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SYMPOSIA AND ORAL SESSIONS

Metabolism and Nutrition III: Feed Additives

118 Efficacy of characterized adsorbents to ameliorate the toxic effects of aflatoxin B1 in broiler chicken. G. Schatzmayr¹, D. Schatzmayr¹, D. R. Ledoux², A. J. Bermudez², and G. E. Rottinghaus², ¹BIOMIN Research Center, Tulln, Austria, ²University of Missouri, Columbia.

Aflatoxins (AF) are a class of mycotoxins that impair poultry health and performance by causing immune suppression, liver damage, and changes in serum chemistry. The toxic effects of AF can be efficiently counteracted by some adsorbents. The aim of this study was to investigate fully characterized clay adsorbents in a feeding trial with broiler chickens to correlate *in vitro* and *in vivo* AF detoxifying efficacy. A completely randomized design was used with 4 replicate pens of 5 chicks assigned to each of 10 dietary treatments from hatch to 21 days. Dietary treatments evaluated included a negative control diet (no AF), a positive control diet (2 mg/kg AF), and 8 treatment groups receiving 2mg/kg AF and 0.5% of one of 8 adsorbents. Results of *in vitro* experiments ranked the adsorbents as 'good' (6 bentonites, R, MB, B7, M32, M34, M5), 'average' (bentonite C2) or 'poor' (zeolite Z08). Compared with the negative control, AF caused lower ($P < 0.05$) feed intake (FI) and body weight gain (BWG). The addition of the 'good' bentonites prevented ($P < 0.05$) the reduction in FI and BWG caused by AF. Adsorbent C2 prevented the reduction in FI ($P < 0.05$) but did not completely prevent the reduction in BWG. Adsorbent Z08 was not effective in reducing or preventing the effects of AF on FI or BWG. Similarly the 'good' adsorbents prevented the decrease in serum albumin, serum globulin and serum total protein caused by AF. Aflatoxin caused an increase in relative liver weight (LWT) and relative kidney weight (KWT). Adsorbents R, B7, M5, M23 and M34 prevented ($P < 0.05$) the increase in LWT caused by AF. Adsorbents R, MB, B7, M5 and M23 prevented ($P < 0.05$) the increase in KWT observed in chickens fed AFB alone. Adsorbents C2 and Z08 were not able to diminish the negative effects of AF on LWT and KWT. The ability of adsorbents to ameliorate AF toxicity in poultry basically correlated with the *in vitro* findings meaning that 'average' and 'good' adsorbents did not (Z08) or only partially (C2) protected against AF *in vivo*. However, several *in vitro* tests are required to differentiate amongst 'good' AF adsorbents.

Key Words: aflatoxin, adsorbent, detoxification, aflatoxicosis, mycotoxin binder

119 Plant-derived essential oils influence intestinal morphology during a coccidial vaccine challenge. N. Reisinger¹, T. Steiner², S. Nitsch², G. Schatzmayr¹, and T. J. Applegate³, ¹Biomin Research Center, Tulln, Austria, ²Biomin Holding GmbH, Herzogenburg, Austria, ³Purdue University, West Lafayette, IN.

Because of pending and current regulations, the poultry industry is searching for alternatives to growth promoting antibiotics which may include plant-derived supplements which may prevent or lessen the severity of coccidiosis. Therefore, a 2 x 2 experiment (8 pens / treatment, 26 birds / pen) was conducted with 2 doses of a coccidial vaccine (1X or 5X; Paracox[®] 5 administered at 1 d of age) with or without supplementation (125 g/1000 kg) with a phytogetic feed additive containing essential oils from oregano, anis and citrus peel (Biomin[®]P.E.P. 125 poultry). Within each pen, 13 birds received the coccidial vaccine while the remainder was naturally infected through recycling of oocysts in the litter. One of the naturally infected birds/pen was euthanized for histological evaluation of the mid-ileum morphology while 5/pen were collected for determination of apparent digestible energy, nitrogen, and mucin content from ileal digesta. The higher (5X) dosage of the coccidial vaccine resulted in an 11% reduction in crypt depth ($P < 0.05$), but there was no effect on villus length or number of goblet cells ($P > 0.05$). The dosage of coccidial vaccine had no effect on the apparent digestibility of energy or nitrogen. At Paracox[®] 1X dosage, birds fed the phytogetic feed additive had 12% longer villi than the control fed birds ($P < 0.05$) with 30% more goblet cells, and 23% more goblet cells per 10 microns villus length ($P < 0.05$). Neither coccidial vaccine dosage nor phytogetic supplementation influenced ileal mucin content (concentration or per unit of feed intake). Birds fed the phytogetic feed additive at a Paracox[®] 5X dosage had 4% less apparent digestible energy ($P < 0.05$), however at the Paracox[®] 1X dosage there was no effect of the phytogetic feed additive ($P > 0.05$). In conclusion, the dosage of coccidial vaccine can have an influence on the crypt depth and supplementation of the diet with a phytogetic additive increased villi length and goblet cell density.

Key Words: broiler, coccidial vaccine, intestinal morphology, plant-derived supplement

120 Micro encapsulation increases carvacrol stability during pelleting and premix and feed storage. D. Bravo, C. Ionescu*, A. Vienne, and S. Oguy, Pancosma, Geneva, Switzerland.

Carvacrol (CA), the active compound of oregano, is widely used in poultry nutrition for its antimicrobial activity. The influence of micro encapsulation technologies on CA recovery during the feed production process was studied. The CA formulations were: silica (SI), fat with a large particle size (HYB), modified starch (MS), maltodextrin (MA), arabic gum combined with maltodextrin (MAG) or maltodextrin coated with either salts (MAS) or with fat (MAF). Encapsulates were produced using adsorption (SI), spray granulation (MA, MS, MAG), spray cooling (HYB), or their combination (MAS, MAF). Encapsulates were then blended into mineral premixes and meal feeds. Unblended encapsulates

were stored at room temperature for 20 wks, premixes were stored at 20 or 40°C for 3 and 5 wks. Meals were expanded at 120°C and then pelleted (75°C). Pelleting stability was checked and samples of meals and pellets stored at 25 or 40°C for 3, 6 and 20 wks. Results were analyzed using GLM procedure of SAS. The CA recovery was determined with in-house validated analytical methods. Under the most stringent condition for mineral premixes (40°C for 5 wks), CA recovery was greater ($P < 0.01$) for MAG, MAS and MA (100, 97 and 97%, respectively) than for MAF (91%), with lower recovery from HYB, SI and MS ($P < 0.01$, 74, 72 and 70%, respectively). Pelleting stability was higher ($P < 0.001$) for MS, MAG and HYB (97, 96 and 96%, respectively) than for MA, MAF, MAS and SI (89, 87, 86 and 81%, respectively). After 6 weeks at 25°C, CA recoveries in meal feed were higher ($P < 0.001$) for MA, MAG, MAS, MS and MAF (100, 100, 100, 97, 97%, respectively) than for HYB and SI (91 and 84%, respectively). Under the same conditions, recoveries in pellets were higher ($P < 0.001$) for MA and MAG (100 and 98%, respectively) compared with MAF, MAS, MS, HYB and SI (94, 93, 92, 92 and 90%, respectively). These results show that micro encapsulation method and formulations of CA are important determinants of its recovery during feed production.

Key Words: carvacrol, microencapsulation, stability, plant extracts

121 Evaluation of a mixture of carvacrol, cinnamaldehyde and capsicum oleoresin for improving growth performance and metabolizable energy for broiler chicks fed corn-soybean meal. D. Bravo*¹, P. Utterback², and C. M. Parsons², ¹Pancosma, Geneva, Switzerland, ²University of Illinois, Urbana.

A carvacrol, cinnamaldehyde and capsicum oleoresin mixture (XTract 6930, XT, Pancosma) was fed in corn-soybean meal diets to broilers to evaluate the effect on AME_n (trial 1) and to confirm the effect with a productive trial (trial 2). For trial 1, 12 replicates of 5 chicks were assigned to the 2 treatments: negative control and inclusion of 100 ppm of XT. Diets were fed from 0 to 21 days, BW, FI, and G:F were measured at 7 and 21 days and excreta collected from each pen at 20-21 days for AME_n determination. For trial 2, 1 day old male chicks were fed a pre-test diet until day 9 post hatching. Following 16 h of feed deprivation, chicks were individually weighed, and randomly distributed among 4 treatment groups with 48 replicates per treatment and 1 bird per replicate. Chicks were placed in battery cages with wire floors for 25 d. Two factors were organized in a complete factorial design. Factor 1 was dietary AME_n content (3000 or 2050 kcal/kg), factor 2 was XT (0 or 100 ppm of XT). For trial 1, XT increased weight gain and G:F from day 1 to 8 (respectively, +6.4% $P = 0.055$ and +6.6% $P = 0.081$) and for the whole period with +4.8% for ADG ($P = 0.117$) and +3.7% for G:F ($P = 0.089$). AME_n content increased with XT of 68 kcal (SEM = 11.0, $P = 0.003$) and its 90% confidence interval (CI) was 49.8 to 86.1 kcal. This is the reason the value of 50 kcal/kg (~49.8) was selected as the energy difference between diets in trial 2 in which no interaction between treatments on daily gain ($P = 0.231$) and G:F ($P = 0.520$) were detected. The decrease of AME_n depressed daily gain (-2.4%, $P = 0.021$) and G:F (-2.1%, $P = 0.009$). Inversely, the addition of XT increased daily gain (+2.4%, $P = 0.024$) and G:F (+2.3%, $P = 0.006$). The results indicate that 100 ppm of XT improves the performance of 21 day old broilers and increases the dietary AME_n. The AME_n value of 50 kcal/kg for 100 ppm of XT corresponding to the lower limit of the 90% CI, was confirmed in a productive trial.

Key Words: broilers, AME_n

122 Effects of functional oils on chickens challenged with coccidiosis. A. E. Murakami¹, L. M. G. Souza¹, J. C. Faveri¹, and J. Torrent*², ¹Universidade Estadual de Maringá, Maringá, PR, Brazil, ²Oligo Basics Ltda, Cascavel, PR, Brazil.

A commercial mixture of functional oils (Essential, Oligo Basics Ltda., Cascavel, PR, Brazil), composed of cashew nut shell oil and castor oil, was supplemented to evaluate its effects on chickens before and after a coccidiosis challenge. A total of 1500 male chicks of one day of old were sorted by weight and randomized among 50 floor pens with 50 chicks per pen. Treatments were: Control (C), Essential at 1.5 kg/ton not challenged (ELN) and challenged with coccidiosis (ELC) and Essential at 2 kg/ton not challenged (EHN) and challenged with coccidiosis (EHC). At 14 days of age, treatments C, ELC and EHC were challenged with approximately 100000, 30000 and 75000 oocysts/bird of *Eimeria acervulina*, *Eimeria maxima* and *Eimeria tenella*, respectively. At 14 days of age, weight gains were higher ($P < 0.01$) and Feed: Gain ratios lower ($P < 0.01$) for the ELN, ELC, EHN and EHC treatments when compared to the C treatment (323 g, 331 g, 339 g 320 g and 235 g, respectively for weight gains; 1.24, 1.23, 1.22, 1.25 and 1.39, respectively for Feed: Gain ratios). Mortality in post seven days challenge reached 13.66% in the treatment C and was higher ($P < 0.05$) than in the other treatments where it ranged between 2 and 3%. For the challenged treatments, intestinal lesion score evaluated seven days post-challenge, was lowered ($P < 0.05$) in the anterior intestine and cecum by the Essential supplementation independent of the level of supplementation (1.63 and 1.87 vs. 2.60 in the anterior intestine; 1.20 and 1.30 vs. 2.30 in the cecum for C vs. ELC and EHC). Gains Weight from 14 to 42 days of age was decreased by the coccidiosis challenge ($P < 0.05$) and improved by Essential supplementation ($P < 0.05$) but not by level of supplementation. No differences were seen in feed efficiencies between 14 and 42 days of age. In conclusion, functional oils improved growth parameters and intestinal lesion scores in chickens after a coccidiosis challenge.

Key Words: functional oils, lesion scores, performance

123 Effect of yeast cell wall fractions on health, performance and white blood cells profile of broiler chicken. A. Ganner*¹, S. Nitsch², S. Schaumberger¹, T. Applegate³, and G. Schatzmayr¹, ¹BIOMIN Research Center, Tulln, Austria, ²BIOMIN Holding GmbH, Herzogenburg, Austria, ³Purdue University, Department of Animal Science, West Lafayette, IN.

The trial objective was to investigate the efficacy of a product containing yeast cell wall fractions on health status, performance and white blood cell profile of broiler chicken.

With a quantitative microplate based test assay binding of *E. coli* F4 and *S. typhimurium* to the yeast cell wall fractions was analyzed; binding amounts up to 10⁴ CFU/mg were noted. A subsequent feeding trial with the respective cell wall product was conducted. In a 35 day study 450 1-d- old mixed sexed broiler were distributed to 3 experimental groups with 8 replicates (26 birds/pen): control group A, group B (1 kg yeast product/t feed) and group C (2 kg yeast product/t feed). In the course of the trial a positive influence was observed by yeast cell wall supplementation. Live weight (1570 g) and daily weight gain (43.8 g) were improved in group B (1 kg/t) compared to the control group A (1381 g live weight, 38.4 g/d, respectively; $P < 0.05$). Group C (2 kg/t) also showed improved final body weight (1415 g) and daily weight gain (39.4 g). FCR was also improved (group B: 1.82; group C: 1.75) when

compared to the control (2.02). Mortality was higher in group A (5.33%) compared to the trial groups (B: 2.62%; C: 4.47%).

Blood samples (1/pen) were taken on d 35. Leukocytes were enhanced in both trial groups (B: 13.45 g/L; C: 12.85 g/L) in comparison to the control (A: 12.15 g/L) ($P > 0.05$). Monocytes were more than doubled in comparison to the control ($P > 0.05$); however lymphocytes were not affected.

Our results clearly indicate that yeast cell wall fractions are able to enhance bird performance and to modulate the immunological blood profile.

Key Words: broiler, yeast cell wall, blood profile

124 Assessment of *Saccharomyces cerevisiae* fermentation product in broiler breeder diets. L. Araujo*¹, C. Araujo¹, D. Moore², R. Upton², C. D. McDaniel¹, H. M. Parker¹, and M. T. Kidd¹, ¹Mississippi State University, Department of Poultry Science, Mississippi State, ²Diamond V, Cedar Rapids, IA.

This study investigated the use of a *Saccharomyces cerevisiae* fermentation product in broiler breeder diets. Forty-eight Cobb 500 hens were randomly allocated into two treatments: control or a control diet plus Diamond V XPC™ (1.5 lbs/ton). All dietary treatments were supplied in mash form. Breeders were provided treatments from 24 to 39 wk of age. Breeders were housed in a floor pen facility with 16 pens (3 hens/pen; 8 replications/treatment). Each pen was equipped with 1 feeder, nipple drinkers, and 1 nest. Hens were inseminated before eggs were collected (150 eggs per treatment) and set at 32 and 39 wk of age. Characteristics examined were egg production, specific gravity, fertility, hatchability, and chick quality parameters such as dehydration, small navels, large navels, open navels, wet chicks, wicks, and red hocks. Egg production was evaluated from 24 to 32 and 33 to 39 wk of age. Egg weight and specific gravity were measured at 29 and 37 wk of age on eggs collected over a three day period. Breeders receiving the control diet showed lower egg production than breeders fed XPC ($P < 0.05$) for both periods. However, egg weight, specific gravity and mortality were not different between treatments ($P > 0.05$). The percentage of small navels was lowest in chicks from breeders fed XPC ($P < 0.05$). Feeding broiler breeders XPC demonstrated increased fertility, hatchability, and hatch of fertile eggs ($P < 0.05$) for all periods. Other chick quality and hen performance characteristics were not influenced by dietary treatments. Overall, when compared to the control diet, it appears that XPC increased fertility and hatchability, as well as improved chick quality.

Key Words: broiler breeder, fertility, hatchability

125 Evaluation of *Lactobacillus reuteri* NHL2 for ameliorating effects of necrotic enteritis caused by *Clostridium perfringens* in broiler chickens. N. Otomo¹, T. Hamaoka¹, G. F. Mathis², C. L. Hofacre³, and D. M. Hooge*⁴, ¹Calpis U.S.A., Inc., Mt. Prospect, IL, ²Southern Poultry Research, Inc., Athens, GA, ³University of Georgia, Poultry Diagnostic and Research Center, Athens, ⁴Hooge Consulting Service, Inc., Eagle Mountain, UT.

Broiler chicken companies producing antibiotic-free chicken require alternative products for necrotic enteritis (NE). Freeze-dried *Lactobacillus reuteri* (*L. reuteri* NHL2; FINELACT™ Poultry, Calpis Co. Ltd, Tokyo, Japan; 10⁸ cfu/bird), an intestinal colonizing and lactic

acid producing bacteria of chicken origin, can be administered via drinking water during exposure to pathogenic *Clostridium perfringens* (*Cp*). Based on successful mortality reductions (approximately back to normal) in 12 commercial broiler flocks diagnosed with NE due to *Cp* in Japan, a broiler chicken trial was conducted using an NE challenge model (developed by Southern Poultry Research, Inc., Athens, GA) in battery cages. There were 8 chicks/cage and 8 replicate cages per treatment. Treatments included: 1 & 2) non-medicated uninfected (NUC) or *Cp* infected (NIC) controls, 3) virginiamycin (Stafac®m, Pfizer Animal Health, New York, NY) 15 g/ton and *Cp* infected (VIT), 4) daily *L. reuteri* NHL2 and uninfected (LUT), 5) daily *L. reuteri* NHL2 and *Cp* infected (LIT), and 6) d 19 *L. reuteri* and *Cp* infected (d19LIT). Each infected treatment bird was dosed with ~5,000 oocysts of *Eimeria maxima* in inoculum on d 14 and with *Cp* at ~10⁸ cfu/mL broth once daily on d 19, 20, and 21. The NE intestinal lesion scoring was done on d 22 using 3 birds/cage (0-3, least to most severe). The 0-28 d BW gain was greatest and feed conversion ratio (FCR) lowest for the NUC and LUT groups. Lesion scores were lowest for NUC, VIT, LUT, and LIT groups. The NE mortality % were equivalent for VIT, LUT, and d19LUT groups. The *L. reuteri* NHL2 given daily by water from 0-28 d to *Cp* challenged broiler chicks produced best BW gain and FCR, with lesion score and NE mortality % equivalent to virginiamycin at 15 g/ton of feed. Further research is needed with broiler chickens to determine minimum doses and days of *L. reuteri* NHL2 administration to help ameliorate effects of necrotic enteritis caused by pathogenic *Cp*.

Key Words: broiler chicken, *Clostridium perfringens*, *Lactobacillus reuteri*, necrotic enteritis, virginiamycin

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127 Comparison of autoinducer-2 inhibition by saponin rich guar extracts and other commercial saponins. R. Kakani*, P. Jesudasan, S. D. Pillai, and C. A. Bailey, *Texas A&M University, College Station.*

Saponin rich extracts from guar meal have recently been shown to exhibit antimicrobial and autoinducer-2 inhibition like activities. Bacterial cells 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 as it influences gene expression in a variety of bacteria. Natural and man-made products that can modulate AI-2 activity may have therapeutic value. The objective of this study was to compare AI-2 inhibition by saponin rich guar extracts and other commercially available Yucca and Quillaja saponins. 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 100 % methanol extracts of guar meal, Yucca and Quillaja saponins were tested for AI-2 inhibition. The 100 % extract showed an average inhibition of 79.5 ± 1.02 % at a concentration of 1 mg/ml(compared with positive control). The Yucca and Quillaja saponins respectively showed an average inhibition of 62.7 ± 2.5 % and 68.3 ± 1.9 % at the same concentration. AI-2 inhibition by these saponins was further analyzed by increasing the levels of concentration. Average inhibition by 100% methanol extract from guar meal was increased to 89.4 ± 1.2 % at a concentration of 5 mg/ml and to a 93.1 ± 0.9 % at a concentration of 10 mg/ml. The Yucca saponins could inhibit AI-2 to a level of 70.9 ± 3.4 % and 76.2 ± 2.8 % at the concentrations 5 mg/ml and 10 mg/ml respectively, whereas the average inhibition by Quillaja saponins was 74.7 ± 2.3 % and 81.2 ± 1.7 % at the concentrations 5mg/ml and 10mg/ml respectively. Saponin rich extracts from guar meal have shown higher inhibition levels compared to commercially available Yucca and Quillaja saponins. Understanding the mechanism behind AI-2 inhibition by saponin rich guar extracts could open doors to use guar saponins to control microbes in poultry feed and other formulations.

Key Words: guar saponins, yucca and quillaja saponins, autoinducer-2, inhibition

128 Net effect of an acute phase response: Alleviation with probiotic supplementation. Z. Jiang*¹, G. Schatzmayr², M. Mohnl², and T. J. Applegate¹, ¹*Purdue University, West Lafayette, IN*, ²*Biomim Research Center, Tulln, Austria.*

The acute phase response (APR) is characterized by inflammation, fever, and altered organ metabolism resulting in muscle catabolism and anorexia. Therefore, a 1 wk growth experiment was conducted to examine whether dietary supplementation of a multi-strain probiotic (PoultryStar[®]) would alleviate growth suppression and anorexia caused by lipopolysaccharide (LPS)-induced APR. The experiment was designed with 4 treatments (n=8 cages/treatment; 6 birds/cage) starting at 14 d of age. Prior to (0-14 d of age) and for the experiment (14-21 d of age), male broiler chicks were fed diets devoid or were supplemented with 1.7×10^8 cfu/kg probiotic. At 14 d of age, birds fed the diet devoid of probiotic diet was further divided into 3 treatments: an unchallenged positive control (PC), LPS challenged negative control (LPS-NC), and pair-fed to LPS-NC. The probiotic-fed birds were also then challenged with LPS. The LPS (*E. coli* O55:B5) was injected intra-peritoneally 4 times at 48h intervals at 1mg/kg BW. The LPS challenge dramatically depressed BW gain from 14 to 21 d of age by 22% ($P < 0.001$). However, 41% of growth depression was attributable to factors other than feed intake reduction when compared with the pair-fed treatment.

Probiotic supplementation recovered 17% of depressed growth (vs. LPS-NC; $P=0.068$), but this improved growth was not due to improvements in feed intake ($P=0.47$). However, recovery of feed intake of the probiotic+LPS birds occurred 48 h earlier than the LPS-NC birds. Growth depression induced by LPS administration resulted in a relative feed intake (RFI; vs. PC) of 0.83. In conclusion, APR (induced by LPS administration) diverted a large portion of consumed nutrients from tissue accretion and dietary probiotic supplementation lessened these growth-depressing effects.

Key Words: acute phase response, broiler, lipopolysaccharide, probiotic

129 Dietary amelioration of acetic acid induced inflammation of the large intestine in chicks. A. B. Batal and P. D. Sedlacek*, *University of Georgia, Athens.*

Production animals encounter heat stress, infection, or toxins, resulting in inflammation and decreased performance. Feed additives are often promoted as beneficial in these situations. The objective of this experiment was to compare the performance of chicks on diets containing no additives, an antibiotic growth promoter (AGP; 300 ppm), short chain fatty acids (SCFA; 300 ppm), butyrate (300 ppm), and α -tocopherol (150 ppm). Fourteen replications of 11 chicks were assigned to one of the five dietary treatments. Eight replications were challenged at 9 d of age intracloacally with 4% acetic acid, and six replications were inoculated intracloacally with phosphate buffered saline (PBS). Broiler performance, serum citrulline concentration and intestinal inflammation were measured 12 and 16 d of age. At 3 d post inoculation, weight gain and feed intake were reduced in all the challenged groups as compared to the non-challenged controls. Serum citrulline was elevated in the challenged groups as compared to the non-challenged controls. Acetic acid inoculated birds were 100% positive for inflammation of the large intestine while PBS inoculated birds were 0% positive. When chicks were challenged, the addition of the antioxidant α -tocopherol to the diet reduced serum citrulline and improved weight gain, however feed efficiency was comparable to the negative control. The addition of AGP to the diet improved both weight gain and efficiency as compared to the negative control diet. The addition of SCFAs and butyrate did not improve weight gain, but did improve efficiency as compared to the negative control diet. These results suggest that feed additives can have different mechanisms of action with regard to the outcome from a challenge. Antioxidants such α -tocopherol appear to reduce reactive species, as demonstrated by lower levels of plasma citrulline. The addition of AGP or SCFAs may act in a different way, possibly as an anti-inflammatory. Dissecting these effects and their mechanisms could result in more beneficial additives, as well as understanding how these additives work in poultry.

Key Words: inflammation, short-chain fatty acid, butyrate

130 The effect of Grobiotic-P, Temulose, and lactose fed for short time periods on growth performance and cecal microbial populations in young chicks. C. M. Jacobs* and C. M. Parsons, *University of Illinois, Urbana.*

The current study was conducted to evaluate the effects of short-term feeding of Grobiotic-P (GB), Temulose, and lactose on growth performance and cecal microbial populations of bifidobacteria, lactobacilli, *Escherichia coli*, and *Clostridium perfringens* in young chicks fed

corn-SBM diets. The GB is a prebiotic-type product that contains dairy and yeast fractions and dried fermentation extracts (International Ingredient Corporation, St. Louis, MO) and Temulose is a prebiotic-type product that contains a high concentration of mannans (Temple Inland, Diboll, TX). Four experiments were conducted using New Hampshire X Columbian chicks, and a fifth experiment was conducted using Ross X Ross commercial broiler chicks. In Experiment 1, GB was added at a 3 or 6% inclusion level and was fed for 1, 3, or 21 days post-hatch. In Experiments 2 and 3, 5% GB was fed for 1, 2, 3, or 7 days post-hatch. In Experiment 4, 5% GB, 0.5% Temulose, and combinations thereof were fed for 3 or 7 days post-hatch. In Experiment 5, 5% GB or 1% lactose from Dairylac-80 (International Ingredient Corporation) or pure lactose was fed for 3, 7, or 21 days post-hatch. In Experiments 3 and 5, weight gain was increased ($P < 0.05$) for chicks fed 5% GB or Dairylac-80 for 7 d. Feed intake from 0 to 7 d was significantly increased by feeding 3 or 5% GB and 5% GB in combination with 0.5% Temulose. Based on selective plate culturing, there was a significant linear increase ($P < 0.05$) in lactobacilli populations as GB was included in the diet for 0, 2, and 7 d post-hatch. Based on quantitative PCR, bifidobacteria populations were significantly increased ($P < 0.05$) for some GB treatments. The current studies indicate that GB, Temulose, and lactose fed for short time periods may increase weight gain, feed intake, and cecal lactobacilli and bifidobacteria populations.

Key Words: chicks, short-term feeding, microbial populations, probiotic, temulose

131 In-ovo feeding and dietary NUPRO[®] enhances triiodothyronine activity and morphological maturation of the small intestinal epithelium of turkey embryos and poults. D. V. Bohórquez^{*1}, N. E. Bohórquez², and P. R. Ferket¹, ¹North Carolina State University, Raleigh, ²Zamorano University, Tegucigalpa, Honduras.

Intestinal development during the perinatal period is critical for post-hatch survival and growth of poults. Triiodothyronine (T3) hormones are major regulatory peptides that modulate intestinal development and feeding behavior. In-ovo feeding (IOF) at 23d of incubation (23E) and post-hatch dietary supplementation of yeast-extract nucleotides (NUPRO[®], Alltech Inc., KY) has been shown to enhance the morphological development and digestive capacity of the intestinal mucosa, but this has not been associated with T3 activity. Three hundred Nicholas turkey 23E embryos were injected with 0.8ml of a saline or IOF solution into the amnion. Hatched poults from these 2 incubation treatments were fed diets supplemented with 0% or 3% NUPRO[®], resulting in 4 treatments arranged as a 2X2 factorial. Each treatment was replicated by 6 cages of 10poults/cage. Body weights (BW) and feed intake (FI) were evaluated at 1, 4, 8 and 12d. Jejunum tissue samples for histomorphometrical analysis and serum for T3 activity analysis (radioimmunoassay) were taken at 24E, 26E, hatch, 4, 8 and 12d. The IOF poults had greater ($P < 0.05$) villus surface area than controls at 24E (20270 vs. 15468 μm^2), 26E (41113 vs. 35499 μm^2) and hatch (58502 vs. 49663 μm^2). IOF poults also had higher ($P < 0.001$) T3 activity than controls at 26E (11.3 vs. 6.87ng/ μl) and hatch (4.26 vs. 2.9ng/ μl). No treatment effects were observed on jejunum histomorphometric measurements at 4, 8 and 12d. A significant IOF*NUPRO[®] interaction effect at 12d showed that either IOF treatment alone or NUPRO[®] supplementation of controls increase T3 activity levels. This treatment response on T3 activity was positively correlated with 12d BW and 1-12d FI, even though histomorphometrical differences dissipated with age. In-ovo feeding turkey embryos at 23E enhances the morphological maturation of the small intestinal epithelium prior to hatch and increases appetite and growth post-hatch, perhaps

through up-regulation of T3 activity, especially when a nucleotide-rich source such as NUPRO[®] is included in the diet.

Key Words: turkey, in ovo feeding, intestinal development, T3, yeast-extract nucleotides

132 Justifying phytogetic feed additive matrix values in conjunction with exogenous feed enzymes. L. K. Worley*, S. A. Loop, C. K. Gehring, K. R. Beaman, and J. S. Moritz, West Virginia University, Morgantown.

The US animal feed industry currently faces tremendous hurdles concerning dietary cost. Increased cost has motivated nutritionists to maximize nutrient availability of feed ingredients. Exogenous enzymes, in part, aid in decreasing diet cost; however, alternative products, such as phytogetic feed additives, may have potential to replace or work in conjunction with feed enzymes. In order for phytogetic feed additives to assist nutritionists in decreasing diet cost, matrix values must be determined and implemented in feed formulation. However, research demonstrating matrix values for phytogetic feed additives is sparse to nonexistent. This study evaluates proposed matrix values for a commercially available phytogetic feed additive and assesses nutrient sparing when the product is combined with commercial phytase, carbohydrase and protease. Assessment was determined on 4-21 day broiler performance. Dietary treatments included a basal, basal with phytogetic product matrix value, basal with phytogetic product matrix value and phytogetic product, and similar treatments evaluating the phytogetic product matrix with exogenous enzyme products. Proposed phytogetic matrix values were 32 kcal/kg metabolizable energy, 0.03% lysine, 0.02% TSAA, 0.02% threonine, 0.07% calcium and 0.07% available phosphorus. Decreasing the basal diet by the proposed phytogetic matrix values decreased broiler live weight gain and increased feed conversion ratio ($P < 0.05$). However, when the same diet included the phytogetic feed additive, live weight gain and feed conversion ratio were restored. The proposed matrix values of the specific phytogetic feed additive tested were justified. The application of the phytogetic product matrix was not additive or synergistic with matrix values of exogenous enzymes. Further research is necessary in order to fully understand the interaction between phytogetic feed additives and exogenous enzymes.

Key Words: phytogetic additives, matrix values, exogenous enzymes, live weight gain, feed conversion

133 Effect of aloe vera juice application through drinking water on performance, carcass characteristics, hematology and organoleptics properties in broilers. J. A. Olupona*, O. R. Omotoso, A. A. Adeyeye, O. D. Kolawole, A. P. Airemionkhale, and O. O. Adejinmi, Federal College of Animal Health and Production Technology, Ibadan, Oyo, Nigeria.

Medicinal plants may act as beneficial feed and water additives in livestock.

This research work was designed to study the effect of application of aloe vera juice through drinking water on broiler performance, carcass characteristics, health status and sensory assessment

One hundred day old broiler chicks belonging to single hatch were weighed and randomly allotted into five treatment groups. The chicks were provided with uniform floor, feeder and waterer space and were

reared under standard management conditions throughout the experimental period of eight weeks. Aloe vera juice was applied through drinking water in four treatments T2, T3, T4 and T5 according to the concentrations of 15, 20, 25 and 30 cm³ per dm³ of water respectively, while T1 was the control without aloe vera inclusion. The idea was to carry out further study on higher concentration of aloe vera. Result of the experiment showed that the final weight and weekly weight gain were significantly ($p < 0.05$) increased by the aloe vera extract supplementation. And as the concentration of aloe vera increases the weight gain increases, (T2, 243.42g; T5, 289.08g). The feed consumption follows the same trend which shows that the weight gain were strongly influenced by the feed intake. Aloe vera treated groups showed better

feed conversion ratio as compared to the control though not significant (0.48 for T1 and 0.90 for T5). There were significant difference ($p < 0.005$) in dressing percentage, breast and gizzard weight among treatments. The trained sensory assessors were able to detect differences ($p < 0.05$) in sensory characteristics between broiler meats from broiler fed control and those fed aloe vera supplementation. The result revealed that aloe vera improved the acceptability of broiler meat. There is also increase in blood protein. Aloe vera juice has no harmful effect on boiler health and performance even with higher concentration. Also, aloe vera might increase digestion and utilization when applied through drinking water.

Key Words: aloe vera, performance, drinking water, carcass

Metabolism and Nutrition IV: Nutrition and Feed Manufacturing

134 Predicting variability in poultry excreta moisture and nutrient level by near-infrared reflectance spectroscopy. J. E. De Oliveira*, V. Larat, E. Hangoor, and T. A. Scott, *Provimi Research and Innovation Centre, Brussels, Belgium.*

Evaluations of poultry excreta composition can give not only an indication of digestive efficiency but supply a means of evaluating bird welfare and environmental impact. Near Infrared Reflectance (NIR) spectrometry technology has been extensively used to predict chemical and nutritional composition of feeds and feed ingredients in commercial operations. Our objective was to develop a rapid diagnostic tool using NIR to measure excreta moisture (i.e. wet litter) and to establish the prediction of nutrient excretion. A total of 216 samples of broiler chicken excreta were collected, homogenized and scanned in two NIR systems (FT and dispersive). They were also analyzed for moisture, nitrogen, mineral and fiber content by chemical assay. The nutrient composition was utilized to develop NIR calibrations using the partial least squares method. For each calibration, a coefficient of determination (R^2) and standard errors of cross validation (SECV) were calculated. Both NIR systems showed similar results and could accurately predict moisture (mean=71.6, SD= 7.18, range=32.9-83.5, $R^2=0.97$, SECV=1.12), nitrogen (mean=1.4, SD=1.8, range=0.8-2.8, $R^2=0.94$, SECV=0.069), NDF (mean=7.03, SD= 2.0, range=4.19-18.15, $R^2=0.91$, SECV=0.54), potassium (mean=0.66, SD=0.18, range=0.39-1.57, $R^2=0.91$, SECV=0.053), and phosphorus (mean=0.4, SD=0.16, range=0.18-1.67, $R^2=0.87$, SECV=0.041) in fresh samples, but need to be improved for calcium (mean=0.54, SD=0.25, range=0.29-2.66, $R^2=0.72$, SECV=0.062) and sodium (mean=0.09, SD=0.05, range=0.05-0.53, $R^2=0.57$, SECV=0.017). Similar calibrations are being developed for other poultry species, and all values are being added to a database from which we can now look for correlation between excreta composition and other parameters like diet composition, animal performance, litter scores and health status.

Key Words: excreta, wet litter, chemical composition, NIR

135 Characterization of turkey growth profiles through mechanistic modeling. V. C. Rivera Torres*^{1,2}, P. R. Ferket³, and D. Sauvart², ¹*Techna, Couëron, France*, ²*AgroParisTech, Paris, France*, ³*North Carolina State University, Raleigh.*

A mechanistic and dynamic turkey growth model was developed to simulate turkey growth kinetics. In this study, experimental data of male and female growing turkeys of different strains were used to test

the adaptability of the model and to determine different growth profiles. The compartments defined in the model corresponded to the protein, lipid, ash, and water content in carcass, viscera and feathers. Ash and water in carcass, viscera and feathers were allometrically described relative to protein. Circulating glucose and total amino acids constituted 2 pools, which enabled incoming and outgoing flows of each body compartment. Glucose constituted the source for energy metabolism, whereas total circulating amino acids corresponded to a transient pool for protein metabolism. Both protein and lipid fractional rates constituted the driving force of the model: the fractional rates of anabolism and catabolism of protein and lipid decreased exponentially until they reached a common asymptotic value, which corresponded to maturity. The fractional rates were fitted through experimental data published on broilers and turkeys. Feather growth was defined as an irreversible loss resulting from anabolic flows. The outputs of the model were defined as daily body weight, feed intake and the mass of the different compartments in carcass, viscera and feathers. The computations of the growth kinetics of the body compartments helped define different growth profiles. Protein and lipid deposition in the carcass constituted the main flows. The inflexion of protein deposition in viscera was observed before the corresponding inflexion in carcass. Protein deposition in the feathers should not be neglected because it reached higher values than protein deposition in the viscera. This model constituted a basis for the study of the effect of environment and diet on the response of growing turkeys.

Key Words: model, growth, metabolism, energy, protein

136 Quantitative analysis of microbial flora in cecum of coccidia infected broilers. A. Nalian*¹, E. Oviedo-Rondón², S. Dowd³, and A. Martynova-Van Kley¹, ¹*Stephen F Austin State University, Nacogdoches, TX*, ²*North Carolina State University, Department of Poultry Science, Raleigh*, ³*Research and Testing Laboratory, Lubbock, TX.*

Coccidiosis is considered to be one of the most economically important diseases in poultry. Coccidiosis causes mucosal damage and predisposes the birds to bacterial infections such as necrotic enteritis. In this study we examined the effect of coccidiosis infection on the microflora of broilers grown on diets supplemented with either antibiotic (BMD[®]) plus an ionophore (Coban[®]) or specific essential oil blends (Crina[®]). We collected DNA samples from the cecum of broilers before and after an infection with mixed *Eimeria* spp. (*E. acervulina*, *E. maxima* and *E. tenella*) and used a 454 FLX pyrosequencer and 16S universal primers