

## Nutrition: Energy and Feed Ingredients

**146 Evaluation of limit feeding low-energy diets for a non-feed withdrawal laying hen molt program.** P. Utterback\*, P. Biggs, C. Martinez, E. Kim, K. Koelbeck, and C. Parsons, *University of Illinois, Urbana*.

An experiment was conducted using 504 Hy-Line W-36 hens (69 wk of age) to evaluate two low-energy non-feed withdrawal molt diets, each fed at three different rates. Treatment 1 consisted of feed withdrawal for 10 d (10-d fast) followed by feeding a 16% CP corn-soybean meal diet for 18 d. Treatment 2 consumed a 47% corn and 47% wheat middlings (C:WM) diet fed ad libitum for 28 d. Treatment 3 received the C:WM diet but was limit fed 54.5 grams/hen/day (g/h/d). Treatment 4 also consumed the C:WM diet but received ad libitum access to the feed for 7 d and was limited to 54.5 g/h/d from 8 d to 28 d. Treatments 5, 6, and 7 were fed a 47% corn and 47% soy hulls diet (C:SH) using the same 3 feeding schemes used with the C:WM diet. At 28 d, all hens were fed a 16% corn-soybean meal layer diet and production performance was measured for the next 20 weeks. Hens on the feed withdrawal treatment ceased egg production by Day 8. Treatments receiving the C:SH diet did reach 0% egg production by Day 10 but laid sporadically for the remaining 18 days of the molt period. However, treatments receiving the C:WM diet never reached 0% production. Body weight loss for hens on the feed withdrawal treatment was 25.2% on Day 10 of the molt period. Hens fed the C:WM diet lost 10-15% of their original body weight, while hens fed the C:SH diet had body weight losses of 20-24% on Day 28. Hen-day egg production was different ( $P < 0.05$ ) for Weeks 5 to 24, with Treatment 2 being statistically lower than the 10-d fast treatment and all treatments receiving the C:SH diet. All hens receiving the C:WM diet were lower than other treatments. No consistent differences were observed among treatments for mortality, egg weight, egg specific gravity, feed efficiency, and feed consumption during the 20-wk post-molt production period. When compared to a 10-d fast, this research indicates that a diet containing a combination of corn and soy hulls fed at varying rates is an effective non-feed withdrawal method for molting laying hens.

**Key Words:** Molt, Laying hens, Limit feeding

**147 Dietary metabolizable energy needs of heavy broilers.** W. A. Dozier, III\*, C. J. Price<sup>2</sup>, M. T. Kidd<sup>3</sup>, A. Corzo<sup>3</sup>, and S. L. Branton<sup>1</sup>, <sup>1</sup>USDA-ARS Poultry Research Unit, Mississippi State, Mississippi, <sup>2</sup>Sanderson Farms, Laurel, Mississippi, <sup>3</sup>Mississippi State University, Mississippi State.

Feedstuffs used as sources for dietary energy constitute approximately 65-85% of the diet for broiler chickens. Therefore, determining the dietary energy need has significant economic ramifications in broiler production, particular when broilers are marketed at heavy BW. This study examined responses of growth performance and meat yield of broilers provided gradient concentrations of apparent metabolizable energy (AME) from 31 to 59 d of age. Nineteen-hundred and twenty Ross x Ross 308 broilers were randomly distributed to 32 floor pens (30 males and 30 females/pen; 0.09 m<sup>2</sup>/bird) at 31 d of age. The dietary treatments consisted of four AME concentrations: 3,175, 3,220, 3,265, and 3,310 kcal ME/kg of diet (8 replications each). Progressive additions of AME decreased ( $P \leq 0.001$ ) feed consumption and feed conversion linearly during 31 to 47 and 31 to 59 d of age, but growth rate and the incidence of mortality were similar among the treatments. With the trend analysis, feed conversion was decreased by 4 points for each unit increase of 45 kcal ME/kg. As dietary AME was increased to 3,310 kcal ME/kg, feed conversion was improved ( $P \leq 0.05$ ) compared with the other dietary treatments from 31 to 59 d of age. The linear trend effect was not different ( $P \geq 0.10$ ) for the absolute and relative amounts of the carcass, abdominal fat, breast fillet, breast tender, and total breast meat. However, increasing dietary AME to 3,265 and 3,310 kcal ME/kg decreased ( $P \leq 0.05$ ) fillet yield and total breast meat yield compared with birds that were provided diets formulated to contain 3,220 kcal ME/kg. AME consumption/BW gain decreased ( $P \leq 0.04$ ) linearly, but AME consumption/total breast meat was not affected. In conclusion, increasing AME may improve feed conversion, but profitability must be evaluated first and considered in practice.

**Key Words:** Broiler, Dietary energy, Nutrient density

**148 Determination of the metabolisable energy of sweet potato tuber meal and its utilization by growing pullets.** O. Ladokun\*<sup>1</sup>, F. Aderemi<sup>2</sup>, and O. Tewe<sup>1</sup>, <sup>1</sup>University of Ibadan, Ibadan, Oyo State, Nigeria, <sup>2</sup>Bowen University, Iwo, Osun State, Nigeria, <sup>3</sup>University of Ibadan, Ibadan, Oyo State, Nigeria.

A preliminary 10-day study was conducted with thirty pullet chicks to determine the metabolisable energy (ME) of sweet potato tuber meal (SPM). The result revealed that SPM has an ME of 3.50kcal/g. Ninety, Yaffa growing pullets were used in the 70 day experiment to determine the utilization of SPM as a replacement for maize in growers diet. The SPM was incorporated at levels of 0,50 and 100% to replace maize. The dietary treatments significantly ( $P < 0.05$ ) reduced the feed intake. Birds on the diet with the partial replacement of maize had the highest body weight gain. Birds on the complete replacement of maize diet recorded the least weight gain. Dry matter, crude protein, crude fibre and ether extract digestibility of the growers were all significantly ( $P < 0.05$ ) affected by the dietary treatments. Cost analysis revealed that SPM was a valuable ingredient in the diet of growing pullets with an economic advantage, as growers on these diets were the cheapest at the end of the feeding trial. Sexual maturity was however delayed by two weeks in growers fed the sweet potato based diets. Mortality on the completely replaced maize diet was highest.

**Key Words:** Sweet potato tuber meal, Growing pullets, Metabolisable energy

**149 Phosphorus availability of distiller's dried grains with solubles: Variation in color.** J. L. Kalbfleisch\* and K. D. Roberson, *Michigan State University, East Lansing*.

A slope-ratio assay was used to estimate the P availability of two samples of distiller's dried grains with solubles (DDGS) that differed in color (brown vs. light golden); both samples were from a commercial ethanol plant. Experiment 1 (EXP 1) evaluated the P availability of brown DDGS and Experiment 2 (EXP 2) evaluated light golden DDGS. In each EXP, dicalcium phosphate dibasic dihydrate (DP) was used as the standard. Diets were formulated on a total P (TP) basis and calcium was kept constant at 1.2%. In each study, 340 day-old male turkey poults were randomly sorted into 42 battery pens (~8 poults/pen) and fed a marginal P starter diet for 5 days (0.5% non-phytate P), respectively. On day 6, poults were sorted, so that average pen starting weight was similar, and fed 1 of 7 dietary treatments (TRT) from 6 to 14 days of age. Growth performance, tibia ash, and rickets incidence and severity were measured. EXP 1 dietary treatments were: 1) Corn-soybean meal basal (0.58% TP), 2) Basal + 0.05% P from DP, 3) Basal + 0.10% P from DP, 4) Basal + 0.15% P from DP, 5) Basal + 13% DDGS (0.63% TP), 6) Basal + 26% DDGS (0.68% TP), and 7) Basal + 40% DDGS (0.73% TP). DDGS diets had greater percent tibia ash compared to the DP diets ( $P < 0.0001$ ). Based on supplemental P intake, regression analysis showed P availability from brown DDGS was greater than DP. EXP 2 dietary treatments were: 1) Corn-soybean meal basal (0.58% TP), 2) Basal + 0.04% P from DP, 3) Basal + 0.08% P from DP, 4) Basal + 0.12% P from DP, 5) Basal + 10% DDGS (0.62% TP), 6) Basal + 20% DDGS (0.66% TP), and 7) Basal + 30% DDGS (0.70% TP). TRT 3 and 4 had greater feed intake and gain compared to TRT 6 and 7 ( $P < 0.01$ ). However, percent tibia ash was greater for TRT 7 than TRT 4 ( $P < 0.0001$ ). P availability of golden DDGS, estimated by the slope-ratio assay, was 90%. Reduction of rickets incidence and severity was similar between P sources in both trials.

**Key Words:** DDGS, P availability, Turkeys

**150 Nutritional characteristics of corn distillers dried grain with solubles produced by different processing techniques.** C. Martinez\*, C. M. Parsons, and V. Singh, *University of Illinois, Urbana*.

In this study, several new processing technologies were evaluated to produce corn distillers dried grain with solubles (DDGS) with increased nutritional value for poultry. Corn was processed under laboratory conditions to produce ethanol and DDGS using the conventional dry grind method and compared with two

modified dry grind methods in which corn was fractioned to remove the germ and pericarp fiber prior to fermentation. One of the modified processes, called the quick germ quick fiber process (QGQF), recovers germ and pericarp fiber by soaking corn in water for a short period (6 to 12 h) of time, with the inclusion of alpha-amylase, followed by milling. The other modified dry grind process was a dry milling (DM) process (no soaking of corn) to recover germ and pericarp fiber. In another process, a commercial DDGS sample was subjected to sieving to remove fiber and increase protein content. The QGQF and DM processes increased the protein in DDGS and reduced the fat and total dietary fiber. The DM process, however, reduced the total lysine level and the lysine as % of the protein. Total P was increased markedly by the QGQF process, but was reduced greatly by the DM process. The TMEn of the DDGS was increased by the DM process but was not affected by the QGQF process. The digestibility of amino acids was generally similar for the conventional dry grind, the DM process and QGQF process. Sieving the commercial DDGS increased the protein, amino acids, fat and TMEn and decreased the total dietary fiber content from 34.5 to 19.7% on a DM basis. In contrast, sieving had no significant effect on amino acid digestibility coefficients in DDGS although the concentration of digestible amino acids was increased (due to the increased protein and amino acid content). The results of this study indicated that nutrient composition can be affected and modified dramatically depending on the technology implemented to produce DDGS.

**Key Words:** Distillers dry grains with solubles, New technologies

**151 The effect of oligosaccharides on growth performance, nutrient utilization, and cecal microbes in young chicks.** P. Biggs\* and C. Parsons, *University of Illinois, Urbana.*

Two experiments were conducted with New Hampshire X Columbian chicks fed a corn-soybean meal diet to examine the effects of inulin, oligofructose (OF), mannanoligosaccharide (MOS), short-chain fructooligosaccharide (SCFOS), and transgalactooligosaccharide (TOS) on growth performance, ME<sub>n</sub>, digestibility of amino acids (AA), and cecal microbial populations. The first experiment tested the oligosaccharides (OS) at 8 g/kg, and the second experiment evaluated each OS at 4 g/kg. Each diet was fed to chicks from 0 to 21 d of age, and body weight and feed intakes were measured at d 7 and 21. Excreta were collected at 3-4, 7, 14, and 21 d of age, and nutrient digestibility was determined using acid insoluble ash as a marker. Neither level of OS had a significant effect on weight gain, feed intake, and gain/feed ratio in the experiments. The ME<sub>n</sub> and AA digestibility increased with increasing age in both experiments. In the first experiment where the OS were fed at 8 g/kg, MOS and TOS had a negative effect (P<0.05) on ME<sub>n</sub> at most ages. In addition, most of the OS significantly reduced (P<0.05) digestibility of AA at various ages. In contrast, when the OS were fed at 4 g/kg in the second experiment, they had no negative effect on ME<sub>n</sub> values, and these values were often increased (P<0.05) by MOS and TOS. The effects of OS (4 g/kg) on AA digestibility in the second experiment were generally small and inconsistent except for MOS, which showed a consistent improvement (P<0.05) in AA digestibility at 7, 14, and 21 d. Diets containing 4 g/kg of an OS had no effect on cecal *bifidobacteria*, *lactobacillus*, *clostridia perfringens*, or *escherichia coli* populations in 21-d old chicks. These results indicate that low levels of indigestible, prebiotic OS (4 g/kg) can be fed with no deleterious effects on ME<sub>n</sub> and AA digestibility. Feeding higher levels of an OS (8 g/kg), however, may depress ME<sub>n</sub> and AA digestibility.

**Key Words:** Oligosaccharide, Prebiotic, Amino acid digestibility

**152 Microbial community analysis of the turkey duodenum by polymerase chain reaction and denaturing gradient gel electrophoresis.** K. Huffman\*, Z. Yu, M. Morrison, and M. S. Lilburn, *The MAPLE Research Initiative, The Ohio State University, Columbus.*

Microbes play an important role in the gastrointestinal tracts of animals and contribute to digestive processes and overall health of the animal. The duodenal microbial communities of turkeys at the age of 4 and 14 weeks fed two different diets (corn-soy vs. corn-soy-fishmeal) were analyzed by molecular-based techniques. Community DNA was extracted from samples of digesta collected from the duodenum. The V3 hypervariable region of the 16s rRNA (*rrs*) gene was amplified by polymerase chain reaction (PCR), and the resultant amplicons

were resolved by denaturing gradient gel electrophoresis (DGGE) to profile the microbial communities in these samples. Distinct DGGE bands were excised, re-amplified and sequenced. Comparisons with BLAST to database sequences identified the bacteria represented by these bands. Analysis of the DGGE profiles did not show any significant differences between the two diets. However, considerable community successions were evident between the younger and the older birds. Most of the *rrs* sequences retrieved from the DGGE bands matched that of *Lactobacillus* spp., with an identity ranging from 95% to 100%. The *Lactobacillus* spp. identified includes *L. aviarius*, *L. salivarius*, *L. acidophilus*, *L. vaginalis*, *L. colehominis*, and *L. rhamnosus*. *Lactobacillus acidophilus* appeared more frequently in the older birds than in the younger birds.

**Key Words:** Denaturing gradient gel electrophoresis, Turkey

**153 Effects of fat and inclusion of fiber on nutrient utilization and digestive traits of broilers.** J. M. González-Alvarado, A. González-Serrano, E. Jiménez-Moreno, R. Lázaro\*, and G. G. Mateos, *Universidad Politécnica de Madrid, Madrid, Spain.*

We studied the influence of type of fat [vegetable oil (VO) or yellow grease (YG)] and source of fiber [none, oat hulls (OH) and sugar beet pulp (SBP)] on digestive traits and apparent nutrient digestibility (TTAD) of broilers at 5 d of age. Each treatment was replicated six times (a cage with 18 birds). The control diets were formulated to contain 1.5% of crude fiber (CF) and were based on rice (58%), soybean protein concentrate (22%), fish meal (7%), fat (5%), and an inert material (3%). The experimental diets included 3% of the corresponding fiber source at expenses of the inert material. At 5 d of age TTAD of dry matter (DM), ether extract (EE), and AME of the diets were measured using acid insoluble ash (2% celite) as indigestible marker. Neither digestive organ size nor digesta pH were affected by type of fat. The inclusion of OH increased the relative weight of the gizzard (4.17 vs 3.21%; P < 0.001) but not of the proventriculus. However, SBP inclusion increased the weight of both organs (P < 0.001). Digesta content of the gizzard was increased by both OH and SBP (P < 0.001). Gizzard pH decreased when fiber was included in the diet (2.90 vs 3.59; P < 0.001) but proventriculus pH was not affected. TTAD and AME were higher for VO than for YG diets (P < 0.001). The inclusion of fiber increased digestibility of DM (78.6 vs 75.8%; P < 0.001) and AME of the diets (3385 vs 3255 kcal/kg; P < 0.001). An interaction type of fat x fiber inclusion was observed; EE digestibility was higher for the high- than for the low-CF diets (89.6 vs 86.0%; P < 0.001) but the beneficial effects of CF were more pronounced for the YG than for the VO diets (87.0 vs 82.1%, and 92.2 vs 89.9%, respectively; P < 0.05). The data indicates that chicks have a minimum requirement for CF and that 1.5% CF in the diet is not sufficient for the first week of life. Therefore, the use of very low level of CF might not be a sound nutritional strategy in prestarter feeds for broilers.

**Key Words:** Crude fiber, Fat digestibility, Broilers

**154 Influence of type of cereal, heat processing of the cereal, and inclusion of fiber in the diet on digestibility of nutrients in broilers.** E. Jiménez-Moreno, J. M. González-Alvarado, R. Lázaro, and G. G. Mateos\*, *Universidad Politécnica de Madrid, Madrid, Spain.*

We studied the effects of type of cereal, heat processing (HP) of the cereal, and inclusion of fiber in the diet on pH of digestive organs at 7, 15, and 22 d of age, and the apparent fecal digestibility of nutrients (TTAD) and AMEn of the diets at 18 d of age in broilers. The experimental design was completely randomized with twelve treatments arranged factorially [two cereals; corn and rice, two HP; raw and cooked at 90 °C during 50 min, and three fiber sources; none, 3% oat hulls (OH), and 3% soybean hulls (SH)]. Each treatment was replicated three times (a cage with 16 chicks). The control diets were formulated to be low in crude fiber (1.5% for the rice- and 2.4% for the corn-based diet) and were based on soy protein concentrate, soy oil, and 60% of either corn or rice. The TTAD was determined using insoluble acid ash as an indigestible marker (1% celite). The inclusion of hulls reduced gizzard pH (3.12 vs 3.39; P < 0.01). The TTAD of nutrients was higher for the rice- than for the corn-based diets (P < 0.05). HP did not affect TTAD of any nutrient except ether extract (87.6 vs 86.5%; P < 0.01). The inclusion of fiber improved TTAD of nutrients but the beneficial effects were more evident for OH than for SH. The AMEn of the diets was

higher for rice- than for corn-based diets (3144 vs 3001 kcal/kg;  $P < 0.001$ ) and increased with both HP of the cereal (3084 vs 3060;  $P < 0.01$ ) and fiber addition (3017 vs 3134 vs 3065 kcal/kg for none, 3% OH, and 3% SH, respectively;  $P < 0.001$ ). An interaction cereal\*HP was observed; HP improved TTAD of nutrients in the corn- but not in the rice-based diets. Also, the inclusion of 3% hulls had greater effect in the rice- than in the corn-based diets. We concluded that rice is a cereal of choice in prestarter feeds for broilers and that the inclusion of fiber to low CF diets improved the TTAD of nutrients and AMEn of the diet. Therefore, broiler chicks might have a minimum requirement of fiber in the diet.

**Key Words:** Crude fiber, Nutrient digestibility, Broilers

**155 Field observation: Trypsin inhibitors in soybean meal are correlated with outbreaks of feed passage in broilers.** N. Ruiz\*<sup>1</sup> and F. de Belalcázar<sup>2</sup>, <sup>1</sup>ContiGroup Companies, Inc., New York, New York, <sup>2</sup>Nutrianálisis, Bogotá, Colombia, South America.

Feed passage (FP; "tránsito rápido" in Spanish) is defined for the purpose of this presentation as the condition observed in commercial flocks of broiler chickens in which droppings lose their normal shape, do not display the characteristic uric acid cover, contain undigested feed visible to the naked eye, have a yellowish-orange color, and frequently are watery, containing intestinal tissue. As a consequence of a FP outbreak the litter becomes wet and slippery. Birds lack uniformity, pigmentation is poor, and although mortality is not increased, and birds do not look sick, feed conversion ratio and body weights are considerably affected with the subsequent economic loss. In at least seven outbreaks occurring between 1998 and 2004 in four countries in north of South America the soybean meal used during those episodes were analyzed for antinutritional factors including lectins, glycinin,  $\beta$ -conglycinin, oligosaccharides, mycotoxins, biogenic amines, urease activity, and trypsin inhibitors (TI). TI [ISO method 14902:2001 (E)] values near 4 (and above) mg TI/g of SBM were consistently present in lots of SBM in use when FP occurred. SBMs with TI values in the range of less than 2 and 3 mg TI/g were associated with no FP in the field. Urease activity values below 0.10 pH units are necessary to be in the range of 2-3 mg TI/g of SBM.

**Key Words:** Trypsin inhibitors, Soybean meal, Feed passage

**156 A comparison of TAAD for soybean meal and meat meal samples determined in two laboratories using the adult rooster assay and estimated using the IDEA *in-vitro* technique.** L. Campbell\*<sup>1</sup>, C. Parsons<sup>2</sup>, S. Peak<sup>3</sup>, A. Golian<sup>1</sup>, C. Schasteen<sup>3</sup>, and M. Nyachoti<sup>1</sup>, <sup>1</sup>The University of Manitoba, Winnipeg, MB, Canada, <sup>2</sup>The University of Illinois, Urbana, <sup>3</sup>Novus International Inc., St. Charles, Missouri.

Three samples of soybean meal (SBM) and three samples of meat meal (MM) were distributed in duplicate to two different laboratories, University of Manitoba (UM) and University of Illinois (UI). True amino acid digestibilities (TAAD) were determined in each of the laboratories using the precision-fed adult rooster assay and estimated by Novus International using the Immobilized Digestive Enzyme Assay (IDEA) *in-vitro* technique. Amino acid analyses of feed and excreta samples were determined in the same laboratory. TAAD values for individual amino acids in SBM samples were similar except for aspartic acid while significant ( $P < 0.05$ ) differences were noted for several amino acids among the three MM samples. TAAD values for UM and UI were similar among SBM samples except for significant ( $P < 0.05$ ) differences in cystine (78 vs 86), arginine (94 vs 90) and threonine (85 vs 89). In MM samples, similar TAAD values were noted for methionine, cystine, lysine, arginine, tryptophan and histidine while significant ( $P < 0.05$ ) differences were evident for all other amino acids with UM values generally higher (1.8 - 5.8 percentage units) than UI values. For both SBM and MM samples, generally, there was good agreement between the *in-vitro* IDEA predicted TAAD values and the *in-vivo* UM / UI determinations. However, relatively high variability was noted for some amino acids (cystine, tryptophan, aspartic acid, tyrosine and proline) and with the data for these amino acids removed the overall deviation between IDEA and UM / UI TAAD values was  $\pm 1.55$  percentage units ( $n = 48$ ). The data indicate good agreement between laboratories for *in-vivo* determination of TAAD and demonstrate reliable prediction of these values using the IDEA *in-vitro* technique.

**Key Words:** Poultry, TAAD/IDEA, Soybean meal / meat meal

**157 Performance of broilers fed diets formulated in a corn-soybean meal all vegetable basis added with carbohydrases or having animal by-products, with or without antibiotic growth promoter.** R. Ott, S. Vieira\*, and O. Conde, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.

Soybean meal has practically no starch. Instead, it is rich in low digestible carbohydrates such as pectins, hemicelluloses and oligosaccharides. Broilers raised on all vegetable feeds, as required by the European Community and Saudi Arabia, are generally fed increased amounts of soybean meal when compared to those on diets having animal by-products. A study was conducted with broilers fed regular diets containing 10% poultry by-product meal (Regular) or corn-soybean meal all vegetable diets (All-Veg). Both diets were formulated with or without antibiotic growth promoter (BMD, 33 ppm). The All-Veg antibiotic free diets were supplemented with enzymes targeting the carbohydrate fraction of soybean meal. Pectinase, xylanase and alpha galactosidase were added to the feeds in the amount of 100 g/Ton. Enzymes were included over the top of the feeds individually, on a two by two basis, or the three altogether. One-d-old Ross X Ross 308 broiler chicks were placed in 2.3 X 1.75 m floor pens, with 7 replicates of 40 broilers per feed treatment. In parallel, diet digestibility was evaluated with Cobb X Cobb 500 28-d-old broilers, individually housed in cages to 35 days of age, and fed the same treatments with 6 replicates each. Broilers fed antibiotic growth promoter had an improvement in live performance when compared to those fed antibiotic free diets, which was not extended to the yield of carcass and breast fillets. This effect was similarly observed with the Regular and the All-Veg diets. Enzyme supplementation did not ameliorate any response of broilers fed the All-Veg diets. Digestibility of diets having poultry by-product was higher than the All-Veg ones, but it was not affected by antibiotic growth promoter inclusion. Enzyme supplementation did not improve feed digestibility, in fact the supplementation of the three enzymes altogether led to an impaired response. Enzymes added to the feeds failed to demonstrate improvements when fed to broilers at the concentrations present in this study.

**Key Words:** All-veg diet, Enzymes, Soybean meal carbohydrases

**158 Organic and inorganic acids added to feed and water affect live performance and water intake of broilers fed without antibiotic growth promoters or anticoccidials.** S. Vieira\*, E. Viola, O. Conde, and J. Berres, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.

Organic acids have been utilized as antimicrobials in stored grains and feeds for several species of animals and have been proposed as alternative to growth promoter antibiotics in broiler feeds. Theoretically, organic acid blends have advantages over single supplementations. Blends provide combinations of pKa's but also a larger range of minimum inhibitory concentrations against microorganisms. In this study, 1,980 Ross X Ross 308 broiler chicks were placed in 48 floor pens using second crop pine shavings litter. All birds in the study were fed corn-soybean meal all vegetable diets without antibiotic growth promoters or anticoccidials. Birds were allocated to 6 different treatments: 1- Control feed without organic acids; 2- Inclusion of lactic, formic, acetic and orthophosphoric acids in feed; 3- Inclusion of lactic, formic and acetic acid in feed; 4- Inclusion of lactic, formic and orthophosphoric acid in feed; 5- Inclusion of formic acid in feed; and 6- as Control but having lactic, acetic and orthophosphoric acid in water. Feeds were formulated considering energy and phosphorus from organic and orthophosphoric acids. Acids were added to pre-starters, starters, growers and finishers in the amount of 8, 4.5, 2.5 and 2.5 kg per Ton in treatments 2, 3, and 4, whereas treatment 5 were added with 2.5, 2.5, 2.0, and 2.0 kg per Ton. Water of birds from treatment 6 was added with 3, 2, 1, and 1 kg per 1,000 L of water in the same feeding phases of the other treatments. Birds of treatments 4 and 5 responded with higher body weight gain to the end of the study but slightly reduced water intake in comparison to the other feeding treatments. Acids added to water led to reduced body weight gain and water intake. No apparent effects were observed for feed conversion or mortality. Organic acids led to increased intestinal weight at 7 days of age, but not at 20 days. Results obtained indicate benefits of the inclusion of blends having lactic, formic and orthophosphoric acids but also of the single inclusion of formic acid in broiler feeds.

**Key Words:** Broiler, Organic acids, Water intake

**159 Analysis of mucosa-associated and luminal bacteria in chicken intestine following feeding dietary additives.** Z. Uni\*, A. Smirnov, and R. Perez, *Hebrew University, Rehovot, Israel.*

A diverse bacterial community exist throughout the chicken small intestine and have an important metabolic and protective function in the gastrointestinal tract. Most of the knowledge about bacterial diversity in the chicken intestine has been obtained by analysis of the luminal content, either by culture methods or by ribosomal DNA and PCR based molecular techniques. However, the mucosa-associated bacteria (MAB) was not considered although its presence and composition might be critical in determining epithelial health through their ability to exclude pathogens.

In this study, a PCR-based method was used for quantifying the selective bacterial species in MAB fraction and in the luminal content. For the experiment Cobb hatchlings were fed commercial diet containing either probiotic (Pro) supplement (PrimaLac 2 g/kg) or antibiotic growth promoter (AGP) (Virginiamycin, 2 mg/kg). Control group was fed diet with no additives. Jejunum was taken at 7 and 28 days and the intestinal content was collected for analysis of luminal bacteria. MAB was removed from the everted intestine by incubation in citrate buffer containing 0.5 mM DTT. Bacterial DNA was isolated and relative amounts of the bacteria species was analyzed in luminal and MAB samples by PCR amplification of the 16S ribosomal DNA targets. Universal primers were used to determine total bacterial DNA and specific primers were directed to the *Lactobacillus* and *Bifidobacterium* species. Results showed that feeding dietary probiotic led to 32% increase in relative amount of mucosa-associated *Lactobacillus* at day 7 in comparison to the control group ( $P < 0.05$ ). Mucosa-associated *Bifidobacterium* was undetectable at day 7, whereas at day 28 only Pro and control groups showed *Bifidobacterium* presence. The relative amount of the *Lactobacillus* species in luminal content was unaffected by the treatments while *Bifidobacterium* was detected only in luminal content of Pro and Control groups.

The later demonstrated the importance of analysis both luminal and mucosa-associated bacteria.

**Key Words:** Intestine, Bacteria, Feed additives

**160 Maternal dietary fatty acids alter the retention of long chain n-3 fatty acids in the cardiac and hepatic tissue of growing chickens.** G. Cherian\* and M. P. Goeger, *Oregon State University, Corvallis.*

The effect that egg yolk or maternal n-6 and n-3 fatty acids have on cardiac and hepatic tissue long chain (>20C) n-6 and n-3 polyunsaturated fatty acids (PUFA) of chicks during growth was investigated. Long chain PUFA of n-6 and n-3 series are the precursors of eicosanoids that are lipid mediators of inflammation. Eicosanoids derived from n-3 PUFA are less proinflammatory than those derived from n-6 PUFA. Fertile eggs with diverse n-6 and n-3 PUFA were obtained by feeding New Hampshire hens a corn-soybean meal-based diet containing 3.0% sunflower oil (Low n-3), 1.5% sunflower oil and 1.5% fish oil (Medium n-3), or 3.0% fish oil (High n-3). The hatched chicks were fed a commercial diet containing 3.4% alpha-linolenic acid (LNA 18:3 n-3), but was devoid of long chain n-6 or n-3 PUFA. The fatty acid composition of cardiac and hepatic tissues at days 7, 14 and 21 of chick growth were determined. At days 7, 14 and 21 the cardiac and hepatic tissue of chicks hatched from hens fed High n-3 diet retained higher levels of docosahexaenoic acid (DHA, 22:6 n-3) and eicosapentaenoic acid (EPA, 20:5 n-3) than Low n-3 diets ( $P < 0.05$ ). With time, the levels of EPA and DHA declined significantly in all treatments and, after day 14, dietary LNA did not sustain the content of long chain n-3 PUFA in chick heart and liver ( $P < 0.05$ ). No difference due to maternal diet on cardiac and hepatic arachidonic acid (20:4n-6) was observed after day 7 of growth ( $P > 0.05$ ). No effect of maternal diet on chick cardiac tissue saturated or monounsaturated fatty acids was observed ( $P > 0.05$ ). However, monounsaturated fatty acids were higher at day 7 in chicks from hens fed High n-3 diets. The alteration in n-3 PUFA in cardiac and hepatic tissue may affect the synthesis of eicosanoids derived from n-3 PUFA and may lead to increased health to chickens.

**Key Words:** n-3 Polyunsaturated fatty acid, Chicken, Heart

## Pathology: Pathology I

**161 Ionophore toxicosis in White Leghorn pullets.** R. Porter\*<sup>1,2</sup>, D. Zoromski<sup>1</sup>, and J. Brown<sup>3</sup>, <sup>1</sup>*Wisconsin Veterinary Diagnostic Laboratory, Madison, Wisconsin*, <sup>2</sup>*University of Wisconsin School of Veterinary Medicine, Department of Pathobiological Sciences, Madison*, <sup>3</sup>*Centurion Poultry, Inc., Lexington, Georgia.*

A flock of 213,000 white leghorn pullets were raised in three-tier, drop-through cages with nipple drinkers. Livability was normal until the birds were diagnosed with coccidiosis at four weeks of age. At five weeks, shortly after delivery of feed containing an ionophore, many of the birds were depressed, laterally recumbent and unable to walk when manually positioned upright. Many of the affected pullets were thought to be dead, lying motionless in the cage and flattened laterally by the weight of other cagemates, but when examined were actually alive. Recumbent pullets, when removed from cages and separated from other birds, were often alert and walking in several hours or less. At this time a preliminary diagnosis of ionophore toxicosis was made and 20 tons of replacement feed were delivered to the farm, but mortality continued for four days. Necropsy of affected birds revealed bruising on the ventral aspect of the wings and mild subcutaneous edema over the thigh and tibiotarsus. There was multifocal intramuscular hemorrhage of varying degrees in the caudal aspect of the thigh, digital flexor muscles of the tibiotarsus, and lumbosacral muscle (gluteal muscles). Histologic examination of affected muscles revealed attenuation, hyalinization and myocytolysis of muscle fibers with loss of cross-striations, varying infiltrates of mononuclear cells, mostly macrophages, and proliferation of satellite and fibroblast nuclei. Total mortality directly resulting from ionophore toxicosis was 3.9% and an additional 2.2% of the flock was culled over the next thirteen weeks for lack of uniformity and poor growth. A pre-mix error resulted

in pullets consuming ionophore at five times the recommended concentration of 110 grams/ton. When replacement feed was delivered to the farm, the new feed was not mixed with the remaining 10,000 pounds of toxic feed, and pullets continued to consume toxic levels of ionophore for four days.

**Key Words:** Ionophore, Toxicosis, Pullets

**162 Myopathy in turkeys: Are the mechanisms similar to those in broilers and pigs? Effects of halothane.** M. Mitchell\*<sup>1</sup>, L. Gatcliffe<sup>2</sup>, and D. Sandercock<sup>1</sup>, <sup>1</sup>*Roslin Institute, Roslin, Midlothian, United Kingdom*, <sup>2</sup>*BUT, Broughton, Chester, United Kingdom.*

Previous studies in this laboratory described the induction of myopathy in rapidly growing modern broiler chickens by exposure to halothane anaesthesia. It was proposed that the mechanism of this pathology might involve elevation of intracellular calcium through activation of the intracellular sarcoplasmic reticulum (SR) calcium channel or ryanodine receptor (Ryr). Further studies demonstrated that acute heat stress induced myopathy in broiler chickens was ameliorated by treatment with the specific Ryr antagonist dantrolene sodium. These findings further implicated the SR calcium channel in the etiology in spontaneous and stress-induced myopathy in broiler birds. A defective halothane sensitive Ryr in pigs and humans is responsible for malignant hyperthermia syndrome and porcine stress syndrome. Other workers have attempted to establish a link between halothane sensitivity, myopathy and meat quality problems (e. g. a PSE like condition) in both broilers and turkeys but the findings remain equivocal. The present study therefore examined the effects of halothane upon muscle