249 Energy and protein digestibility of broiler chickens fed corn-soybean basal diets with or without phytase and supplemented with amylase. Catarina Stefanello1, Sergio Luiz Vieira1, Patricia de Carvalho1, Gabriela Santiago3, Daniel José Miranda1, José Otávio Sorbara2, and Rafael Gustavo Hermes3. 1UFRGS, Porto Alegre, RS, Brazil, 2DSM Nutritional Products, Sao Paulo, SP, Brazil.

A study was conducted to evaluate the effects of supplementation of an α-amylase on energy and nutrient utilization in broiler chickens fed corn-soy diets formulated with or without phytase. A total of 448 slow-feathering, Cobb × Cobb 500 male broilers were randomly distributed to 8 treatments (8 replicates of 7 birds each). Birds were fed a common starter diet to d 14 post hatch and the experimental diets were provided from d 14 to 25 post hatch. Birds were fed a Basal diet formulated without or with phytase (1,000 phytase units (FTU)/kg of feed) and supplemented with 40, 80, and 120 kilo-Novo α-amylase units (KNU)/kg of feed (Ronozyme HiStarch (CT), DSM Nutritional Products). A factorial arrangement of 4 × 2 was used (amylase × phytase). Celite at 1% was used as indigestible marker. Total excreta was collected from d 21 to 24 post hatch, whereas all birds were slaughtered at d 25 for ileum content collection. Feed, excreta and ileum samples were submitted to analysis for total-tract retention and apparent digestibility determinations. There were no interactions between amylase and phytase in all parameters evaluated. Broilers fed diets formulated with phytase had higher (P < 0.05) AME, IDE, dry matter and CP ileal digestibility when compared with birds fed the diet without phytase. Relative to the Basal diet without enzymes, AME and IDE were improved (P < 0.05) by 70 and 84 kcal/kg, respectively when birds were fed the Basal supplemented with 80 KNU/kg. In conclusion, dietary supplementation of α-amylase or diets formulated with phytase improved AME, IDE and CP digestibility in broiler chickens.

Key Words: amylase, broiler, metabolizable energy, phytase

250 The effect of Victus across different broiler strains. Nelson E. Ward1, Marc de Beer1, Leonel Majia2, and Boyd Clary3. 1DSM Nutritional Products, Parsippany NJ, 2Cobb-Vantress Inc., Siloam Springs AR, 3Pilgrim’s Pride, Pittsburg, TX.

Continuous genetic changes in broiler strains require periodic testing, as do now technologically-advanced enzyme products for commercially similar corn/SBM (soybean meal)-based diets. This study ascertained (1) the performance of 4 broiler strains and (2) the effect of Victus across strains. Victus is a strategic composite of carbohydrases, debunching enzymes, protease, and phytase. Four strain crosses and 2 nutritional treatments comprised the 4 × 2 randomized complete block design with 4,800 straight-run day-old chicks placed in 96 floorpens. A 3-phase pelleted feed was allocated 0.68, 1.82 and 5.0 kg/bird for the starter, grower and finisher, resp. Birds were weighed at 43 and 54 d of age, and 10 birds/pen (5 males, 5 females) were processed on d 55. Strains were replicated 24 times with 12 replications of each nutritional diet. Victus and a competitor phytase + carbohydrate mix were the 2 nutritional comparisons - each formulated in the corn/SBM-based diets for manufacturer recommended energy, P, Ca, amino acids and Na. On d 43 and 54, Victus improved body weight (BW; P < 0.0001), feed intake (FI; P < 0.0004), FCR-m (adjusted for mortality; P < 0.0001) and FCR-mBW (adjusted for mortality and BW; P < 0.0001). No strain by nutrition interaction existed for any trait (P > 0.05). On d 43, differences occurred across strains for BW (P < 0.0001), FCR-m (P < 0.0074), FCR-mBW (P < 0.02) and FI (P < 0.0077), but not mortality. At 54 d, differences existed for FCR-m (P < 0.004), FI (P < 0.002) and mortality (P < 0.05). Across strains, statistical differences existed for all processing variables except hind half and tenders. Victus significantly increased % WOG, % front half, % breast and % tenders. Victus improved BW, FI, FCR and several yield variables over the competitor enzyme combination. Efficacy was unrelated to broiler strain. Strains differed for several economically important variables, some of which were age-related.

Key Words: Victus, enzyme, broiler, strain

251 The efficacy of xylanase and phytase enzymes on growth performance, jejunal morphology, and nutrient utilization in broiler chickens fed camelina meal. Ahmet Y. Pekel1, Nathan L. Horn2, and Olayiwola Adeola2. 1Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Istanbul University, Istanbul, Turkey, 2Department of Animal Sciences, Purdue University, West Lafayette, IN.

A study was conducted to investigate the effects of phytase (PHY) and xylanase (XYL) enzymes on growth performance, nutrient utilization, jejunal morphology, and duodenal digesta viscosity of broilers when fed camelina meal (CM). The experiment consisted of a 2 × 2 factorial arrangement of treatments with 2 dietary CM levels (0 or 100 g/kg), 2 dietary levels of XYL (0 or 800 unit/kg), and 2 dietary levels of PHY (0 or 4,000 unit/kg). Three hundred eighty-four male Ross 708 broilers were allocated to 8 dietary treatments at d 7 post hatch in a randomized complete block design with 6 replicates of 8 birds. Excreta samples were collected from d 18 to 21 post hatch. Ileal digesta and the left tibia were taken on d 21 post hatch. Broilers fed diets containing CM showed lower (P < 0.001) BW gain and G:F than those fed diets without CM for 7–14 and 7–21 d post hatch, respectively. Phytase supplementation improved (P < 0.05) all the growth parameters and increased (P < 0.05) jejunum villus height. Duodenal digesta viscosity increased (P < 0.001) by CM. Retentions of dry matter, ether extract, N and AMEn were decreased (P < 0.001) by CM addition. Ileal digestibility of DM, N, and ileal digestible energy (IDE) were decreased (P < 0.05) by CM supplementation. Addition of XYL did not improve nutrient utilization and growth performance. Phytase supplementation increased (P < 0.05) the ileal digestibility of DM, N, P, NDF, and energy. Apparent P retention and tibia ash increased (P < 0.05) with PHY supplementation. In conclusion, PHY was effective at improving P digestibility of birds fed CM diet. The data also shows that the villus height increase with PHY addition contributed to the improvements in ileal nutrient digestibility obtained with PHY supplementation.

Key Words: broiler chicken, camelina meal, digestibility, phytase, xylanase
252 Effect of a serine protease on the energy content of soybean meals of different origins in 22-d-old broilers. L. Cámaral, M. V. Kimiaeitalab1, B. Saldañal, H. M. Mandalawil, R. C. Angel3, A. Smith4, and G. G. Mateo5, 61, 62, 63, 64, 65. Deputamento de Producción Agraria, Universidad Politécnica de Madrid, Madrid, Spain, 2CEI Campus Moncloa, UCM-UPM, Madrid, Spain, 3Department of Animal Science, University of Maryland, College Park, MD, 4DSM Nutritional Products (UK) Ltd., Heanor, Derbyshire, UK.

A total of 1,152 one-day-old straight-run Ross 308 broilers were used to study the effect of using a mono component serine protease (PRO; Ronozyme ProAct, DSM Nutritional Products) on the AMEn of soybean meals (SBM) from USA, Brazil (BRA), and Argentina (ARG). The design was a 3 × 2 factorial arrangement of 3 SBM of different origin (USA, BRA, and ARG) and 2 levels of PRO (0 and 200 mg/kg to give 0 to 15,000 PROT units/kg fed) resulting in 6 treatments. Each of the 6 treatments was replicated 24 times and the experimental unit was a cage with 8 broilers. Birds were fed a commercial corn-soybean meal diet from 1 to 18 d of age followed by the experimental diets that resulted from the combination of 42.6% SBM and 57.4% of a nitrogen free diet for 1 to 18 d of age. The AMEn of the diet was 1.4% and 3.8% higher in chicks fed USA SBM than in chicks fed BRA or ARG SBM (2,921 vs. 2,880 kcal/kg, respectively; P < 0.001). PRO supplementation increased the AMEn of the diet by an average of 1.1% (2,888 vs. 2,856 kcal/kg; P < 0.001). An interaction between SBM origin and protease supplementation was detected (P < 0.01); addition of PRO increased AMEn diet with USA or ARG SBM but not those with BRA SBM. In conclusion, AMEn of the diet based on USA SBM was higher than that of diets with BRA SBM, and was lowest for diets with ARG SBM ARG meals. PRO supplementation increased the AMEn of diets, an improvement that varied depending on the origin of the SBM.

Key Words: AMEn, broiler, protease, soybean meal origin

253 Evaluation of a thermostable xylanase dose response in broilers fed corn soybean meal-based diets. Fenglan Yan*, 1, Mercedes Vazquez-Anon1, and Jonny Lyon2, 1Novus International Inc., St. Charles, MO, 2Verenium Corporation, San Diego CA.

A floor pen trial was conducted to evaluate dose response of a newly developed hyper-thermostable xylanase (Cibenza Xylaverse, Novus International Inc.) in broilers fed corn soy-based diets. A 3-phase feeding program was employed: starter (0–18 d), grower (18–35 d), and finisher (35–44 d) phases. Diets were in pelleted form except starter diets, which were crumbled after pelleting. The study consisted of 9 dietary treatments – positive control, negative control (NC) with 100 kcal/kg less ME, test xylanase added to NC at 125, 250, 500, 1000, 2000 U/kg, or at variable doses for different phases (250, 1000, and 2000 U/kg for starter, grower, and finisher), and a commercial xylanase added to NC at 100 g/ton. Each treatment had 8 replicates of 22 male broilers. Body weight, feed intake, FCR, and mortality were determined at 18, 35, and 42 d. On d 16, one bird per pen was killed to measure proventriculus, gizzard, pancreas, gizzard content, and ceca content weight. Carcass parameters were obtained on d 44 from 5 birds per pen. Data were analyzed with one way ANOVA and a P-value ≤ 0.05 was considered significantly different. Body weight was not affected by treatment throughout the trial. Reduction of ME by 100 kcal/kg increased FCR by 3.8% at d 35 and by 4.4% at d 42. All xylanase supplemented groups returned numerically better FCR on d 35 and 42, but only test xylanase at 250 U/kg significantly improved FCR (1.568 vs. 1.594 on d 35; 1.709 vs. 1.732 on d 42). Broilers fed 100 kcal/kg less ME consumed 74 g (2.7%) and 81 g (5.5%) more feed for 18–35 d and 35–42 d; test xylanase at 250 U/kg reduced 18–35 d feed intake by 69 g (2.5%). A reduction of 100 kcal/kg ME was associated with a higher dressing percentage, and xylanase effect on processing traits was not consistent. Test xylanase at 125 and 250 U/kg increased broiler ceca content by 87% and 107% respectively. In summary, the study demonstrated that the effect of the newly developed xylanase in broilers fed corn soy based diets was dose dependent and the moderate dose (250 U/kg) modified hind gut fermentation and improved FCR.

Key Words: thermostable xylanase, broiler, growth performance, dose response


Constant genetic improvements are extending production boundaries. Nutritionists are in continuous search of novel approaches to optimize diet formulations juggling between costs and answering nutritional demands of high performance birds. The objective of the current study was to evaluate the effect of supplementation of a single protease enzyme: Poultrygrow 250 (PTG) on top of a commercial corn/soy diet formulated for laying hens at start. This study was conducted for 7 weeks with 112 White Lohman pullets aged 20 weeks at start of the trial. Pullets were evenly distributed in 28 cages with 4 birds per cage respecting Canadian density standards. Cages were allocated 1 of the 2 groups: (1) control diet (CD): a diet formulated with AME of 2825 kcal/kg, CP of 18.5%, and total lysine content of 0.884%; and (2) protease diet (PTD), which was CD supplemented with 125 ppm PTG on top. Weeks 1 and 2 were buffer weeks to allow pullets to acclimate and all pullets received the control diet. At wk 3, supplementation with Poultrygrow 250 was initiated in diet of pullets allocated to this group up to wk 7. Zootechnical performances (laying rate, egg weight, and feed consumption) were recorded daily and compiled weekly. Data were analyzed by ANOVA with a P-value of 0.05 to determine the level of significance and separated using Fisher’s least significant difference test (NCSS software). During first 2 wk, when both groups received the control diet, performance of layers in group CD was numerically better than that in group PTD. Supplementation of control diet with PTG (PTD group) resulted in better laying rate, egg mass, and feed conversion from wk 3. PTD group feed conversion ratios were significantly improved over CD group at wk 4 (P < 0.05) and egg mass was significantly increase when compared with CD group at wk 6 and 7. In conclusion, addition of Poultrygrow 250 on top of a commercial laying hen diet has the potential to improve egg production parameters and offer a viable solution in diet formulation optimization.

Key Words: protease, enzyme, Poultrygrow 250, laying hen


The objective of this study was to evaluate the effect of the addition of a carbohydrase complex (CC) on the performance and nutrient deposition of broiler chickens fed wheat-soybean-based diets. Six control diets were formulated with different digestible amino acids (DAA) content (−7.5%, −5.0%, −2.5%, 0.0%, +2.5%, and +5.0%) based on commercial recommendations, but with the same ideal protein profile. Six treatment diets were prepared by adding CC (Rovabio Advance L) to the 6 control diets reducing in energy (85 kcal kg⁻¹ or 2.8% of average energy reduction) to

Poult. Sci. 94 (E-Suppl. 1)
isolate the energy effect. Each of the 12 treatments included 8 replicate pens of 15 male birds. Performance parameters (BWG, FI and FCR), efficacy of energy and protein deposition (calculated as g of BWG for each cal of AME or mg of dig. Lys ingested) and carcass and cuts yield were calculated for the period between 0 and 42 d. The reduction of DAA linearly degraded (P < 0.05) all performance, nutrient deposition and carcass parameters. Carcass and cuts yield were not affected by CC addition or DAA reduction (P > 0.05). No interaction was observed between DAA content and the addition of the CC. The addition of the CC significantly improved (P < 0.001) BWG (+3.2%), FCR (−2.7%), and deposition of energy (+5.7%) and protein (+2.8%). In conclusion, the addition of CC could improve the performance and deposition of nutrients, regardless the level of tested DAA in diets.

**Key Words:** NSP enzyme, broiler, amino acid, nutritional matrix, nutrient deposition

256 Phosphorus and calcium digestibility is improved with the addition of a carbohydrase complex in broiler chickens fed wheat-soybean-based diets. Roberto Montanini Neto* and Aurélie Freynat, Centre of Expertise and Research in Nutrition, Adisseo France SAS, Malicorne, France.

This study aimed to evaluate the efficacy of a carbohydrase complex (CC) in improving the digestibility of P and Ca in broilers’ wheat-soybean-based diets, compared with that observed for a single 6-phytase. Four diets were formulated with different available phosphorus levels (2.0, 2.7, 3.4, and 4.1 g kg⁻¹), with a fixed Ca:P ratio. To each diet, either CC (Rovabio Advance L) at 0.2 mL kg⁻¹ or 6-phytase at 4 different inclusion levels (0, 80, 160, and 240 FTU kg⁻¹) was added. For each diet, 120 male birds were reared between d 10 and 28 in individual cages suitable for digestibility trials. Excreta collections were performed at d 15–18 and d 25–28 for the determination of the true digestibility of P and Ca. We estimated the potential of the CC in comparison with the phytase effect using the factorial regression of dietary P levels and the phytase inclusion. No significant interaction was observed between P levels and phytase inclusion. P levels promoted a linear reduction (P < 0.001) of the digestibility of both minerals in the 2 periods of evaluation. The phytase inclusion promoted a linear improvement (P < 0.05) of P and Ca digestibility. The addition of the CC increased (P < 0.05) the P and Ca digestibility. For P true digestibility, the improvement rate was 7.9% and 3.8% respectively at d 18–21 and d 25–28; for Ca, it was 5.0% and 5.8%. The improvements on P and Ca digestibility promoted by the CC were observed regardless the level of P in the diets.

**Key Words:** NSP enzyme, phytase, calcium, phosphorus, digestibility

257 Effect of a carbohydrase complex in feeds with different metabolizable energy and available amino acids levels for broilers reared in a hot climate. Roberto Montanini Neto*, Friedrich Rouffineau, and Aurélie Freynat, Centre of Expertise and Research in Nutrition, Adisseo France SAS, Malicorne, France.

The objective of this study was to evaluate the effect of a carbohydrase complex (CC) added to corn-soybean-based broiler feed formulated with different apparent metabolic energy (AME) and digestible amino acids (DAA) levels. Four diets were prepared as following: T1, Positive Control (PC) with regular commercial nutritional levels; T2, Negative Control (NC) 1, with less 80 kcal of AME kg⁻¹ (2.6% of average energy reduction) and less 2% of DAA; T3, NC 2, −80 kcal kg⁻¹ and −4% of DAA; and T4, NC 3, −80 kcal kg⁻¹ and −6% of DAA. CC (Rovabio Advance L) was added or not in each of those 4 diets, totaling 8 treatments, with 12 repetitions and 40 male birds in each. Air temperature inside the facility was kept above the breeder recommendations (29°C) and humidity was in constant rise during the experimental (0–36 d). DAA reduction in feed linearly reduced (P < 0.01) all performance parameters. No interaction between feed nutritional levels and the addition of the CC was observed. For the overall period, the addition of CC improved (P < 0.01) BWG (+3.3%) and FCR (−2.7%), regardless of nutritional reduction levels. The efficacy of energy and protein deposition (calculated as g of BWG for each cal of AME or mg of digestible Lysine ingested) were significantly improved by the CC addition (+2.7% and +2.8%, respectively). This study also allowed us to estimate the ideal DAA reduction resulting from CC addition between −2% and −4%, when AME is reduced by 80 kcal.

**Key Words:** NSP enzyme, broiler, amino acid, nutritional matrix, nutrient deposition


The most utilized energy system for broilers diet formulation in most of the world is metabolizable energy (ME); however, this may not be the best system to account for energy provided by exogenous enzymes because it does not consider the heat increment of the diets. The purpose of the study was to determine the effect of adding exogenous enzymes on the apparent metabolizable energy corrected by nitrogen (AMEn) kcal/kg and net energy (NE) kcal/kg. Two diets were studied: T1 Negative control (NC); and T2 NC + Enzyme composite (phytase + xylanase + glucanase + protease + pectinase). Four hundred fifty Cobb male chicks were fed the respective dietary treatments during the 5–13 d starter and 14–28 d grower phases. Birds were moved to the reproductive chambers 3 d before evaluation for a period of adaptation. The feed evaluations in the chambers were accomplished for 3 d for determining heat production (HP); after HP evaluation the birds were kept in the chambers for 24 h more without feed to measure fasting heat production (FHP). AMEn was determined by total collection accounting the feed consumed and excreta voided for the 3 d and NE was determined using an open flow calorimetry system. The calculations for NE = ME – HI kcal/kg, where HI (heat increment) = HP – FHP kcal/kg. The statistical analysis was achieved using JMP pro 11 (SAS, 2013). A CRBD was used with 6 replications in each phase per treatment. AMEn kcal/kg was not statistically different in both starter and grower with and without enzymes. NE kcal/kg was +127 kcal more for the enzyme composite diet in the starter with a P-value = 0.0283*; +90.4 kcal in the grower with a P-value = 0.1071. The calorimetry data shows a net energy system accounts for more calories from the enzymes in the starter and it shows a trend of higher energy in the grower. This study suggests that in the future if more enzymes are to be added to poultry diets we may need a more sensitive energy system than ME.

**Key Words:** enzyme composite, net energy, metabolizable energy

259 Effect of adding different blends of enzymes on two diets based on different corns and its effects on the nutrient utilization by grower broilers. Sergio Gomez Rosales*, Lourdes Angeles, Silvestre Charraga Aguilar,1,2, and Sergio Fernandez Tinoco1,2, 1National Center of Disciplinary Research in Animal Physiology, National Institute of Research in Forestry, Agriculture and Livestock, Mexico, DF, Mexico, 2DSM Nutritional Products Mexico SA de CV, El Salto, Jalisco, México.

The objective of this research was to evaluate the effects of adding carbohydrases enzymes in diets based on white (W) or yellow (Y) corn
on the apparent ileal digestibility (AID) and balance of nutrients. W and Y corns were added to semi-purified diet with appropriate amounts of vitamins, minerals and phytase. Five treatments were tested in each diet: none (NC), 100 ppm of X (Ronozyme WX), 75 ppm of G+X (Ronozyme G2 G), 400 ppm of A (Ronozyme A), 300 ppm of A+X (Ronozyme A and Ronozyme WX). Male B308 broilers from 16 to 26 d of age were used. Total excreta was collected during 3 consecutive days to estimate the nutrient balance. The last day of the trial, the ileal content was collected to determine the AID of nutrients using titanium oxide as a marker. Between 9 to 18 chicks were killed to get each replicate sample. There were 10 replicates per treatment and results were subjected to ANOVA. The AID of energy (82.6 vs 80.9, %) and phosphorus (30.4 vs 25.9, %; SEM = 1.23) were higher \( (P < 0.01) \) in W compared with Y corn. In the balance trial, the fat intake was higher (0.90 vs 1.01, g/d; SEM = 0.64), the fat excretion was lower (0.36 vs 0.32 g/d; SEM = 0.010) and the fat retention was higher (58.7 vs 68.5, %; SEM = 1.19) in Y compared with W corn \( (P < 0.01) \). But the AMEn was higher in W compared with Y corn (3.23 vs 3.16, Mcal/kg; SEM = 0.021; \( P < 0.05 \)). In regards to the enzyme treatments, the AID of protein, calcium, and phosphorus as well as the balance of nutrients were similar among treatments. On the AID of energy, there was a corn and treatment interaction \( (P < 0.05) \). In W corn, the AID of energy was higher when the diets were added with X, G+X, A and A+X compared with the NC; but in Y corn the AID of energy was higher only when diets were added with A and AX compared with the NC. In summary, W corn showed higher energy value than Y corn. The greater AID of energy was seen in W corn when diets were added with X, G+X, A and A+X; in Y corn the AID of energy was improved with the addition of A and a combination of A and X.

Key Words: broiler, corn, xylanase, glucanase, amylase

Effect of adding different blends of enzymes on diets based on different formulation on the nutrient utilization of grower broilers. Sergio Gomez Rosales*1, Lourdes Angeles1, Silvestre Charraga Aguilar1,2, and Sergio Fernandez Tinoco1,2, 1National Center of Disciplinary Research in Animal Physiology; National Institute of Research in Forestry, Agriculture and Livestock, Mexico, DF, Mexico, 2DSM Nutritional Products Mexico SA de CV, El Salto, Jalisco, Mexico.

The objective of the experiment was to evaluate the effect of adding blends of a protease (P), xylanase (X) and glucanase-hemicellulose-pentosanase-pectinase (GHPP) enzyme activities on diets including different feed ingredients as sources of energy and amino acid on the apparent ileal digestibility of nitrogen and energy and the nutrient balance. One hundred 9 2 Ross 308 male broilers from 28 to 42 d of age were allocated in individual pens and randomly assigned to 6 treatments in a factorial arrangement of 2 diet formulations and 3 enzyme blends. The dietary treatments were: 1) a corn-SBM diet; and 2) a sorghum-SBM-dried distiller’s grain with solubles (DDGS)-canola meal (CM) diet. In both diets, the AME and digestible Lys were 3050 kcal/kg and 0.85%, respectively. The blends composition was: Blend 0: No enzymes; Blend 1: 200 ppm of P (Ronozyme ProAct) + 150 ppm of X (Ronozyme WX); and Blend 2: 150 ppm of P, 150 ppm of X and 150 ppm of GHPP (Ronozyme VP) activities. From d 37–41 excreta were totally collected to estimate the nutrient balance and the AMEn. The last day of the trial, all broilers were killed and the ileal content was recovered to estimate the ileal digestibility of nutrients. The data was subjected to ANOVA using the GLM procedures of SAS. Broilers fed the Corn-SBM diet showed higher ileal nitrogen and energy digestibilities higher dry matter and nitrogen retention and higher AMEn \( (P < 0.01) \) compared with broilers fed the sorghum-SBM-DDGS-CM diet. The apparent ileal nitrogen digestibility \((B0 = 70.9, B1 = 77.0 and B2 = 79.4, %; SEM = 1.342), the apparent ileal energy digestibility \((B0 = 66.8, B1 = 71.6 and B2 = 74.9, %; SEM = 1.624), the nitrogen retention \((B0 = 53.3, B1 = 58.9 and B2 = 59.2, %; SEM = 0.985) and AMEn \((B0 = 2815, B1 = 2949 and B2 = 2932, Kcal/kg; SEM = 20.69) were lower in B0 compared with B1 and B2 \( (P < 0.01) \). Between B1 and B2 no differences were observed for any of the variable responses. In summary, the nutrient utilization was improved in broilers fed the corn-SBM diet, as well as in broilers fed the B1 and B2 combinations, regardless of the type of diet.

Key Words: broiler, xylanase, glucanase, pectinase, protease