

in the state. In addition, 5 of the integrators each formed an 'Integrator Educational Advisory Committee' with membership from the company staff as well as representatives from the growers supplying the complex. These committees set their own educational goals and agenda for what they want to accomplish within the 2-yr time frame of the project. Each committee is provided funding for educational programs based on the priorities they have identified. In some cases this involves bringing in invited speakers on specific topics, but the committees are encouraged to 'think outside the box' and develop creative and unique educational programs that can benefit others in the community in addition to the poultry growers.

**Key Words:** broilers, extension, energy

**209 Development of an interactive comparative nutrition course for poultry science and other majors.** J. Croom\*, G. B. Havenstein, J. M. Wock, and S. Pardue, *North Carolina State University, Raleigh.*

The Department of Poultry Science, North Carolina State University (NCSU) has offered an on campus course in Comparative Nutrition (ANS/PO/NTR 415) since 1975. This class fulfills curriculum major requirements, at NCSU, for Poultry Science, Animal Science, and Nutrition. It has also been accepted by a number of colleges of veterinary medicine as an entrance prerequisite. NCSU first offered a distance education course (DE) in Comparative Nutrition in 2000. The course's DE learning platform was developed by the department, offered for one summer session, and discarded as too cumbersome and non-sustainable. After commercial learning platforms, such as Vista® and Blackboard® (now merged as Blackboard®) became available, the department began offering this course, starting in the summer of 2004, each fall, spring and summer. This DE version contains the same course content as the on-campus course. In order to maintain a productive and healthy scholarly atmosphere for distance education learners, several important features were added. The first was NCSU, approved, proctored, online examinations within the community of the student, regardless of location. Professionally produced course content movies were added that were meant to replace a textbook. We felt this was more cost effective and a more time efficient method for the student to obtain an overview of all course content units (basic physiology, metabolism and nutrient characteristics). Subject matter covered in the movies was elaborated on in the lecture material within a species comparative context. Lecture material was provided by printable notes and "voiced over" PowerPoint® presentations. Additionally, live Webinars that feature lectures

by distinguished scholars in nutrition and metabolism, were offered via the conferencing program, Elluminate®. Finally close contact with the instructor was encouraged via the use of the free computer to computer conferencing program, Skype®, as well as virtual office hours and exam review sessions using Elluminate®. No differences in learning outcomes between the on-campus and DE sections were noted.

**Key Words:** distance education, comparative nutrition, animal science, poultry science

**210 "ASPIRE" acquiring SAT preparation in rural education: An initiative designed to provide rural high school students with first-hand experience in the poultry industry while gaining SAT preparation necessary to gain college admission.** J. B. Hoffman\*, *North Carolina State University, Raleigh.*

The ASPIRE program is geared towards creating a partnership between the North Carolina Poultry Industry and rising high school juniors in order to provide students with summer internships in the industry while preparing them for the Scholastic Assessment Test (SAT) necessary to gain college admission. Many students residing in counties that are major broiler, turkey, and egg producers have a sincere interest in entering the poultry industry in the future. However, many of these students have not been successful in gaining admission to the Department of Poultry Science at North Carolina State University due to low SAT scores. Specifically, students living in the top poultry producing counties in North Carolina scored on average 200 points lower than the average SAT score of last year's entering freshman class at NCstate. In order to ensure the longevity of the industry, North Carolina State's Department of Poultry Science must graduate more students who are interested in entering the industry. Achieving this goal will be dependent upon increasing SAT scores of students interested in careers in the poultry industry so that they are successful in gaining admission to NCSU. With the participation of North Carolina's Poultry Industry, we are in the process of implementing a six week summer internship program for rising high school juniors. Students will intern at a poultry company's headquarters while participating in an SAT test preparatory class sponsored by their partner poultry company. By implementing the ASPIRE program, students interested in pursuing careers in the poultry industry will be able to begin forming relationships with leaders in the industry while improving their SAT scores and likelihood of college admission.

**Key Words:** SAT, college, admissions, poultry, industry

## Metabolism and Nutrition VI: Enzymes

**211 Thermostability and feeding effects of exogenous phytase on performance variables of 3-21 day old broilers.** S. A. Loop\*, L. K. Worley, C. K. Gehring, K. R. Beaman, and J. S. Moritz, *West Virginia University, Morgantown.*

Feed ingredient price and environmental regulations have dictated an increased incorporation of the feed enzyme phytase into broiler diet formulations. Most broilers consume pelleted feed that must be steam conditioned, extruded through a die, and dried. Phytase may be denatured due to exposure to heat and moisture. Phytase manufacturers have addressed this concern by using carbohydrate/lipid coatings, selecting phytase sources that are naturally heat stable, or genetic modification. Regardless, there is potential for heat stable phytase to survive the pelleting process but lose efficacy in liberating phytate bound phosphorus

*in vivo*. The objective of the current study was to demonstrate differences among an *in vitro* retention assay and *in vivo* feeding of nine different genetically modified, heat stable phytases. Dietary treatments consisted of positive and negative controls, as well as negative control diets including one of nine experimental phytases. All diets were pelleted at 71, 77, and 82°C. Feed samples were analyzed for phytase retention. The 77°C pellets were chosen for further evaluation due to all enzymes having high retention. The *in vivo* study consisted of male broilers being placed on a three day pretest, blocked by weight, and allocated to treatments in eight replicate raised wire cages. On day 21, birds were killed and right tibias were extracted for three point breaking force. Feed intake, feed conversion ratio, and live weight gain were calculated. Seven out of nine enzymes showed similar live weight gain to that of the positive control ( $P>0.05$ ). However, using contrasts, five

of these enzymes demonstrated decreased feed conversion ratio of eight points on average compared to the other two enzymes ( $P=0.0102$ ). Bone breaking force followed feed conversion trends; however, illustrated further differences among these five enzymes ( $P<0.05$ ). Evaluations of phytase must include *in vivo* animal testing beyond *in vitro* retention assays in order to fully assess efficacy.

**Key Words:** phytase, heat stability, pellet quality, broiler performance, breaking force

**212 Effect of phytase and carbohydrase supplementation of corn-soy diets with or without the inclusion of distillers dried grains with solubles (DDGS).** M. H. Schwartz\*, P. R. Ferket, J. L. Grimes, and C. R. Stark, *North Carolina State University, Raleigh.*

Increasing the dietary inclusion of DDGS may contribute to variable growth performance of turkeys because of its high nutritional variability and low energy value, but this may be remediated by dietary enzyme supplementation. Turkey toms were assigned to eight dietary treatments arranged as a factorial of 2 dietary inclusion levels of DDGS (0 and 15%) and 4 Diets: 1) positive control (PC), 2) negative control (NC), 3) NC with phytase (1000 FTU/kg feed), and 4) NC with phytase and a combination of xylanase, amylase, and protease (XAP) enzymes (Avizyme 1502, Danisco Animal Nutrition). The PC and NC diets differed by 150 kcal ME/kg, 0.15% Available P and 0.14% calcium. Turkeys were fed *ad libitum* 8 phases of pelleted feed that approximated requirements of digestible nutrients by age. Body weight (BW) and Feed/Gain (FCR) were determined at 23, 43, 57, 85, 98, 119, and 137 d of age. There were neither DDGS X Diet interaction effects on growth performance, nor DDGS effects on BW throughout the experiment. DDGS reduced 1-57d FCR (1.79 vs 1.76,  $P<0.05$ ), but this effect reversed after 85d, such that 1-137d FCR was significantly increased by DDGS (2.47 vs 2.55,  $P<0.005$ ). The effect of DDGS on FCR was associated with its effect on crumble and pellet quality of the respective feed phases. Supplementation of the NC diets with phytase +/- XAP significantly ( $P<0.05$ ) increased BW by 3% over the PC and NC diets through to 98d without effect on FCR. DDGS significantly reduced the efficiency of manufacturing low-energy starter feeds (fed from 1 to 57d), and reduced feed pellet durability of high-energy finisher feeds. Increasing DDGS to 15% had no negative effect on BW gain but negatively affected FCR and pellet quality. The addition of phytase +/- XAP enzymes resulted in an apparent uplift of over 150 kcal ME/kg, reducing the need for dietary fat and inorganic phosphate inclusion, regardless of the dietary DDGS level.

**Key Words:** turkey growth performance, DDGS, phytase, carbohydrase

**213 Effects of phyzyme XP and avizyme 1502 on the performance of broiler breeders and their progeny.** M. Argüelles-Ramos\*<sup>1</sup>, J. T. Brake<sup>1</sup>, and P. W. Plumstead<sup>2</sup>, <sup>1</sup>*North Carolina State University, Department of Poultry Science, Raleigh,* <sup>2</sup>*Danisco Animal Nutrition, Marlborough, United Kingdom.*

Previous research has suggested that there may be negative vertical effects of multi-enzyme cocktails fed to broiler breeders on broiler progeny performance when the progeny also received the same enzyme in the feed. A study was conducted to evaluate the use of phytase (Phyzyme XP; PXP) with or without a combination of xylanase, amylase, and protease (XAP) enzymes (Avizyme 1502, Danisco Animal Nutrition) in broiler

breeder diets on the performance of broiler breeders and their progeny when the progeny also received similar diets. A total of 1104 22-wk-old Ross 708SF females and 128 Ross 344 males were allocated to 4 treatments with 4 replicate pens. Treatments were a Positive Control (PC), Negative Control (NC), NC+PXP, and NC+PXP+XAP. The PC diet contained 2900 kcal ME/kg and all NC diets were 80 kcal ME/kg lower in diets formulated with corn, soybean meal, and 20% distillers dried grains with solubles. Phytase was added at 500 FTU /kg and replaced 0.12% available P and 0.1% Ca. Eggs and mortality were collected and recorded twice daily. Fertility and hatchability were determined weekly from 27 wk of age. Egg production, fertility, fertile hatchability, and mortality differences were not observed among the breeder treatments. Similar dietary treatments were applied to broiler progeny at 30 and 40 wk of breeder age to complete a 4 X 4 design. A total of 2304 chicks (278 males and 278 females per breeder treatment) were distributed among 96 pens at each breeder age. BW and feed consumption were measured at 0, 16, 35, and 41 d, and mortality was collected and weighed twice daily. At 42 d one male per pen was killed to evaluate carcass traits. There were no significant main effects or interactions for broiler BW, feed conversion, or carcass traits due to the breeder diets, which indicated no vertical effect of parental treatment on progeny response to the dietary enzymes evaluated in this study.

**Key Words:** broiler breeders, broilers, enzymes

**214 The effects of feeding an enzyme complex containing carbohydrase and phytase on the performance of broilers fed a diet containing 15% corn distiller's dried grains with solubles.** J. Brandon\*<sup>1</sup>, A. Batal<sup>1</sup>, V. Gady<sup>2</sup>, S. Virden<sup>3</sup>, and P. Geraert<sup>2</sup>, <sup>1</sup>*University of Georgia, Athens,* <sup>2</sup>*Adisseo France SAS, Antony, France,* <sup>3</sup>*Adisseo USA, Inc., Alpharetta, GA.*

This experiment was conducted to investigate the benefits of a multi-enzyme complex (Rovabio<sup>®</sup> Max) containing carbohydrases (from *Penicillium funiculosum*) and phytase (bacterial 6-phytase) on the performance of broilers fed corn-soybean meal based diet containing 15% corn distiller's dried grains with solubles (cDDGS). Male Cobb 500 chicks were randomly assigned to five dietary treatments with 7 replicates of 40 birds per pen. The five dietary treatments were: 1) a positive control (PC) formulated to meet NRC (1994) nutrient recommendations; 2) negative control 1 (NC1) which was lower in AME (-65 kcal/kg), CP and amino acids (-1.5%), avP (-0.15%), and Ca (-0.12%) as compared to the PC; 3) NC1 + 0.005% Rovabio Max; 4) negative control 2 (NC2) which was lower in AME (-85 kcal/kg), CP and amino acids(-3%), avP (-0.15%), and Ca (-0.12%) as compared to the PC; 5) NC2 + 0.005% Rovabio Max. Rovabio<sup>®</sup> Max provided 1,100 visco units of endo- $\beta$ -1,4-xylanase, 100 AGL units of endo-1,3(4)- $\beta$ -glucanase, and 500 FTU of phytase per kg of feed. Growth performance was measured at 14, 28, and 42 days of age. The addition of Rovabio<sup>®</sup> Max to the negative control diets (treatments 3 and 5, respectively) improved ( $P<0.05$ ) weight gain and feed conversion as compared to birds fed NC1 and NC2 (treatments 2 and 4, respectively). Birds fed NC2 + Rovabio<sup>®</sup> Max (Treatment 5) had better feed conversion than those fed the PC. The addition of a multi-enzyme complex of carbohydrases and phytase to a diet containing 15% cDDGS allowed for a reduction in AME (up to -85 kcal/kg), protein and amino acids (up to -3%), dietary phosphorus (-0.15 % avP), and calcium (-0.12 % Ca) without negatively impacting performance, while improving feed conversion.

**Key Words:** carbohydrase, phytase, broilers, performance, distiller's dried grains with solubles

**215 Effects of phytase supplementation during a live coccidia oocyst vaccination on broiler performance, gut morphology, and apparent ileal amino acid digestibility.** C. L. Walk\*<sup>1</sup>, C. L. Wyatt<sup>2</sup>, M. R. Bedford<sup>2</sup>, A. J. Cowieson<sup>2</sup>, and A. P. McElroy<sup>1</sup>, <sup>1</sup>Virginia Polytechnic Institute and State University, Blacksburg, <sup>2</sup>AB Vista, Marlborough, Wiltshire, United Kingdom.

An experiment was conducted to evaluate the effects of phytase supplementation on broiler performance, bone ash, and gut morphology when using a live coccidia oocyst vaccine. One-day-old, Cobb 500 male broilers were obtained from a commercial hatchery and half were sprayed with a live coccidia vaccine. Chicks were weighed and placed in floor pens on clean pine shavings according to five dietary treatments (7 replicate pens/diet/treatment). Dietary treatments were 1) positive control (PC; 0.92% Ca and 0.45% npP), 2) PC + phytase (1000 FTU), 3) negative control (NC; 0.79% Ca and 0.32% npP), 4) NC + phytase (1000 FTU), and 5) NC + phytase (5000 FTU). Diets were formulated to meet or exceed Cobb nutrient requirements with the exception of Ca and P, which was reduced 0.13% in the starter, grower, and finisher. There were no diet by vaccination interactions. Phytase supplementation improved ( $P < 0.05$ ) feed intake (FI), body weight gain (BWG), feed conversion (FC), and tibia ash. Coccidia vaccination reduced ( $P < 0.05$ ) FI, BWG, and tibia ash and negatively ( $P < 0.05$ ) affected FC. Crypt depth and villi height to crypt depth ratios (VCR) were significantly different ( $P < 0.05$ ) between diets. Coccidia vaccination increased ( $P < 0.05$ ) duodenal crypt depth regardless of dietary treatment. Phytase supplementation to NC increased ( $P < 0.05$ ) ileal crypt depth in vaccinated broilers. Vaccination increased ( $P < 0.05$ ) crypt depth and reduced VCR in intestinal sections measured. Phytase supplementation improved ( $P < 0.05$ ) apparent ileal amino acid digestibility. Coccidia vaccination reduced ( $P < 0.05$ ) apparent ileal amino acid digestibility for all amino acids evaluated except arginine. These data indicate vaccination using live coccidia oocysts reduced apparent ileal amino acid digestibility and altered gut integrity in broilers raised in floor pens, which may lead to associated reductions in broiler performance. Phytase supplementation improved performance and apparent ileal amino acid digestibility by removing the negative impact of phytate.

**Key Words:** phytase, broiler, coccidia, vaccination, intestinal morphology

**216 The effect of phytase in combinations with 1 $\alpha$ -OHD<sub>3</sub> added to P-deficient corn-soybean meal, and corn-peanut meal based broiler diets.** A. Liem\*, G. M. Pesti, A. A. Atencio, and H. M. Edwards Jr., University of Georgia, Athens.

Phytase and vitamin D<sub>3</sub> derivatives, such as 1 $\alpha$ -OHD<sub>3</sub> improve birds' ability to utilize phytate phosphorus. The objective of the current study was to evaluate the effects of increasing levels of phytase in combination with 1 $\alpha$ -OHD<sub>3</sub> on broilers performance and mineral utilization in broiler chicks. The potency of 1 $\alpha$ -OHD<sub>3</sub> on the criteria above was also compared to the effects of phytase. Two battery studies were conducted from 1 to 16d with P-deficient corn-soybean meal and corn-peanut meal diets. In Experiment 1, the birds were randomly allocated to 6 treatments: 5 treatments with increasing phytase levels from 0 to 12000 U/kg, and 1 treatment with of 5  $\mu$ g/kg of 1 $\alpha$ -OHD<sub>3</sub>. In Experiment 2, the birds were subjected to 8 treatments: 0, 433, 1333, and 4000 U/kg phytase, with and without of 5  $\mu$ g/kg of 1 $\alpha$ -OHD<sub>3</sub>.

Supplementation of 1 $\alpha$ -OHD<sub>3</sub> and phytase to P-deficient corn-soybean meal and corn-peanut meal based broiler diets increased P, and phytate P utilization, as indicated by an increase in bone ash, body weight gain,

plasma P, phytate P and P retention, and also reduction in incidence of P-deficiency rickets. The effect of 5  $\mu$ g/kg of 1 $\alpha$ -OHD<sub>3</sub> in Experiment 1 was comparable to 444 U/kg of phytase in increasing phytate P and total phosphorus retention, also in reducing the incidence of P-deficiency rickets. The same level was comparable to approximately 650 U/kg of phytase in increasing body weight gain. Retention numbers are often calculated by using indigestible markers such as chromic oxide and celite (for acid insoluble ash determination). In Experiment 1, both markers were utilized. While there were differences between results due to markers used, there were moderately high correlations, leading to similar general conclusions.

**Key Words:** 1 $\alpha$ -OHD<sub>3</sub>, phytase, phytate P utilization, chromic oxide, acid insoluble ash

**217 Stability of a novel serine protease in premixes and broiler feed applications.** R. Brugger\*<sup>1</sup>, M. Gadiant<sup>1</sup>, K. Vogel<sup>1</sup>, P. E. Jensen<sup>2</sup>, and J. O. B. Sorbara<sup>3</sup>, <sup>1</sup>DSM Nutritional Products AG, Kaiseraugst, Switzerland, <sup>2</sup>Novozymes A/S, Bagsvaerd, Denmark, <sup>3</sup>DSM Nutritional Products, São Paulo, SP, Brazil.

A novel Serine protease (RONOZYME® ProAct) expressed in *Bacillus licheniformis* was granulated and coated by vegetable fat to obtain a thermostable and dust free product form. The stability of this protease, which was originally selected for improving the digestibility of amino acids in animal feed, was tested in premix and different broiler feed applications. In addition, the compatibility of the protease with other RONOZYME® feed enzymes such as Phytase, Amylase, Xylanase and Glucanase was investigated. The granulated protease was mixed with a complete premix (including minerals) and a vitamin premix and was subjected to stability testing at room temperature. The results showed excellent protease recoveries in both premixes after 1 month (99%), 3 months (93%) and 6 months (87%). Pelleting of protease supplemented broiler feed at 70-80-90°C, respectively, revealed an excellent stability of the feed enzyme product with recoveries of 99%, 99% and 94%, respectively. Subsequent storage stability testing of the pellets for 3 month at room temperature showed limited losses of <10% of the protease activity. Under very aggressive feed processing conditions (30s conditioning at 80°C and 15s expansion at 120°C) the recovery of the protease activity was higher than 90%. Compatibility testing of the protease with other enzymes was performed using liquid enzyme formulations. On top spraying of the protease in combination with other liquid enzymes such as Phytase, Xylanase, Glucanase and Amylase on pelleted feed showed no negative impact of the protease on the enzyme activities tested.

In summary, all results with this novel Serine protease demonstrated excellent per se and application stability for all feed processes investigated.

**Key Words:** enzyme, pellet, processing, protease, stability

**218 Evaluation of *Peniophora lycii* phytase on phytate phosphorus release for growth and tibia strength in broilers fed a sorghum-SBM diet.** B. Fuente<sup>1</sup>, E. Avila<sup>1</sup>, E. Rosales<sup>2</sup>, S. Charraga<sup>2</sup>, and S. R. Fernández\*<sup>2</sup>, <sup>1</sup>Universidad Nacional Autónoma de México, Mexico City, Mexico, <sup>2</sup>DSM Nutritional Products México, El Salto, Jalisco, Mexico.

In order to test the effect of several inclusion levels of *Peniophora lycii* (PLP) phytase on phytate P (PP) release, 96 1-d-old-Ross 308 male

broilers were randomly allocated to 8 treatments with 3 replicates of 4 chicks each. The birds were housed in thermostatically controlled starter batteries with raised wired floor. Feed & water were provided ad libitum. The birds were fed a sorghum-SBM pre-starter diet from day 1 to 7 formulated to fulfill all nutrient requirements for Ross 308 males. Trial lasted from day 8 to 21, the birds were assigned to the following feeds; treatment 1 was a basal diet sorghum-SBM deficient in Av P (0.22%). Treatments 2 to 4 were added with constant increases of 0.075% inorganic P in order to get a linear broiler growth response to P addition. Treatments 5 to 8 consisted of the addition of 185, 400, 800 & 1,200 ppm of PLP to the basal diet. All diets were formulated to fulfill the Ross 308 male nutritional requirements, but Av. P (formulated as mentioned above). Variables to be analyzed were: weight gain (WG), feed intake, feed efficiency, tibia strength (TS), tibia ash (TA), tibia Ca (TC) & tibia P (TP). The results from treatments 1 to 4 were analyzed by a regression model to test for a significant linear response. Then for every level of PLP added (treatments 5 to 8) the linear regression equation was solved to find out the equivalent value of released P. It was found a linear response for WG ( $Y = 529.5 + 739.67X$   $R^2 = 0.96$   $P < 0.02$ ), TS ( $Y = 12,033.8 + 52,578.19X$   $R^2 = 0.92$   $P < 0.04$ ), TA ( $Y = 38.03 + 51.91X$   $R^2 = 0.81$   $P < 0.10$ ) & TC ( $Y = 13.19 + 22.88X$   $R^2 = 0.86$   $P < 0.07$ ). Under the experimental conditions of the present trial, the average P release values per level of PLP inclusion in the sorghum-SBM diet were; 185 ppm, 0.1%, 400 ppm 0.13%, 800 ppm 0.18% & 1,200 ppm 0.18%

**Key Words:** *Peniophora lycii*, phytase, broiler, available, phosphorus

**219 Use of a protease to enhance the utilization of meat and bone meal amino acids by broilers.** J. C. C. Carvalho<sup>1</sup>, A. G. Bertechini<sup>1</sup>, F. R. Mesquita<sup>1</sup>, R. L. Rios<sup>1</sup>, E. M. C. Lima<sup>1</sup>, and J. O. B. Sorbara<sup>2</sup>, <sup>1</sup>Universidade Federal de Lavras, Lavras, MG, Brazil, <sup>2</sup>DSM Nutritional Products, São Paulo, SP, Brazil.

Meat and bone meal (MBM) is the main animal by-product used in poultry diets as a source of phosphorus and protein. However, several studies find the crude protein (CP) and amino acid digestibility of MBM often to be lower than expected and highly variable. This study tested the ability of a commercially available protease to improve the protein and amino acid digestibility of a conventional commercial 45% protein MBM. The metabolism trial was performed with Cobb 500 male broilers over a 14 to 21 days period with the traditional methodology of replacing the test ingredient in a diet with 70% of the basal diet and 30% MBM. Two levels of the protease (RONOZYME<sup>®</sup> ProAct - 75000 PROT/g product) was tested: 0 and 200 ppm. After an adaptation period of four days, total excreta was collected for three days, and analyzed for 17 amino acids: aspartate (Asp), glutamine (Glu), serine (Ser), glycine (Gly), histidine (His), arginine (Arg), threonine (Thr), alanine (Ala), proline (Pro), tyrosine (Tyr), valine (Val), methionine (Met), cystine (Cys), isoleucine (Ile), leucine (Leu), phenylalanine (Phe), lysine (Lys) and total amino acids (total AA). The apparent digestibility coefficient was determined for each amino acid and for all amino acids (AMCAA) together. The experimental design was completely randomized with eight replicates per treatment. The data were analyzed according to SAS procedures (2001). With the use of the protease, increases in digestibility were significant ( $P < 0.05$ ) for Asp, Glu, Ser, His, Arg, Thr, Ala, Pro, Val, Met, Cys, Phe and Lys. The average improvement in the utilization of these amino acids was determined to be 8% ( $P < 0.05$ ). The average improvement achieved using the protease was 8.63% ( $P < 0.05$ ) when considering only the limiting amino acids, Met, Lys and Thr. This compared to an improvement of 6.32% considering total AA, which

was also significant ( $P < 0.05$ ). We conclude that the use of 200 ppm of RONOZYME<sup>®</sup> ProAct effectively increased the average utilization of amino acids in a commercial MBM by 6.32%.

**Key Words:** enzyme, protease, meat and bone meal, amino acid, metabolism

**220 Use of a protease to enhance the utilization of corn amino acids by broilers.** J. C. C. Carvalho<sup>1</sup>, A. G. Bertechini<sup>1</sup>, R. L. Rios<sup>1</sup>, F. R. Mesquita<sup>1</sup>, E. M. C. Lima<sup>1</sup>, and J. O. B. Sorbara<sup>2</sup>, <sup>1</sup>Universidade Federal de Lavras, Lavras, MG, Brazil, <sup>2</sup>DSM Nutritional Products, São Paulo, SP, Brazil.

Corn is the ingredient most widely used in poultry diets, with a marked contribution to the amino acids (proximally 10 to 20% of the requirement, depending which amino acid we are considering) and crude protein (proximally 20% of the requirement) composition to the total feed. This makes corn a critical ingredient from an economic and environmental point of view, since an increased utilization of amino acids would presumably improve economics with a reduced nitrogen excretion. In this study, we tested the ability of a commercially available protease (RONOZYME<sup>®</sup> ProAct) to improve the digestibility of amino acids in corn fed to broilers. The metabolism trial was performed with over a 14-21 day period with Cobb 500 males. Traditional methodology was applied and used 60% basal diet and 40% Corn across two levels of protease (0 and 200 ppm RONOZYME<sup>®</sup> ProAct - 75000 PROT/g product). After four adaptation days, total excreta was collected for three days, dried and analyzed for the following amino acids: aspartate (Asp), glutamine (Glu), serine (Ser), glycine (Gly), histidine (His), arginine (Arg), threonine (Thr), alanine (Ala), proline (Pro), tyrosine (Tyr), valine (Val), methionine (Met), cystine (Cys), isoleucine (Ile), leucine (Leu), phenylalanine (Phe), lysine (Lys) and total amino acids (total AA). The apparent digestibility coefficient was determined for each amino acid and for all amino acids (AMCAA). The experimental design was fully randomized with eight replicates per treatment. The data were analyzed according to SAS procedures (2001). Supplementation of the protease significantly ( $P < 0.05$ ) improved the digestibility for serine, glycine, threonine, proline, cystine, isoleucine and total amino acids, considering these amino acids, there was an average 6.63% increase in digestibility. The use of this protease resulted in an average 3.18% improvement of the corn amino acids metabolism during the broilers starter period.

**Key Words:** enzyme, protease, corn, amino acid, metabolism

**221 Use of a protease to enhance the utilization of soybean meal amino acids by broilers.** A. G. Bertechini<sup>1</sup>, J. C. C. Carvalho<sup>1</sup>, F. R. Mesquita<sup>1</sup>, S. F. Castro<sup>1</sup>, C. Meneghetti<sup>1</sup>, and J. O. B. Sorbara<sup>2</sup>, <sup>1</sup>Universidade Federal de Lavras, Lavras, MG, Brazil, <sup>2</sup>DSM Nutritional Products, São Paulo, SP, Brazil.

Energy costs have significantly driven up the price of solvent-extracted soybean meal (SBM) for poultry feeds, and subsequently, the cost of poultry production. Studies are constantly in search of methods to utilize SBM more efficiently to reduce costs, as well as to reduce nitrogen excretion. The objective of this study was to test the ability of a protease to increase the amino acid digestibility of SBM. The metabolism trial was performed with over a 14-21 day period with Cobb 500 males. Traditional methodology was applied and used 70% basal diet and 30% SBM across two levels of protease (0 and 200 ppm RONOZYME<sup>®</sup> ProAct - 75000 PROT/g product). After four adaptation

days, total excreta were collected during three days and dried for amino acid analyses: aspartate (Asp), glutamine (Glu), serine (Ser), glycine (Gly), histidine (His), arginine (Arg), threonine (Thr), alanine (Ala), proline (Pro), tyrosine (Tyr), valine (Val), methionine (Met), cystine (Cys), isoleucine (Ile), leucine (Leu), phenylalanine (Phe), lysine (Lys) and total amino acids (total AA). The apparent digestibility coefficient was measured for each individual amino acid and for all amino acids together (AMCAA). The experimental design was fully randomized with eight replicates per treatment. Significant ( $P < 0.05$ ) increases were found in the digestibility (%) of most amino acids when feeding 200 ppm RONOZYME<sup>®</sup> ProAct protease: Ser (4.67), Gly (12.09), His (6.34), Arg (8.74), Thr (10.23), Pro (5.77), Val (4.06), Met (6.32), Cys (10.23) and Lys (3.80) for these amino acids by using 200 ppm protease, with an average improvement ( $P < 0.05$ ) was 7.26% for all amino acids. improvement. For total AA, there was an average 5.3% improvement using the protease ( $P < 0.05$ ). We concluded that the use of this particular protease resulted in an average 5.3% improvement in the utilization of the total AA of soybean meal.

**Key Words:** enzyme, protease, soybean meal, metabolism, amino acid

**222 Use of a protease to enhance the utilization of full fat soybean amino acids by broilers.** A. G. Bertechini<sup>\*1</sup>, J. C. C. Carvalho<sup>1</sup>, F. R. Mesquita<sup>1</sup>, S. F. Castro<sup>1</sup>, D. F. Remolina<sup>1</sup>, and J. O. B. Sorbara<sup>2</sup>, <sup>1</sup>Universidade Federal de Lavras, Lavras, MG, Brazil, <sup>2</sup>DSM Nutritional Products, São Paulo, SP, Brazil.

Because of its protein content (35 to 42%) and lipid concentration (18 to 22%), and in spite of a lower amino acid digestibility full fat soybean (FFS) meal is often considered as an alternative for solvent-extracted soybean meal. In this study, a protease was evaluated for its ability to improve the amino acid digestibility of FFS for broilers. The metabolism trial was performed with over a 14-21 day period with Cobb 500 males. Traditional methodology was applied and used 70% basal diet and 30% FFS across two levels of protease (0 and 200 ppm RONOZYME<sup>®</sup> ProAct). After four adaptation days, total excreta was collected for three days, and dried for analyses of 17 amino acids: aspartate (Asp), glutamine (Glu), serine (Ser), glycine (Gly), histidine (His), arginine (Arg), threonine (Thr), alanine (Ala), proline (Pro), tyrosine (Tyr), valine (Val), methionine (Met), cystine (Cys), isoleucine (Ile), leucine (Leu), phenylalanine (Phe), lysine (Lys) and total amino acids (total AA). The apparent metabolism coefficient was measured for each individual amino acid and for all amino acids together (AMCAA). The experimental design was completely randomized with eight replicates per treatment. With the use of protease, significant ( $P < 0.05$ ) increases

the digestibility all individual AA and AMCAA were found for FFS, with the exception of Tyr. Total AMCAA was improved ( $P < 0.05$ ) by 6.15%. Average improvement for the limiting amino acids Met, Lys and Thr was 5.76. In this experiment, this protease significantly increased the digestibility of amino acids in FFS by 6.15%, and presumably improved the nutritional value of FFS as an ingredient for poultry diets.

**Key Words:** enzyme, protease, full fat soy, amino acid, metabolism

**223 The effect of a protease on performance of broilers fed corn-soybean meal diets containing different levels of crude protein and amino acids.** M. K. Manangi<sup>\*1</sup>, M. E. Wehmeyer<sup>1</sup>, J. D. Garlich<sup>2</sup>, N. Odetallah<sup>1</sup>, and M. Vazquez-Anon<sup>1</sup>, <sup>1</sup>Novus International, Inc., St. Charles, MO, <sup>2</sup>North Carolina State University, Raleigh.

A 28 d experiment was conducted to evaluate the effect of supplementation of protease (*Bacillus licheniformis* PWD-1) enzyme (activity of 600,000 U/g product: CIBENZA<sup>™</sup> DP100) preparation to broiler chicks fed isocaloric corn-SBM diets containing different levels of crude protein (cp) and amino acids (aa). A total of 720 Cobb-500 male broiler chicks were assigned to 6 treatments with 12 cages/treatment and 10 chicks/cage. The trial design was a 3 x 2 factorial with 3 levels of crude protein and aa, and with or without protease (source) supplementation. Individual dietary treatments for starter (0-12d) consisted of: T1 with 22.4% cp, 1.19% Dig Lys, 0.89% Dig TSAA, and 0.81% Dig Thr; T2 with 5% less cp and aa compared to T1; T3 with 10% less cp and aa compared to T1; T1 to T3 were without protease supplementation whereas T4 to T6 were similar to T1-T3, respectively, but supplemented with protease @0.05% of the diet. The grower (12-28d) diets were similar to starter diets except for change in cp and aa concentration. The grower T1 diet had 20.26% cp, 1.07% Dig Lys, 0.82% Dig TSAA, and 0.73% Dig Thr. No interaction ( $P > 0.05$ ) was observed for level and source for any of the performance parameters. Both level and source effects ( $P < 0.01$ ) were observed for cGain and adj F:G, whereas only source effect ( $P < 0.01$ ) was found for cFI. In summary, irrespective of dietary cp and aa levels the dietary protease supplementation to broiler chicks under present experimental conditions improved weight gain by 54 g (4.5%), cFI by 52 g (2.74%) and adj F:G by 2.5 points (1.6%) compared to chicks fed diets containing no protease enzyme preparation. Also, the study indicates that this dietary supplemental protease would allow reduction in nutrient (cp, aa) density of broilers diets from 5 to 10% depending on the variable (cGain or F:G).

<sup>™</sup>CIBENZA is a trademark of Novus International, Inc.

**Key Words:** protease, broiler, TSAA, Lys, Thr

## Processing, Products, and Food Safety II

**224 Consumer perception of specialty turkeys: Free-range, organic, and heritage.** A. C. Fanatico<sup>\*1</sup>, H. L. Goodwin<sup>2</sup>, C. M. Owens<sup>2</sup>, and A. M. Donoghue<sup>1</sup>, <sup>1</sup>Poultry Products and Product Safety Research, Agricultural Research Service, USDA, Fayetteville, AR, <sup>2</sup>University of Arkansas, Fayetteville.

Consumer interest is growing in specialty poultry products including free-range production and alternative turkey products, such as heritage. Heritage turkeys are slow-growing, naturally-mating turkeys and are typically raised with outdoor access. There is interest in sensory attri-

butes of the meat, as well as conservation of livestock breeds/varieties. Our objective was to investigate consumer perception of specialty turkey. A consumer focus group was held to gather data and allow consumers to sample several types of turkey meat including slow-growing heritage turkeys raised with outdoor access, fast-growing turkeys raised with outdoor access, and fast-growing turkeys raised indoors (a conventional, marinated product). Consumers with an interest in natural and local food were targeted by collaborating with a local food organization and outreach through natural food stores. Roasted breast and thigh meat