Dietary amino acid density (AA) and fat content has been reported to affect gut physiology in diets containing xylanase. One study was conducted to evaluate the effects of AA, additional energy from fat post-pellet (FL), and xylanase levels (X) in corn-soybean diets on intestinal and cecal length, pH and volatile fatty acid (VFA) concentrations in cecal contents. A total of 2,112 d-old male Ross 708 were placed in 96 pens. Treatments involved 16 diets as result of combinations of 2 AA (High and Low, with 10% difference), 2 FL (0 and 100 kcal/kg ME) and 4 X (0, 8000, 16000 and 32000 BXU/kg). Starter, grower and finisher diets were fed. At 16 and 42d of age, broilers were sampled to evaluate length (cm/kg) of intestines and ceca. Cecal content pH and VFA profile (VFA % and total Mmol) were measured. Data were analyzed as a RCBD with a $2 \times 2 \times 4$ factorial arrangement. At 16 d, chickens fed 100kcal FL and 8000BXU diet had smaller ceca ($P < 0.05$) than broilers fed other diets. At 42 d, another interaction ($P < 0.05$) was observed between AA and X levels. Broilers fed 32000BXU diet had longer ceca than those fed 8000 and 16000BXU and, similar to 0BXU in Low AA diets, but in High AA diets 16000 and 32000BXU had ceca longer than 0BXU. In VFA profiles at 16d, chickens fed 16000BXU had less ($P < 0.05$) cecal acetate than those fed 0BXU. The butyrate content was affected ($P < 0.05$) by a 3 way interaction. Chickens fed Low AA, 100kcal, 8000BXU and High, 100kcal, 16000BXU had more butyrate than the other groups. Chickens fed Low AA, 100kcal, 0BXU had the lowest butyrate contents. Chickens fed Low AA and 0BXU diet had the lowest ($P < 0.05$) valerate content. At 42d, broilers fed High AA diet had more ($P < 0.05$) isovalerate than those fed Low AA diet. An interaction between FL and X was observed ($P < 0.05$) for butyrate and the lowest contents were observed on 100kcal 8000BXU. Cecal pH was affected ($P < 0.01$) by X and the lowest pH was observed with 16000BXU. In conclusion, xylanase can modify cecal length, its VFA profile and pH. Effects vary with nutrient density and less cecal fermentation correlate with better broiler performance.

**Key Words:** amino acid, broiler, cecal, energy, volatile fatty acids

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**P324** The relative importance of calcium to phosphorus ratio and the use of phytase matrix values in total tract nutrient utilization response to phytase supplementation for broilers. O. A. Olu­kosii, F. Fru-Nji, L. Beeson*, 1Avian Science Research Centre, SRUC, Auchincruive, Ayr, United Kingdom, 2DSM Nutritional Products AG, Kaisersaugst, Switzerland.

Five-hundred and 76 broilers allocated at one day old to 12 treatments in a randomized complete block design and a $2 \times 2 \times 3$ factorial arrangement were used for a 21-d experiment to study the effect of Ca:P, phytase matrix and phytase supplementation on total tract nutrient utilization of broilers. Each treatment had 8 replicates with 6 birds per replicate. The factors were 2 levels of Ca:P (2:1 and 2.5:1), 2 levels of phytase matrix (with or without matrix values) and 3 levels of phytase (0, 1000 and 2000 FTYT/kg). Matrix values allowances for each 1000 FTYT/kg were 75 kcal/kg AME, 1.5 g/kg non-phytate P, 1.8 g/kg Ca, and 0.26 g/kg protein. Excreta were collected on d 19–21 and nutrient utilization data were analyzed using the GLM procedure of SAS. All the 2-way interactions were significant but 3-way interaction was only significant for AME. Phytase supplementation increased ($P < 0.05$) total tract retention of DM, N, total P and phytate-P relative to the control in the diets with 2:1 Ca:P and phytase matrix. Phytase increased ($P < 0.05$) total tract retention of total P relative to the control (42.5% vs. 54.6%) in diets with 2.5:1 Ca:P and with phytase matrix. In the diet with phytase matrix and 2:1 Ca:P, increasing phytase supplementation to 2000 FTYT/kg increased ($P < 0.05$) total P (56.1% to 69.1%) and phytate-P utilization (63.6% to 71.8%) but there was no difference in total P utilization in similar diets when Ca:P was increased to 2.5:1. Greater nutrient utilization response ($P < 0.05$) to phytase supplementation was observed in the diets with 2:1 Ca:P matrix and phytase matrix. In the diet with the same matrix values but different Ca:P, total P and phytate-P utilization were greater ($P < 0.05$).
in the diet with 2:1 Ca:P. It was concluded from this study that nutrient utilization response to phytase supplementation depended on both the Ca:P as well as phytase matrix values but Ca:P had greater effect on response to phytase supplementation and that phytase supplementation at 2000 FYT/kg was more effective in diet with 2:1 Ca:P.

**Key Words:** broiler, Ca:P, nutrient utilization, phytase, phytase matrix


In a 5-week study, a phytase product from *Citrobacter braakii* was tested in broilers to evaluate its effects on growth performance, myo-inositol concentration in plasma and bone mineralization. In addition an evaluation of its effects on the gut morphology was studied. The birds were allotted to 2 treatments each fed a basal diet in 2 regimens (starter and grower) formulated to contain 4.6 g and 4.2 g total P per kg diet, respectively. The 2 regimens contained also 8.9 g and 7.9 g Ca and 1.28 and 0.98 g available P per kg diet, respectively. The basal diet (NC) was fed either with or without phytase added at 1000 U per kg feed. As expected phytase supplementation significantly improved the weight gain. Supplementing phytase resulted in significant improvement of tibia strength and tibia ash percentage (*P* < 0.001). A highly significant (*P* < 0.001) increase of myo-inositol, the end product of phytate P hydrolysis, concentration in blood plasma, was recorded with phytase supplementation. The intestinal morphology was also modified, resulting in longer jejunal (*P* < 0.001) and ileal villi and wider villi in the duodenum (+27%) and jejunum (+25%) compared with NC. From this study phytase supplementation did not only help the hydrolysis of phytate-P but also had a significant modification of the intestinal tract, even more so in the proximal parts, which could help increase absorption. These are indications that a phytase has more nutritional values than just releasing phosphates. Further studies are necessary to confirm these effects.

**Key Words:** phytase, intestinal morphology, myo-inositol, broiler chicken

**P326 The effect of enzyme supplementation on growth performance and energy utilization in broiler chickens fed corn-SBM diets of different AMEn content.** A. Rogiewicz*1, R. Patterson2, and B. A. Slominski3. 1University of Manitoba, Winnipeg, MB, Canada, 2Canadian Bio-Systems, Calgary, AB, Canada.

A study was conducted to determine the effect of a multienzyme product Superzyme CS containing xylanase, glucanase, cellulase, invertase, mannanase, amylace and protease activities on energy utilization and growth performance of broiler chickens. Broilers were assigned to 7 dietary treatments, each consisting of 9 pens of 8 birds each, and were fed 6 corn-SBM titration diets containing 3125, 3100, 3075, 3050, 3025 and 3000 kcal ME/kg from 1 to 21 d of age. A control diet formulated to contain 3150 kcal/kg with no enzyme added was used for comparison with the titration diets. Energy reduction within the experimental diets was achieved by decreasing fat (canola oil) content from 5.4 to 2.6% and increasing corn inclusion from 42.6 to 46.0%. All diets contained the same amounts of SBM (33–34%), wheat (10%), meat and bone meal (5%), methionine (0.09%), and mineral and vitamin supplementments (2.9–3.0%). When compared with the control treatment, there was no effect (*P* > 0.05) of fat reduction with enzyme supplementation on growth performance. Body weight gain averaged 903.7 g/bird for the control diet, and 927.6, 930.2, 915.0, 897.8, 893.2 and 891.9 g/bird for the enzyme supplemented diets containing 3125, 3100, 3075, 3050, 3025, and 3000 kcal ME/kg, respectively. In the same order, FCR averaged 1.30 for the control diet, and 1.30, 1.27, 1.30, 1.31, 1.33, and 1.34 for the enzyme supplemented diets. Although not statistically different, the last 2 enzyme-supplemented diets showed some slight reduction in BWG and FCR. This was confirmed by a linear decrease (*P* < 0.05) in the determined AMEn values which averaged 2923, 2886, and 2852 kcal/kg for the last 3 diets and were lower than that of the control (i.e., 3004 kcal/kg). Considering a conservative energy level of 3075 kcal/kg showing the identical growth performance parameters as those of the control diet (i.e., 3150 kcal/kg), enzyme supplementation could represent a gross savings of $14.80 per tonne of feed.

**Key Words:** enzyme, broiler chicken, AMEn

**P327 The response of 22- to 47-day-old broiler chickens to heat stress and low-nutrient-dense-diets that are supplemented with or without an enzyme complex containing non-starch polysacch­ride (NSP) enzymes and a 6-phytase.** C. Soto1, E. Avila2, J. Arcé3, F. Rosas1, and R. B. Shirley*4. 1Adisseo de México, Guadalajara, Jalisco, México, 2Centro de Enseñanza, Investigación y Extensión en Producción Avícola, México, Distrito Federal, México, 3Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Michoacán, México, 4Adisseo USA, Alpharetta, GA.

The following 2 × 2 factorial arrangement evaluated broiler performance (BP) in the presence or absence of Rovabio Max supplementation (RM; a multi-enzyme complex containing 19 carbohydrase enzymes and a 6-phytase), and in the presence or absence of heat stress (HS). Body weight (BW; kg/bird), feed conversion ratio (FCR), water consumption (WC; L/bird) and heterophil:lymphocyte ratio (HLR) were the dependent variables. On d-0, 2,800 d-of-hatch, Ross 308 mixed-sex broiler chickens were randomly allocated across 4 treatments (7 reps/trt; 100 birds/rep). Ross nutrient guidelines for the common starter (21 d), grower (14 d) and finisher (13 d) phases were used (−95 kcal/kg, −2% TAA, −0.153 aP and −0.12% Ca). These diets were split into 2 batches, one with and one without RM. From 22 to 47 d-of-age, broilers were held at a constant temperature (28.1°C; non-stressed birds) or chronically heat stressed (32.1°C for ~16 h/d). Supplementing with RM resulted in a significantly (*P* < 0.01) higher BW (1.91 vs. 1.74 on d-35 and 2.87 vs. 2.72 on d-42), and a lower FCR (1.59 vs. 1.69 on d-35 and WC (7.68 vs. 7.78 on d-35 and 13.58 vs. 13.73 on d-42). Heat stress resulted in a statistically (*P* < 0.01) reduction in BW (1.84 vs. 1.81 on d-35 and 2.83 vs. 2.76 on d-42) and an increase in WC (7.67 vs. 7.79 on d-35 and 13.60 vs. 13.72 on d-42). On d-33, the HLR was 17.6% lower for broilers fed with RM under HS conditions reduced (*P* < 0.01) BW (1.74 without RM vs. 1.84 on d-35 and 2.83 vs. 2.76 on d-42), and a lower FCR (1.59 vs. 1.69 on d-35 and WC (7.68 vs. 7.78 on d-35 and 13.58 vs. 13.73 on d-42). Heat stress resulted in a statistically (*P* < 0.01) reduction in BW (1.84 vs. 1.81 on d-35 and 2.83 vs. 2.76 on d-42) and an increase in WC (7.67 vs. 7.79 on d-35 and 13.60 vs. 13.72 on d-42). On d-33, the HLR was 17.6% lower for broilers fed the RM-supplemented diet and 13.8% higher for HS birds (*P* < 0.01). Under HS, supplementing RM improved (*P* < 0.01) BW (1.74 without RM vs. 1.88 with RM on d-35 and 2.69 without RM vs. 2.83 with RM on d-42), had no significant effect on FCR (1.67 without RM vs. 1.59 with RM on d-35 and 1.90 without RM vs. 1.87 with RM on d-47), and improved (*P* < 0.01) WC (7.89 without RM vs. 7.70 on d-35 and 13.38 vs. 13.61 on d-47). On d-33, the use of RM under HS conditions reduced the HLR by 58.9% (*P* < 0.01). These results demonstrate the negative effects of HS on BP, and the benefits of Rovabio Max against HS.

**Key Words:** broiler chicken, carbohydrase, heat stress, immunity, phytase

The main objective of this study was to evaluate the effects of supplementing 2 protease enzymes; (CDP) Cibenza DP100 (600,000 U/g) and (RPA) Ronozyme ProAct (75,000 PROT/g), in mash corn/soy diets with 2 levels of reduced digestible amino acids; (-7% AA) or (-10% AA). A total of 1400 Cobb 500 male broilers were distributed in a completely randomized design with 7 treatments and 8 replicates each. All treatments with the exception of the positive and negative control diets contained a phytase (Phyzyme XP, 10,000 FTU/g) and a carbohydrase (Ronozyme A, an α-amylase-200 kNU/g, and β-glucanase-350 FGB/g based product). The treatments (TRT) were 1) Positive control (PC) with an ME of 3,050/3,150/3,200 Kcal/kg, Lys 1.30/1.19/1.10%, Met + Cys 0.94/0.85/0.79% and Thr 0.85/0.81/0.78%, to 1–21d, 22–35d, and 36–41d, respectively, 2) Negative control 1 (NC1) with ME reduced 100 kcal/kg and –7% Lys, Met + Cys, Thr and –0.12% av P and Ca 3) Negative control 2 (NC2) with reduced ME, av P and Ca as NC1 but with –10% Lys, Met + Cys and Thr 4) NC1 + 500 FTU/kg of phytase, 0.03% carboxylyase and the 0.05% CDP protease 5) as TRT 4 + 0.02% RPA protease 6) NC 2 + 500 FTU/kg of phytase and 0.03% carboxylyase + 0.05% CDP protease 7) as TRT 6 + 0.02% RPA protease. All enzymes were added individually and according to the indicated levels for use. Performance and carcass characteristics (carcass yields and fat pad) of chicks at 41 d were measured. The NC1 and NC2 diets showed higher values (P < 0.05) of FCR and FI, similar BW (P > 0.05) in relation to PC diets at 1–41 d. The CDP protease was effective (P < 0.05) on recovering the FCR of the birds in early phase (1–21d) on NC1, while RPA protease resulted in a similar (P > 0.05) FCR and BW (1–41d) to the PC, regardless of nutritional reductions of the negative controls. No effects (P > 0.05) on carcass yield or fat pad were found due to any dietary treatment. In conclusion, the supplementation of the phytase, protease and carbohydrase studied in corn/soybean meal diets reduced in 100 kcal of ME/kg, up to 10% in limiting amino acids and 0.12% of Av P and Ca, can be used in chicks up to 41 d without detrimental effect on performance and carcass characteristics.

Key Words: broiler performance, enzyme, nutrient reduction

P329 In vitro evaluation measurements for phytase products. C. Schauerhuber*, M. Pfeffer, and G. Schatzmayr, Biomim Research Center, Tulln, Austria.

Phytase is a well-known feed enzyme to degrade indigestible phytate. This degradation reduces the anti-nutritive value of phytate and provides additional phosphorus to the animal. Animal feed is hence reformulated to reduce the content of inorganic phosphorous, calcium and other matrix components as well as feed costs. Many phytase products differ in microbial origin and production host and highly in their properties. To get an understanding of existing products available on the market and learn more about the needs for a competitive product, the properties of existing products were evaluated in vitro. Five commercially available phytase products (A, B, C, D and E) were evaluated for 4 measurements: thermal stability (75°C, 5 min), stability against the digestive enzyme pepsin (12.5 U/μL, 40°C, 60 min), pH profile (pH 2.0–5.5) and maximal releasable phosphorus. For all measurements, the products were dissolved in sodium acetate buffer and treated for the respective measurement. Phytase activity (pH 5.5, 37°C, 30 min) was determined according to the ISO 30024:2009 method. As indicated by the manufacturer’s data, 4 (A, B, C and E) of 5 products showed thermal stability. The thermal stability of these products ranged from 65 (C) to 90% (E) recovery compared with non-heated controls (P = 0.000). Incubation with pepsin showed a reduction of phytase activity from 41 (C) to 85% (B) compared with non-treated controls (P = 0.000). As expected, the pH-profile of all tested products was similar but the optimum pH value ranged from 3.0 (E) to 4.0 (B, C and D) and 5.0 (A). The greatest difference in activity was observed at pH 2.0 where a reduction of 44 (E) to 90% (D) of the maximal activity was measured. For the measurement of maximal releasable phosphorus, all products showed the same result. Only 4 out of 6 phosphorus groups were released although the enzyme was present in high surplus. In summary, it was observed that product E performed best in terms of stability against heat and pepsin and activity at pH 2.0 in contrast to product D which performed worst. The demands for a competitive product will be to keep up with the properties of product E at least.

Key Words: phytase activity determination, thermal stability, proteolytic stability, pH-profile, phosphorus

P330 Phytase enzyme supplementation in laying hens diet containing varying levels of NPP. M. Neijat*, E. Kebreab2, W. Guenter3, B. Slomniski1, and J. D. House1, 1University of Manitoba, Winnipeg, MB, Canada, 2University of California, Davis.

An experiment was conducted to evaluate the effect of phytase enzyme (Phyzyme XP, Danisco) supplementation on phosphorus (P) intake, excretion and balance in laying hens (50 to 56 wks of age) fed a wheat-soybean meal diet containing 2 levels of non-phytate phosphorus (NPP). The diets contained similar levels of calcium, energy and crude protein. In the study, 3 levels of phytase enzyme (0, 250 and 500 units/kg of diet) and 2 levels of NPP (0.25% and 0.40%) were used. Hen performance, P intake, excretion and balance were measured over a 4 wk period and the data were analyzed using a 2 × 3 factorial design as a repeated measures analysis using the MIXED procedure of SAS. No significant differences were observed among the dietary treatments in egg production, egg weight or feed intake. However, body weight gain decreased significantly (P < 0.001) with increasing levels of phytase. Phosphorus (P) intakes were significantly (P < 0.0001) greater for diets containing 0.40% NPP than 0.25% level (0.58 vs. 0.38 ± 0.01 g/hen/day, respectively). Similarly, hen consumed higher (P < 0.0001, 0.61 ± 0.01 g/hen/d) levels of P when phytase was not added compared with 0.44 and 0.39 ± 0.01 g/hen/d for 250 and 500 units/kg of diet, respectively. However, P balances in hens were significantly lowest (P < 0.0001) with 500 units/kg phytase for both levels of NPP. Phosphorus excretion decreased (P < 0.001) for 0.25% NPP with either level of phytase supplementation (0.055 and 0.078 ± 0.013 g/hen/d for 250 and 500 units/kg phytase, respectively). On the other hand, phytase supplementation to laying hen diets containing higher levels of NPP (0.40%), exhibited the highest (P < 0.001) P excretions. In summary, when using phytase-supplemented diets, attention to NPP levels is critical to avoid excessive P excretion. Funding: Manitoba Egg Farmers and Manitoba Rural Adaptation Council.

Key Words: phytase, NPP, phosphorus, laying hen

P331 Evaluation of β-mannanase and NSPase inclusion separately or intermittently in reduced energy diets on broiler performance parameters and processing yield. M. P. Williams*, J. Klein1, B. Brown2, S. Rao3, and J. T. Lee1, 1Texas A&M Agrilife Research, Department of Poultry Science, College Station, 2Enzyvia LLC, Sheridan, IN, 3Foster Farms, Livingston, CA.
The object of the current study was to evaluate the impact of feeding β-mannanase and NSPase (cocktail carbohydrase) separately or intermittently in reduced energy broiler diets on performance and processing parameters. The experimental design consisted of 5 dietary treatments including a positive control (PC), negative control (NC) with a reduction of 88 kcal/kg ME through the starter and grower 1 phase and 132 kcal/kg reduction in the grower 2, finisher, and withdrawal phases compared with the PC, and the NC supplemented with β-mannanase, NSPase, and β-mannanase and NSPase intermittently. The intermittent treatment included β-mannanase inclusion from d 1–21 and NSPase from d 22–47. Each treatment included 9 replicate pens with 35 male broilers placed per replicate. The dietary program consisted of 5 dietary phases including the starter (1–10), grower 1 (11–21), grower 2 (22–32), finisher (33–40), and withdrawal (41–47). Broilers were weighed and feed consumption determined on days of dietary changes. On d 48 following an 8 h feed withdrawal period, 6 broilers from each replicate pen were removed and processed for carcass and fat pad measurements. For the duration of the experiment, the reduction in energy in the NC diet reduced (P < 0.05) male broiler body weight and the inclusion of β-mannanase and NSPase separately and intermittently in the NC diet improved growth performance to levels that were comparable to the PC. The NC yielded the highest mortality corrected FCR and the inclusion of β-mannanase and NSPase separately and intermittently reduced (P < 0.05) FCR to levels comparable to the PC for the duration of the trial. The NC diet yielded the lowest processing yields and the inclusion of β-mannanase and NSPase separately and intermittently increased carcass yield to a level similar to the PC, however all enzyme treatments exhibited a reduced fat pad yield compared with the PC. These data confirm the inclusion of β-mannanase and NSPase separately or intermittently improve growth performance parameters in broilers fed reduced energy.

Key Words: broiler, performance, processing, enzyme
on d 14, 28, 37, and 44 which coincided with dietary changes. Body weight was reduced (P < 0.05) in the NC compared with the PC on d 14. Body weight was increased (P < 0.05) with the inclusion of NSPase pelleted at 80°C beginning on d 28 and continued throughout the rest of the experiment compared with NC. The inclusion of NSPase pelleted at 85 and 90°C increased body weight (P < 0.05) on d 28 and 37 compared with NC. Cumulative mortality corrected feed conversion ratio (FCR) was increased (P < 0.05) in the NC diet throughout the experiment as compared with the PC diet. The inclusion of NSPase pelleted at 80°C reduced (P < 0.05) FCR compared with the NC throughout the experiment. The inclusion of NSPase pelleted at 85°C and 90°C reduced (P < 0.05) cumulative FCR compared with the NC at 28 and 37 d. At the conclusion of the trial, NSPase inclusion pelleted at 85°C and 90°C yielded FCR similar to the PC. These data indicate that increasing pelleting temperature did not negatively affect NSPase efficacy.

Key Words: NSPase, pelleting temperature, performance.

P335 Evaluation of the pelleting stability of Ronozyme HiPhos GT under commercial conditions. L. Mejia*, N. E. Ward, and M. de Beer, DSM Nutritional Products LLC, Parsippany, NJ.

Elevated pelleting temperatures, moisture, conditioning time, and pressure can be detrimental to enzymes. Ronozyme HiPhos GT is formulated to minimize enzyme loss without interfering with efficacy. The patented GT (granulated thermostable) stabilization technology is composed primarily of a system of cellulose fiber and sodium sulfate. This commercial formulation was evaluated under various feed processing conditions in 2 experiments. Experiment 1 was conducted at the Department of Grain Science at Kansas State University. The evaluation compared different conditioning temperatures (82, 88, and 93°C) at 30 and 60 s conditioning times in a typical corn/soybean meal broiler starter feed. Ten mash and 10 pellet samples of the feed were collected for each conditioning temperature and time combination, and analyzed to compare "before and after" pelleting. All samples were analyzed for phytase unit content and the mean and standard deviation were determined. The percent retention was calculated by the following formula: (phytase units in pelleted feed/phytase units in mash feed) × 100. In Experiment 2, mash and pellet samples of feed were likewise collected, analyzed, and percent retention was calculated from 10 different commercial feed mills with different pelleting conditions. Results from Experiment 1 indicated that Ronozyme HiPhos GT experienced retention values as high as 98% depending on the conditioning time and temperature. Survivalability was inversely related to increased temperature and time. In Experiment 2, conditioning temperatures ranged between 82 and 91°C and conditioning times were between 20 and 60 s for all the commercial feed mills sampled. Phytase retention values ranged between 82 and 100% depending on the conditioning temperatures and times. These results find Ronozyme HiPhos GT to experience a mean phytase retention of 88% ± 6 SD across a variety of feed conditioning times and temperatures.

Table 1.

<table>
<thead>
<tr>
<th>Commercial feed mills</th>
<th>Mean pelleting temperature, °C</th>
<th>Mean conditioning time, s</th>
<th>Mean phytase retention, %</th>
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<td>10</td>
<td>84</td>
<td>48</td>
<td>88</td>
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Key Words: phytase, enzyme, feed conditioning, pelleting, retention.

P336 Effect of β-mannanase supplementation on nutrient utilization of laying hens. R. Adhikari*,1 M. Kugo1, J. H. Lee2, J. M. Heo1, C. M. Nyachoti1, and W. K. Kim1, 1University of Manitoba, Winnipeg, MB, Canada, 2CTC BIO Inc., Seoul, Korea, 3Chungnam National University, Daejeon, Korea.

A study was conducted to investigate the effects of β-mannanase on nutrient digestibility of laying hens fed corn-soybean meal (SBM) based diet with or without dried distillers grains with solubles (DDGS). A total of 72 Lohmann White laying hens (3 birds/pen) at 42 wks of age were randomly assigned to 4 dietary treatments: corn/SBM based diet (CS), CS with 0.4% β-mannanase (CS-Enz), Corn/SBM/10% DDGS (CSD), and CSD with 0.4% β-mannanase (CSD-Enz) in a 2 × 2 factorial arrangement. There were 6 replicate cages per treatment. Chronic Oxide (0.3%) was added to the diets as an indigestible marker. The hens were fed the treatment diets for an adjustment period of 9 d then for subsequent 3 d for collection of excreta. Excreta samples were analyzed for gross energy, nitrogen (N), calcium (Ca), phosphorus (P) and dry matter (DM) digestibility. Two birds per cage were killed by cervical dislocation and the jejunal content was obtained to determine viscosity. Contents of the lower ileum were collected and analyzed for amino acids, DM and N content. Supplementation of β-mannanase increased (P < 0.05) apparent ileal digestibility (AID) of DM and protein whereas there was no effect with inclusion of DDGS. Inclusion of DDGS or β-mannanase did not show significant difference in AID of amino acids and viscosity. There was no significant difference in apparent metabolizable energy and apparent total tract digestibility (ATTD) of Ca, P and protein with inclusion of DDGS or β-mannanase. Inclusion of DDGS decreased (P < 0.05) ATTD of DM. There was no significant enzyme and DDGS interaction in any of the ATTD and AID parameters measured. The results indicate that supplementing laying hen diets with β-mannanase improves ileal digestibility of dry matter and protein in feed; however it may not have significant effects on ileal amino acid digestibility and ATTD of nutrients in laying hens.

Key Words: β-mannanase, laying hen, nutrient utilization.