Nutrition). At 21 d, birds were euthanized. Ileal digesta was collected, pooled per cage, and analyzed to determine apparent digestibility of starch, fat, and protein. Data were analyzed with a generalized linear model. Significant differences were assessed at P < 0.05. Both XA (+2.1%) and XAP (+2.0%) increased starch digestibility compared with the control diets (94.6%) without a significant interaction between enzyme and diet. XA (+7.5%) and XAP (+7.3%) also increased fat digestibility compared with the control diets (85.4%) without a significant interaction. Protein digestibility increased gradually from the NC (82.0%) to the XA (+3.2%) and the XAP treatment (+5.2%) in both diets. In mixed diets, ileal energy digestibility improvements of enzymes were primarily provided by protein (XA: 40.1 kcal/kg; XAP: 62.2 kcal/kg), followed by fat (XA: 34.5 kcal/kg; XAP: 35.1 kcal/kg), and starch (XA: 24.6 kcal/kg; XAP: 18.2 kcal/kg). In CS diets, the relative energy contribution of starch (XA: 36.1 kcal/kg; XAP: 62.2 kcal/kg), fat (XA: 19.9 kcal/kg; XAP: 17.8 kcal/kg) or protein (XA: 27.2 kcal/kg; XAP: 48.6 kcal/kg) in response to enzymes depended on the enzyme combination, with a greater energy contribution from protein only when protease was present. Energy contribution from starch, fat and protein was clearly determined by differences on digestibility and substrate availability between diets.

Key Words: broiler, starch, fat, protein, enzyme

63 Evaluating the efficacy of enzymes under varying levels of dietary fat inclusion in broiler diets. J. D. Hamburg6 and A. B. Batal, University of Georgia, Athens.
The objective of this study was to determine the efficacy of 2 different enzymes in diets with various levels of fat inclusion. A 4 × 3 factorial study was conducted in which a standard corn-SBM-DDGS diet was fed to broilers for 28 d for performance and AME determination and also to roosters for TMEₐ determination. There were 4 levels of supplemental fat: 0, 1, 2, and 3% and 3 levels of enzyme: no enzyme, a xylanase at 0.2lbs/ton, and a β-glucanase at 0.2lbs/ton. Diets were formulated to meet the birds digestible amino acid requirements; however the ME of the diets varied with fat inclusion. The calculated ME of the control diet (0% fat and no enzyme) was 2,900 kcal/kg and the ME increased 84 kcal/kg for every 1% inclusion of fat. The rooster assay was a traditional precision-fed rooster assay in which 8 birds per diet were fasted for 24 h then crop intubated with 35g of the test diets. Excreta was then collected for 48 h for AME determination.

The broiler performance assay used 1152 Cobb 500 male chicks, obtained on day of hatch. They were placed in 72 floor pens and fed a standard broiler starter diet until d 14. At 14 d of age 6 replications of 16 chicks were weighed and assigned to one of the 12 dietary treatments. Body weight was measured at d 14, 21, and 28. Feed intake was measured and ileal contents were collected at d 21 and 28. The TMEₛ and AME values of the diets increased as fat inclusion in the diets increased. Body weight decreased with the addition of fat in all treatments until 3% fat inclusion where there was a slight increase. Feed intake decreased with the addition of fat to the diet in all treatment groups. Feed efficiency was variable but was not significantly different within or between treatments due to the decreased BW and FI. The efficacy of the enzymes on releasing energy and increasing the TMEₛ and AME values improved as the inclusion of fat increased. Based on the results of these studies, fat inclusion levels in the diet appear to have an effect on enzyme efficacy.

Key Words: broiler, fat, xylanase, beta glucanase

Effect of a protease on the digestibility of amino acids and the energy value of canola meal in starter broilers. S. Gómez*,1,2, M. L. Angeles1, E. Ramírez1,2, and S. Fernández3,

An experiment was carried out to evaluate the effect of a protease on the apparent ileal (AID) and apparent fecal (AFD) amino acid (AA) digestibility and the apparent metabolizable energy corrected to zero nitrogen retention (AMEn) of distillers dried grains with solubles (DDGS) in broilers from 13 to 21 d of age. One hundred and 20 13 d old, male B308 Ross broilers were allocated in groups of 3 in individual crates. Broilers were randomly assigned to 4 treatments in a complete randomized design with a factorial arrangement of 2 dietary treatments × 2 levels of a protease (Ronozyme ProAct). The dietary treatments were as follows: 1. Basal diet: formulated with corn and soybean meal and nutrient content (3141 kcal of ME/kg of feed, 1.05% of digestible lysine, 0.90% of Ca and 0.45% available P) according to the recommendations of Ross for broilers from 15 to 28 d of age; 2. As 1) plus 200 g/ton of protease; 3. 30% of the basal diet was replaced by 30% DDGS; and 4. As 3) plus 200 g/ton of protease. Feed was offered ad libitum during 9 d and the last 4 d excreta was totally collected every 24 h. At the end, all birds were killed to collect the ileal content. The experimental unit was 2 adjacent crates with 6 chicks and there were 5 replicates per treatment. The AMEn was calculated for the diets and DDGS and the ileal or fecal output of AA and the AID and AFD of AA were estimated using the substitution method. Results were subjected to ANOVA. The AID of Lys, Trp, Thr, Arg, Ile, Val, Leu and His were higher (P < 0.05) on the Basal than on the Basal + DDGS diet. Also, the AFD of Lys, Trp, Met, Val, Leu and His were higher (P < 0.05) on the Basal than on the Basal + CM diet. The AID of all AA on the Diets and CM was arithmetically improved by the addition of Protease. The average AFD of Lys was improved (P < 0.05) across all diets by Protease as well as the AFD of Lys in CM (P < 0.05). In addition, protease increased the AMEn of CM from 2181 to 2287 kcal/kg. In summary, the results suggest that the availability of amino acids and the energetic value of diets formulated with canola meal can be enhanced by the addition of a protease.

Key Words: starter chicks, canola meal, AA digestibility, protease