

1.51%) content than samples from B ( $P \leq 0.001$ ). Samples from B had higher NDF content than samples from C with samples from A being intermediate (12.0 vs. 8.4 vs. 9.3%;  $P \leq 0.001$ ). The Ca (0.43 vs. 0.31 and 0.40%) and K (2.52 vs. 2.11 and 2.21%) content were higher in A samples than in B samples, with C samples being intermediate ( $P \leq 0.01$ ). The C samples had higher PDI (22.6 vs. 15.2 vs. 20.1%) and TI content (3.9 vs. 2.8 and 3.4 g/kg) than B samples with A samples being intermediate ( $P \leq 0.001$ ). In addition, C samples had higher KOH (87.6 vs. 83.9 and 84.8%;  $P \leq 0.001$ ) than A and B samples. The TI content was positively correlated with PDI ( $r = 0.67$ ;  $P \leq 0.001$ ) and KOH ( $r = 0.75$ ;  $P \leq 0.001$ ). In addition, PDI was positively correlated with KOH ( $r = 0.52$ ;  $P \leq 0.001$ ). Finally, lysine ( $r = 0.31$ ) and methionine ( $r = 0.40$ ) were lower in those samples with lower KOH ( $P \leq 0.001$ ). In summary, the origin of the soybean meal influences nutrient content and the value of the parameters used to evaluate protein quality.

**Key Words:** soybean meal, chemical composition, quality control

**93 Field observation: Effects of long term feeding of soybean meal high in trypsin inhibitors to broiler breeders.** N. Ruiz\*<sup>1</sup>, E. A. Vargas<sup>2</sup>, and F. de Belalcázar<sup>3</sup>, <sup>1</sup>Continental Grain Company, New York, NY, <sup>2</sup>Avícola de Occidente, Maracaibo, Estado Zulia, Venezuela, <sup>3</sup>Nutritional, Bogotá, Colombia.

Nineteen broiler breeder flocks involving a total of 311,904 birds (271,705 hens and 40,199 roosters) of a commercial vertical integrated operation were fed commercial breeder feeds containing soybean meal (SBM) whose trypsin inhibitor (TI) contents fluctuated between 3.04 and 5.02 mg of TI per gram of SBM. Out of these 19 flocks 11 flocks were exposed to high TI intake since one day of age. The general evolutionary observation of the effects of TI antinutritional activity is wet droppings accompanied with feed passage, dirty cloacae, and loss of uniformity. Necropsies of these birds show a consistent nonspecific enteritis and liver damage in every single flock. As the exposure to high TI continues over several weeks feather loss is evident in both males and females during the growing period. Roosters seem severely affected. However, the first exposure of sexually matured flocks to high TI follows basically the same pattern as the growing flocks, but egg production, percent of dirty eggs, fertility, and total hatch were negatively affected. Histopathology of the 19 flocks not only confirmed the nonspecific enteritis, but also consistently underlined the presence of liver toxicity suggesting mycotoxins as one of the several possible etiological agents. However, the routine analysis of white and yellow corn were always below 20 ppb, and the analyses of 15 additional mycotoxins in selected samples were either within normal levels, or not detectable. Only when the TI contents of the feed was reduced in concentration to the "normal" expected levels

contributed by adequately processed SBM (around 2 mg of TI/gram of SBM) the enteritis and feed passage were not observed. Our conclusion is that the TI contents of adequately processed SBM fed to broiler breeders should be at 2 mg/gram of SBM or lower. As the TI contents gets closer to 3 mg/g and higher, feed passage and enteritis are likely to occur at the normal inclusion levels of SBM in corn-soy diets.

**Key Words:** soybean meal, trypsin inhibitors, broiler breeder

**94 Nutritional value of imported corn versus locally produced bronze and white sorghum grain when fed to broiler chicks in Nicaragua.** C. Feoli\*<sup>1</sup>, J. D. Hancock<sup>1</sup>, M. G. Viscarra<sup>2</sup>, R. Rodriguez<sup>2</sup>, M. J. Rios<sup>2</sup>, F. J. Baltodano<sup>2</sup>, F. Vargas<sup>3</sup>, and S. C. Mason<sup>4</sup>, <sup>1</sup>Kansas State University, Manhattan, <sup>2</sup>Universidad Nacional Agraria, Managua, Nicaragua, <sup>3</sup>Asociación Nacional de Productores de Sorgo, Managua, Nicaragua, <sup>4</sup>University of Nebraska, Lincoln.

Four hundred sixty-eight 2-d-old broiler chicks (Cobb × Cobb with an avg initial BW of 57 g) were used in a 14-d growth assay to determine the nutritional value of imported corn (US no. 2 with 7.7% CP and 3.6% crude fat) vs. locally produced bronze (CB-8996, a hybrid with 7.9% CP and 2.5% crude fat) and white (Pinolero-1, a variety with 6.7% CP and 2.5% crude fat) sorghum grain. The chicks were allotted to 1.6-m × 2.9-m pens with 26 birds/pen and 6 pens/treatment. Feed and water were consumed on an ad libitum basis. The corn and sorghums were ground through a hammermill (4-mm screen openings) and blended into diets that were formulated to 1.29% Lys, 0.99% Met+Cys, 1.1% Ca, and 0.49% available P. All data were analyzed as a randomized complete block with location within the barn as the blocking term and initial BW as a covariate. Orthogonal contrasts were used to separate treatment means with comparisons of corn vs. the sorghums and bronze sorghum vs. white sorghum. There was no effect ( $P > 0.22$ ) of grain source on average daily gain. However, average daily feed intake was greater ( $P < 0.007$ ) and gain to feed ratio was lower ( $P < 0.007$ ) for chicks fed the corn-based diet compared to those fed the sorghum-based diets. There were no differences in rate of gain or food intake among chicks fed the 2 sorghums ( $P > 0.22$ ), but those fed white sorghum tended to have greater gain-to-feed ratio ( $P < 0.09$ ). For the diets with corn, bronze sorghum, and white sorghum, average daily gain was 24.7, 25.2, and 25.9 g/d, average daily feed intake was 48.5, 45.2, and 43.7 g/d, and gain to feed ratio was 509, 558, and 593 g/kg, respectively. In conclusion, bronze and white sorghums produced in Nicaragua supported equal or greater growth performance compared to imported corn when fed to broiler chicks.

**Key Words:** broilers, corn, sorghum

## Metabolism and Nutrition III: Nutrition

**95 Effects of *Echinacea purpurea* fermented juice supplementation through drinking water on performance, serum proteins, and liver enzymes in broilers.** Z. Nasir\* and M. A. Grashorn, Hohenheim University, Stuttgart, Germany.

Present experiment was conducted to study the effects of *Echinacea purpurea* (EP) fermented juice supplementation through drinking water on broiler performance, serum protein, and liver enzymes. In total, 96

one-day-old broiler (Ross 308) chicks were randomly divided into 8 groups (12 chicks/group). Four randomly selected groups received EP fermented juice at the rate of 0.25 mL/kg<sup>0.75</sup>/chick/day for 3 days followed by a 9-day interval, while 4 other groups served as control with no supplementation. During the experiment, daily feed intake, weekly weight gain, and daily mortality were recorded. Blood collected on 35th day (at slaughtering) was analyzed to determine the levels of serum total protein, albumin, globulin, ALT,  $\gamma$ -GT, alkaline phosphatase, lactate

dehydrogenase, and creatine kinase. Results showed that treatment groups supplemented with EP showed better FCR than control. Serum total protein and globulin contents were significantly ( $P < 0.05$ ) higher in EP supplemented group as compared to control, while no significant treatment effect was observed on albumin contents. Levels of creatine kinase were significantly ( $P < 0.05$ ) less in EP supplemented groups as compared to control, while levels of ALT,  $\gamma$ -GT, alkaline phosphatase, and lactate dehydrogenase were nonsignificantly different. Improvement of FCR, serum total protein, and globulin contents showed positive effects of EP fermented juice supplementation through drinking water on protein metabolism and broiler performance, with no harmful effects on liver enzymes.

**Key Words:** *Echinacea purpurea*, broiler performance, serum proteins, liver enzymes

**96 Development of a precision-fed ileal digestibility assay utilizing 3-week-old broiler chicks.** E. J. Kim\*, P. L. Utterback, and C. M. Parsons, *University of Illinois, Urbana*.

The objective of this study was to develop a precision-fed ileal digestibility assay, primarily for amino acids, using 3-week-old chicks. Day-old chicks were fed a standard corn-soybean meal diet until 22 days of age in all experiments. In Experiment 1, feed was removed and excreta were collected at 2, 4, 6, 8, 10, 12, and 14 hours postfeed withdrawal. Results indicated that 8 hours of feed withdrawal was sufficient to empty the ileum of feed residues. In subsequent experiments, cross-bred (New Hampshire  $\times$  Columbian) or commercial broiler chicks (Cobb or Ross) were fasted overnight and then tube-fed 6, 9, 12, or 15 g of a corn-soybean meal mixture. Ileal digesta from the Meckel's diverticulum to the ileo-cecal junction were then collected at 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, and 7.0 hours postfeeding. Results indicated that the amount of digesta in the ileum was generally maximized by 4.0 hours postfeeding. In addition, the amount of digesta in the ileum was maximized by feed intakes of 9 g or greater. Apparent ileal digestibility of amino acids in the corn-soybean meal mixture was determined at 2.5, 3.0, 3.5, and 4.0 hours postfeeding in both the cross-bred and commercial broiler chicks. Ileal amino acid digestibility coefficients were similar for the 2 types of chicks. Digestibility values were similar for the 3.0-, 3.5-, and 4.0-hour collection times, but were lower at the 2.5-hour collection time. The results of this study indicate that ileal amino acid digestibility can easily be determined in 3-week-old broiler chicks using a precision-fed assay. For such an assay, it is recommended that the chicks be fasted for at least 8 hours prior to tube-feeding, that the level of feed intake should be approximately 10 g, and that the ileal contents be collected at approximately 4 hours postfeeding.

**Key Words:** ileal digestibility, amino acids, precision-feeding

**97 Effect of in ovo feeding on turkey embryo intestinal morphology.** J. E. de Oliveira\*<sup>1</sup>, C. M. Ashwell<sup>2</sup>, Z. Uni<sup>3</sup>, and P. R. Ferket<sup>2</sup>, <sup>1</sup>*Provimi Research and Innovation Centre, Brussels, Belgium*, <sup>2</sup>*North Carolina State University, Raleigh*, <sup>3</sup>*Hebrew University, Rehovot, Israel*.

During the first few days posthatch, turkey poults are susceptible to high morbidity and mortality and many have stunted growth due to

poor digestive capacity and low energy status. Means that improve early gut development and stimulate digestive and absorptive capability may greatly reduce these early losses. Several studies have demonstrated that in ovo feeding improves morphological development of the gut in chicks and enhances gene expression of digestive enzymes and nutrient transporters in both chicks and poults. This study investigated the effects of in ovo feeding (IOF) metabolic co-factors on the development of jejunal and ileal morphology. Eggs were injected into the amnion of embryos at 24 d of incubation a 0.4 mL saline solution containing a proprietary blend of nutrients. Jejunum and ileum sections of noninjected controls and IOF embryos were sampled at 25 days of incubation and at hatch, fixed, and stained with hematoxylin for histological evaluation. Morphological parameters measured were villus basal width, tip width, and height, crypt depth, villus height: crypt depth ratio, and muscularis depth. Relative to controls, IOF significantly increased villus height and height to crypt ratio at hatch by 30 and 37% in the jejunum ( $P < 0.05$ ), and by 17 and 20% in the ileum ( $P < 0.05$ ), respectively. However, the IOF treatment reduced the thickness of ileal muscularis layer by 12% in the jejunum and by 32% in the ileum ( $P < 0.05$ ) relative to the control treatment. These changes indicated that the IOF solution tested stimulated a shift of resources from building muscular structure to enteric mucosa, therefore increasing brush-border surface available for digestion and absorption of nutrients. In ovo feeding may be an effective method to enhance enteric morphological development of poults at hatch, which may improve their posthatch survival and growth.

**Key Words:** turkey embryos, in ovo feeding, gut development

**98 Effects of feed form and fiber inclusion in the diet on digestive traits and nutrient utilization in eight-day-old broilers.** E. Jiménez-Moreno<sup>1</sup>, J. M. González-Alvarado<sup>2</sup>, A. de Coca-Sinova<sup>1</sup>, J. García<sup>1</sup>, R. Lázaro<sup>1</sup>, and G. G. Mateos\*<sup>1</sup>, <sup>1</sup>*Universidad Politécnica de Madrid, Madrid, Spain*, <sup>2</sup>*Universidad Autónoma de Tlaxcala, Tlaxcala, México*.

We have evaluated the influence of feed form and inclusion of different fiber sources in a low fiber diet on digestive traits, total tract apparent retention (TTAR) of nutrients, and AME<sub>n</sub> of diets in 8-d-old chicks. The control diet was based on rice (58%) and had 2% celite added. It contained 3,200 kcal AME<sub>n</sub>/kg, 1.4% total lysine, and 1.6% crude fiber, and was offered either in mash or pellet form. In addition, 6 diets that consisted in a combination of 3 fiber sources (OH, oat hulls; RH, rice hulls; and SFH, sunflower hulls) at 2 levels of inclusion (2.5 and 5%) were also formulated and offered as mash or in pellet form. The fiber source was included (wt/wt) in the control diets at expenses of the whole diet. Each of the 14 treatments was replicated 6 times (14 chicks caged together). Pelleting increased the relative weight (RW; %BW) of the liver ( $P \leq 0.05$ ) and reduced that of the gizzard ( $P \leq 0.001$ ). Also, gizzard pH was increased with pelleting ( $P \leq 0.001$ ). The TTAR of N was not affected by feed form and in fact, pelleting reduced TTAR of EE and EMAN of the diet ( $P \leq 0.01$ ). Hulls inclusion increased the gizzard RW ( $P \leq 0.001$ ) and reduced the pH ( $P \leq 0.001$ ) of its digesta and the effects were more pronounced with OH than with RH or SFH. Hulls inclusion improved TTAR of soluble ash ( $P \leq 0.01$ ), N ( $P \leq 0.01$ ), and EE ( $P \leq 0.05$ ), and increased the AME<sub>n</sub> of the diet ( $P \leq 0.001$ ). The AME<sub>n</sub> of the diets was lower in chicks fed OH than in chicks fed SFH, with chicks fed RH being intermediate ( $P \leq 0.01$ ). We conclude that pelleting reduces gizzard RW and does not improve nutrient digestibility of the diet. Also, the inclusion of hulls in a low-fiber diet improves

utilization of nutrients. Young broilers might have a requirement for a minimal amount of fiber in the diet.

**Key Words:** hulls, nutrient digestibility, broilers

**99 Inhibition of autoinducer-2 activity by saponin rich guar extracts.** R. Kakani, O. Gutierrez\*, C. A. Bailey, P. Jesudhasan, and S. D. Pillai, *Texas A&M University, College Station.*

Saponin rich extracts from guar meal have recently been shown to exhibit antimicrobial activity. Bacterial cells within microbial communities communicate amongst each other using signaling molecules termed autoinducers, a process that has been termed quorum sensing. The autoinducer-2 (AI-2) molecule produced by bacteria is considered to be a universal signaling molecule since it influences gene expression in a variety of bacteria. Natural and manmade products that can modulate AI-2 activity may have therapeutic value. The objective of this study was to determine whether guar saponins have the capability to inhibit AI-2 activity. The luminescence-based response of the reporter strain *Vibrio harveyi* BB 170 was used as the basis for determining AI-2 activity. Conditioned media (cell free supernatant) from *E. coli* #5 (a prolific AI-2 producer) was used as a positive control. Freeze dried methanol extracts of guar meal (20% peak A&B, 60 and 100%) were tested for inhibition of AI-2 activity. The 100% extract showed an average inhibition of  $80.3 \pm 1.18\%$  at a concentration of 1 mg/mL (compared with positive control). The 60% extract showed an average inhibition of  $54.7 \pm 6.5\%$  at a concentration of 1 mg/mL and the 20% A&B extracts showed an average of  $42.7 \pm 2.7\%$  and  $20.1 \pm 0.2\%$  inhibition, respectively. Interestingly, further purified extract from the 100% MEOH extract showed only  $54.7 \pm 0.87\%$  inhibition at a concentration of 1 mg/mL. The inhibitory activity by 100% MEOH extract was further analyzed by increasing the levels of concentration. Average inhibition increased to  $89.8 \pm 1.24\%$  at a concentration of 5 mg/mL and to a  $93.4 \pm 0.9\%$  at a concentration of 10 mg/mL. Understanding the mechanism behind the inhibition of AI-2 activity by guar saponins could open doors to use guar saponins to control microorganisms in poultry feed and other formulations.

**Key Words:** guar saponins, autoinducer-2, inhibition

**100 Femoral head disarticulation disorder in chickens.** V. Durairaj\*<sup>1,2</sup>, C. N. Coon<sup>1</sup>, W. E. Huff<sup>2</sup>, G. R. Huff<sup>2</sup>, F. D. Clark<sup>1</sup>, and N. C. Rath<sup>2</sup>, <sup>1</sup>University of Arkansas, Fayetteville, <sup>2</sup>PPPSRU,ARS,USDA, Fayetteville, AR.

Femoral head disarticulation (FHD) and necrosis is an idiopathic skeletal metabolic disorder that causes degenerative changes in the proximal growth plate of the femur. It is common in meat-type poultry and negatively impacts broiler breeder performance. With no overt signs of the disease, it is difficult to diagnose the problem until the birds are lame. To understand the mechanisms of FHD, suitable experimental models are desirable. A field study with 6-week-old chickens showed the birds with FHD had elevated serum levels of cholesterol, low density lipoprotein (LDL), and triglycerides. Therefore, an experiment was conducted feeding chickens diets enriched with 8% poultry fat or administered either cholesterol or prednisolone at week 6 to determine whether these treatments would increase the incidence of FHD. Neither the high fat diet nor cholesterol injection produced FHD. However, when the chickens were treated with prednisolone showed a significantly high incidence

of FHD and had elevated levels of serum lipids. It appears that elevated blood lipid levels may be a risk factor in the development of FHD and the prednisolone-induced disease may be a suitable experimental model to study this disease in young broilers.

**Key Words:** femoral head disarticulation, serum chemistry, prednisolone

**101 Evaluation of the effect of diet and phytase on broiler performance using a live coccidia oocyst vaccine.** C. L. Walk\*<sup>1</sup>, C. Wyatt<sup>2</sup>, R. Upton<sup>2</sup>, and A. P. McElroy<sup>1</sup>, <sup>1</sup>Virginia Polytechnic Institute and State University, Blacksburg, <sup>2</sup>Syngenta Animal Nutrition, Research Triangle Park, North Carolina.

An experiment was conducted to evaluate the effects of diet and phytase on broiler performance and bone ash when using a live coccidia vaccine. One-day-old, Cobb 500 chicks were obtained and half were sprayed with Coccivac B. All chicks were weighed and placed in battery brooders according to 7 dietary treatments (n = 72). Dietary treatments were positive control (PC; 3,050 ME, 0.95% Ca, and 0.45% P), negative control 1 (NC1; 3,010 ME, 0.85% Ca, and 0.32% P), NC1 + phytase A (NC1+EnA), negative control 2 (NC2; 3,050 ME, 0.95% Ca, and 0.45% P), NC2 + phytase B (NC2+EnB), negative control 3 (NC3; 3,050 ME, 0.95% Ca, and 0.45% P), and NC3 + phytase C (NC3+EnC). Phytase supplementation to NC improved ( $P < 0.05$ ) feed intake (FI) comparable with PC, but not different than nonsupplemented NC. Phytase A or B supplementation improved ( $P < 0.05$ ) body weight gain (BWG) comparable to PC but not different than NC1 or NC2, respectively. Dietary treatment did not significantly affect feed conversion (FC). Coccidia vaccination significantly increased ( $P < 0.05$ ) FI during days 14 to 21 which resulted in significantly increased ( $P < 0.05$ ) BWG with no effect on FC. Diet and vaccination interactions significantly affected ( $P \leq 0.05$ ) FC from day 0 to 7. Phytase supplementation significantly improved ( $P < 0.05$ ) 21-day tibia ash as compared to the NCs. Phytase A significantly improved ( $P < 0.05$ ) 21-day tibia ash comparable to PC. Diet and vaccination interaction significantly affected ( $P \leq 0.05$ ) 21-day tibia ash. Mortality was significantly higher ( $P < 0.05$ ) in unvaccinated broilers compared to vaccinated broilers from day 0 to 21. Phytase supplementation improved FI and BWG in diets with reduced ME, Ca, and P. There was no negative impact of coccidia vaccination in combination with phytase supplementation on broiler performance.

**Key Words:** phytase, coccidia vaccination, broilers

**102 Spleen tissue n-3 and n-6 fatty acid distribution and cyclooxygenase-2 (COX-2) protein expression during lipopolysaccharide challenge in broiler chickens: Effect of dietary lipids and time of feeding.** D. Gonzalez\* and G. Cherian, *Oregon State University, Corvallis.*

Newly hatched chicks are often subjected to a 48- to 54-h delayed access to feed and water due to shipment distances. Delayed access to feed has been reported to reduce growth and development of the small intestine, reduce organ weights and a lower final body weight. The current study investigated the effect of early vs. late access to feed and dietary lipids on lipopolysaccharide (LPS)-induced alterations in fatty acid metabolism in broiler birds, and cyclooxygenase-2 (COX-2) protein expression in spleen tissue. COX-2 is induced upon cell activation and

its expression is associated with inflammation. A total of forty ( $n = 40$ ) chicks were used for the study. The chicks were fed a high or low n-3 diet within 5 h of hatching (early) or after 48 h of hatching (late). LPS injection led to a decrease in total n-6 fatty acids in the spleen when compared with noninjected birds ( $P < 0.05$ ) in all treatments. When exposed to LPS challenge, feeding high n-3 diets resulted in an increase in n-3 fatty acids in the spleen tissue when compared to low n-3 group ( $P < 0.05$ ). Expression of COX-2 protein in spleen tissue was lower in noninjected birds fed high n-3 diet when compared to injected birds ( $P < 0.05$ ). During inflammation, lipid substrates for the activated immune system are provided by fatty acids. As a major lymphoid organ, the spleen tissue plays an important role in immune function. Thus, dietary management strategies directed at attenuating spleen COX-2 expression may be beneficial to reducing immune inflammatory responses in broiler chickens.

**Key Words:** spleen, n-3, n-6 fatty acids, cyclooxygenase-2

**103 Influence of turkey genetic selection and parent flock age on embryonic metabolism.** J. A. Hamidu\*, G. M. Fasenko, E. E. O'Dea-Christopher, and J. J. R. Feddes, *University of Alberta, Edmonton, AB, Canada.*

In this study the effect of turkey breeder genetic strain [Hybrid (H) and Nicholas (N)] and parent flock age [Young (Y – 30 wk), Peak (P – 34 wk), Mature (M – 55 wk) and Old (O – 60 wk)] on eggshell conductance (G), egg components, poult carcass and residual yolk sac wt (RYS), and embryonic metabolism were investigated. A total of 15 eggs/strain/age were placed in a desiccator and used to assess G. Oxygen and CO<sub>2</sub> concentrations from embryos ( $n = 11$  eggs/strain/age) in individual metabolic chambers inside an incubator were used to calculate embryonic heat production (HP) throughout incubation. The data were analyzed by SAS<sup>®</sup> Proc Mixed Model at  $P \leq 0.05$ . Average egg weight (N = 91.58 ± 0.88; H = 88.15 ± 0.88 g) and G (N = 22.29 ± 0.62; H = 20.36 ± 0.63 g/d/mmHg) were higher in N vs. H strain but there were no differences in hatched poult wt, egg components or other poult characteristics due to strain. For parent flock age, egg wt (Y = 71.89 g; P = 89.05 g; M = 94.99 g; O = 98.12; SEM = 1.11 g), poult wt (Y = 51.34 ± 1.09 g; P = 64.15 ± 1.06 g; M = 71.10 ± 1.16 g; O = 70.89 ± 1.12 g) and % wet RYS wt (Y = 12.00 ± 0.57; P = 13.68 ± 0.56; M = 19.57 ± 0.61; O = 18.84 ± 0.59) increased with flock age. However, the % wet YFBM decreased with flock age (Y = 87.42 ± 0.65; P = 85.93 ± 0.64; M = 79.93 ± 0.69; O = 80.33 ± 0.67). This shows that the increase in poult wt with age were due to RYS wt not body mass. Daily embryonic HP per unit wet embryo wt was consistently higher in Y compared to all other flock ages except on 9–12, 15–19, 23, 24, 27 and 28 d of incubation. This means that the embryos from the younger flocks were metabolizing at a much higher rate to gain 1 gram of wet body wt compared with embryos from the older parent flocks. The results from this study showed that turkey embryonic metabolism (HP) is more dependent on parent flock age than genetic strain. This information would be useful for hatchery managers when trying to decide which eggs to group together in order to adjust incubator condition for optimum hatchability.

**Key Words:** egg incubation, embryo weight, embryonic heat production

**104 Role of phytogetic feed and water supplements in poultry nutrition.** Z. Nasir\* and M. A. Grashorn, *Hohenheim University, Stuttgart, Germany.*

In-feed antibiotics have been used in poultry for maintaining health and improving performance for more than 60 years. The potential risk of bacteria acquiring resistance to specific antibiotics and detrimental effects that it may have on human health lead to complete ban imposed on their use in European Union since January 2006. After the ban imposed in European Union and growing demand of natural, organic and antibiotic free animal products in other parts of the world, there is need to find alternative substances that can ensure health and performance, without residual effects on human health. Phytogetic products (having plant origin) are a source of various nutrients as well as provide a number of bioactive compounds. Bioactive compounds present in phytogetic substances have shown activities in different body systems (digestive, endocrine, reproductive, and immune), inhibitory activities (against bacteria, fungi and parasites), and effects on physiopathologies (antiinflammatory, antioxidant, and anti-diarrheal properties). Most extensively investigated phytogetic products in poultry nutrition include herbs and spices (like garlic, turmeric, *Echinacea* spp., black seed, pepper, chillies, rosemary, thyme, anise, and fenugreek), their extracts (water, ethanol/alcohol, expressed juices), and essential and volatile oils. They can be administered through feed and/or drinking water. Beneficial effects of phytogetic products in poultry may arise from activation of feed intake and digestive secretions, immune stimulation, antibacterial, coccidiostatic, anthelmintic, antiviral, antiinflammatory activity and antioxidant properties. However, the desired activity of phytogetic products is not always constant, as affected by a number of factors. This paper summarizes the results of contemporary research work done on application of phytogetic products in poultry and their future role as alternative to antibiotics.

**Key Words:** phytogetic additives, essential oils, alternative to antibiotics

**105 Transepithelial HMTBA transport and utilization as methionine source in intestinal Caco-2 cells.** R. Matin-Venegas<sup>2</sup>, Y. Mercier<sup>1</sup>, M. J. Rodriguez-Lagunas<sup>2</sup>, P. A. Geraert<sup>1</sup>, and R. Ferrer<sup>\*2</sup>, <sup>1</sup>ADISSEO France S.A.S., Commeny, France, <sup>2</sup>Facultat de Farmacia, universitat de Barcelone, Barcelona, Spain.

The Met hydroxy analog, DL-2-hydroxy-(4-methylthio)butanoic acid (HMTBA), is a synthetic source of Met commonly added to commercial animal diets to ensure that the nutritional requirement is satisfied. Taking into account the utilization of this analog in animal production, it is important to establish the role of intestinal absorption in its bioefficacy. In intestinal Caco-2 cells, HMTBA is transported across the apical membrane by the H<sup>+</sup>-dependent transport system MCT1 (monocarboxylate transporter 1). The results of HMTBA efflux across the basolateral membrane suggest the participation of a transport mechanism sensitive to H<sup>+</sup> gradient although the lack of effect obtained with MCT1 inhibitors (CHC and phloretin) and substrates (L-lactate and butyrate) rules out the participation of this transport system. The kinetic of HMTBA efflux was described by a model involving passive diffusion ( $K_d$ , 0.26 ± 0.05 nL/μg protein) plus a single mediated transport mechanism ( $K_m$ , 18.2 ± 1.1 mmol/L and  $V_{max}$ , 22.6 ± 1.8 pmol/μg protein). These results indicate that basolateral efflux rates were significantly lower than uptake across the apical membrane, thereby enabling enterocytes to accumulate and therefore to incorporate HMTBA into cellular metabolism. The

biological utilization of HMTBA relies on its conversion to L-Met, a process that already starts in the intestine upon absorption. In this sense, the results of HMTBA radioactivity incorporation into cellular proteins during transepithelial transport suggest its conversion to L-Met. These results were confirmed by the data obtained revealing D-HADH activity (D-2-hydroxy acid dehydrogenase), an enzyme involved in D-HMTBA conversion. In conclusion, the data of transepithelial HMTBA transport and its incorporation into cellular metabolism confer to this epithelium a notable role in the utilization of the hydroxy analog.

**Key Words:** methionine hydroxy analog, absorption, transport

**106 Processing characteristics of commercial and heritage broilers fed standard or organic diets.** K. Hopkins and M. S. Lilburn\*, *The Ohio State University/OARDC, Wooster.*

A randomized, complete block design experiment consisted of 4 treatments: commercial broilers ad libitum-fed conventional or organic broiler diets, heritage strain broilers fed the conventional diets and commercial broilers fed conventional diets but restrict-fed to the same growth curve as the organic treatment. The birds in each treatment were processed at approximately similar body weights but not necessarily similar ages. At harvest, live body weight, hot carcass weight, chilled carcass weight (24 h), moisture retention (24 h), breast muscle weight, and 24-h drip loss were determined. The organic and restrict-fed broilers had similar carcass weights (Org, 2.02 kg; BrRF, 2.03 kg) and were significantly heavier than the heritage and full-fed broilers (Her, 1.86 kg; BrFF, 1.82 kg). Moisture pickup after 24 h was similar among the Org (9.3%), BrRF (9.44%), and BrFF (9.45%) birds but all were less than the Her (11.10%) treatment. Hot carcass temperature was significantly higher in the Org (112.2°F) and Her (112.5°F) compared with the BrRF (110.2°F) and BrFF (108.5°F) treatments and by 180 min postharvest, carcass temperature had dropped in all treatments to 35 to 40°F. The weight of the pectoralis major breast muscle was lowest in the Her (137 g) and Org (168 g) birds compared with those in the BrRF (207 g) and BrFF (193 g) treatments. Drip loss (24 h) in the pectoralis major breast muscle was not significantly different among treatments ( $P < 0.101$ ) but the Org (1.15%) and Her (1.12%) treatments had greater drip loss than the BrRF (0.76%) and BrFF (0.73%) birds. At 90 min postharvest, carcass temperature in the Org (50.8°F) and BrFF (52.1°F) birds (2 heaviest treatments) were significantly greater than in the Her (46.8°F) and BrFF (45.8°F) treatments. The data suggest that genotype, age, and diet can influence postprocessing characteristics and may influence consumer acceptance of alternative poultry products.

**Key Words:** organic, broiler, processing

**107 Influence of soybean meal source and feed form of the diet on performance, organ size and gizzard pH of broilers from 0 to 25 days of age.** F. J. Corchero, G. Brumano, M. P. Serrano, D. G. Valencia, M. Frikha, and G. G. Mateos\*, *Universidad Politécnica de Madrid, Spain.*

We investigated the effects of soybean meal source (SBM) and feed form of the diet on productive performance and digestive traits of broilers from 0 to 25 d of age. The experimental design was completely randomized with 12 treatments arranged factorially with 4 commercial SBM and 3 feed forms (mash, pellets, and crumbles). The SBM were collected at random from the market and had a CP content that varied

from 46.30 to 48.10%. Each treatment was replicated 6 times and the experimental unit was a cage with 12 chicks. The quality of the pellets and crumbles was visually good, they were uniform in size, and dust was absent. The pellet had a diameter of 2 mm and an average length of 5.3 mm. SBM source did not affect any trait studied and therefore, only data on feed form are presented. From 0 to 2 d of age chicks fed crumbles had 9% higher BW gain (BWG) than chicks fed pellets or mash ( $P \leq 0.05$ ). Feed consumption was 11% lower ( $P \leq 0.05$ ) in chicks fed pellets than in chicks fed crumbles, probably because of the excessive length of the pellets. From 3 to 25 d of age birds fed pellets compensated and for the global experimental chicks fed pellets had 21% higher feed consumption and 26% higher BWG than chicks fed mash with chicks fed crumbles being intermediate ( $P \leq 0.001$ ). Feed form affected relative size (% BW) of most digestive organs. Gizzard weight was reduced in chicks fed pellets or crumbles with respect to chicks fed mash ( $P \leq 0.001$ ). Also, liver weight was increased ( $P \leq 0.001$ ) in chicks fed pellets, suggesting that fat metabolism was exacerbated with pellet feeding, probably as a consequence of the higher feed intake. Gizzard pH was higher in chicks fed pellets than in chicks fed mash, with chicks fed crumbles being intermediate ( $P \leq 0.001$ ). The results indicate that feed form affects performance and digestive traits of chicks and that pellets and crumbles are preferred to mash diets.

**Key Words:** broiler, performance, feed form

**108 Comparison of source and levels of sodium in broilers under low temperature condition.** A. Mahmud\*<sup>1</sup>, Z. Hayat<sup>1,2</sup>, Z. Ullah<sup>1</sup>, M. M. H. Mushtaq<sup>1</sup>, and A. Khalique<sup>1</sup>, <sup>1</sup>*University of Veterinary & Animal Sciences, Lahore, Pakistan,* <sup>2</sup>*University College of Agriculture, University of Sargodha, Sargodha, Pakistan.*

Sodium (Na) is attracting increased interest in poultry nutrition. The objective of the present study was to evaluate the effect of 2 sources of sodium at different levels on broiler performance, water consumption and blood Na concentration under low temperature conditions. 240 day-old Hubbard broilers were subdivided into 24 replicates of 10 chicks each. Six corn- and soy-based experimental diets containing graded levels (0.15, 0.20, or 0.25%) of sodium either from sodium chloride or sodium bicarbonate were formulated. Each of these treatments was assigned to 4 replicate pens of 10 broiler chicks (40 birds/treatment). Daily water consumption was measured. Body weight and feed consumption were recorded weekly and used to calculate feed efficiency. At the end of experiment blood samples were collected from 2 birds in each replicate. Mean temperature was 70.6°F (61.4 to 79.8°F) and average relative humidity was 48.5 (40 to 57). Higher level of sodium (0.25%) especially when the source was sodium chloride, resulted in an increase ( $P < 0.05$ ) in body weight and feed efficiency during first 2 weeks of age. However, there was no carryover effect of this increase at the end of experiment. Feed consumption was independent of dietary Na treatments ( $P > 0.05$ ). Water consumption was increased ( $P < 0.05$ ) with the increasing level of Na in diet, but source of Na did not show any difference. Blood Na concentration showed a linear increase ( $P < 0.05$ ) from low to high level of Na. This increase was more pronounced when Na was added in diet as sodium bicarbonate. It can be concluded that feeding higher sodium levels especially as sodium chloride for first 2 weeks may result in increases in body weight and feed efficiency but this effect did not persist till marketable age of broiler. Water consumption and blood Na concentration has direct relationship with level of Na in diet.

**Key Words:** sodium, low temperature, broiler