levels of fiber, moisture and protein on pellet manufacture variables. Treatments were arranged in a 3 x 3 x 3 factorial design consisting of 3 levels of added fiber (0, 2 and 4% oat hulls), added moisture (0, 2 and 4% tap water) and added protein (0, 2 and 4% soybean meal). Fiber, moisture and/or protein were added to a corn/soybean based basal diet that was formulated to Cobb specifications. Feed was manufactured at the West Virginia University pilot feed mill utilizing a randomized complete block design over a 4-week period. Steam conditioning temperature was held at 80 ± 2°C. Steam pressure was held constant at 262kPa. Fiber decreased modified pellet durability index (MPDI), bulk density and production rate (P = 0.0001, 0.0001, and 0.0524, respectively) and increased total fines (P = 0.0234). Detrimental pellet manufacture effects of fiber were likely associated with particle size. Moisture increased MPDI and decreased bulk density and production rate (P = 0.0030, 0.0001, and 0.0001, respectively). Protein increased MPDI (P = 0.0440). Ingredient interactions (fiber|moisture|protein) were not significant (P > 0.05). Results suggest that further research is warranted using increased levels of moisture and protein in practical diet formulations.

Key Words: pellet quality, feed manufacture, diet formulation

169 Effects of diet preconditioning on digestive system morphology in roosters fed increasing levels of guar meal. O. Gutierrez*, A. Haq, and C. A. Bailey, Texas A&M University, College Station.

Several studies report adaptive morphological responses in the digestive system of gallinaceous birds fed high-fiber diets over an extended period of time. This often results in increased utilization of diets low in nutrient density. The purpose of the current study was to determine whether morphological adaptations could occur as a result of feeding relatively high levels of guar meal (GM) to adult Leghorn roosters over a 3-week period. Guar meal is a high fiber by-product of guar gum processing and contains approximately 18% residual gum, which is comprised of a β-1→4-linked α-mannopyranose chain with α-1→6-linked α-galactopyranose branches. A total of 28 roosters were fed 1 of 4 diets containing differing amounts (0, 6, 12, and 24%) of GM for a period of 3 weeks. Following this preconditioning period, all birds were euthanized and evaluated for changes in villus height and incidence of intestinal mucosal damage as determined by light microscopy. Changes in relative organ weights (ventriculus, liver, heart, pancreas, spleen, and small intestine), cecum length, body weight, and feed consumption were also measured. Significant increases in cecum length, villus height and severity of intestinal mucosal injury were observed in birds consuming the 24% GM diet. Additionally, increased pancreas and liver weight and decreased heart and body weight was noted for this group. Birds consuming the 6% GM diet exhibited intestinal lesion scores and relative heart weights intermediate to those of the control and 24% GM groups. No significant differences were noted for any other parameters. These results indicate that a diet preconditioning period of 3 weeks is sufficient to induce morphological adaptations of the digestive system of chickens consuming a 24% GM diet. However, the effect of these adaptations on nutrient utilization is unknown due to factors such as the increase in intestinal mucosal damage associated with the 24% GM diet.

Key Words: diet preconditioning, digestive morphology, guar meal


Horizontal transmission within and between flocks is an important aspect of the epidemiology of Salmonella Enteritidis (SE) in poultry. Previously, a series of passages through infected laying hens increased the frequency of SE isolation from organs was similar in the 2 rounds

Pathology


Attenuated Salmonella Enteritidis (ΔSE) recombinant vaccine vectors incorporating a Salmonella flagellar protein (fliC) subunit, a hydrophobic putative cell-mediated epitope, (ΔSEfliC) for Lamb expression, with or
without co-expression of a putative immune-enhancing CD154 oligopeptide (ΔSE/fliC-CD154) were developed and compared to wild type SE (wtSE) as initial vaccine candidates against Salmonella infection. Two initial exp. were performed to assess the clearance of each construct and antibody response to the fliC peptide. Each construct was orally administered to broiler chicks at day-of-hatch by oral gavage (~10^5 cfu/chick). At d21 liver/spleen (LS) and cecal tonsils (CT) were removed aseptically for recovery of SE or ΔSE mutants. For exp. 1 vector recovery from LS and CT was as follows: Control (nonvaccinated) LS-0/7 (0%), CT-0/7 (0%); wtSE LS-5/8 (63%)a, CT-8/8 (100%)a; ΔSE/fliC LS-0/9 (0%)b, CT 0/9 (0%); ΔSE/fliC-CD154 LS-4/8 (50%)b, CT-4/8 (50%)b. In exp. 2 vector recovery was as follows: Control (nonvaccinated) LS-1/10 (10%)b, CT-3/10 (30%)a; wtSE LS-5/10 (50%)b, CT-8/10 (80%)a; ΔSE/fliC LS-0/10 (0%)b, CT 2/10 (20%)b; ΔSE/fliC-CD154 LS-4/10 (50%)b, CT-7/10 (70%)ab. A significant difference in antibody response to the fliC peptide was not detected, which may be anticipated for a hydrophobic epitope. These preliminary exp. suggest that cell surface expression of fliC alone markedly increased clearance rate at 21 d postvaccination. Although more total exogenous peptide sequence is expressed by the ΔSE/fliC-CD154 than ΔSE/fliC, clearance was enhanced by the fliC sequence alone, suggesting that insertion of this candidate epitope was responsible for enhanced immune response in these preliminary experiments. Since a significantly different antibody response against fliC was not found, we suspect that ΔSE/fliC induces a cell-mediated response. ΔSE/fliC-CD154 was less effective, possibly due to steric hindrance or production of anti-CD154 antibody. Ongoing studies will evaluate the effect of immunization with these vectors on protection from wt challenge and further characterization of the immune response to ΔSE/fliC.

Key Words: Salmonella vaccine, fliC, Salmonella vector

172 Comparison of vitamin U, Bio-Mos and BMD on Salmonella control and intestinal measures. A. L. Shaw*, K. S. Macklin, and J. P. Blake, Auburn University, Auburn, AL.

This study evaluated the effectiveness of Vitamin U (in-methionine methlysulfonyl chloride), Bio-Mos (mannan-oligosaccharide), and BMD (bacitracin methylene disalicylate) on cecal loads of Salmonella and characteristics of the small intestine villi in broilers challenged with S. Typhimurium. Two-hundred day-old broilers of mixed sex were randomly allotted to treatments (3 reps/trt) employing a corn-soy basal diet (21.5% CP, 3,142 kcal/kg). Dietary treatments were: 1) Control, 2) Mos (Ctl + 0.095% Bio-Mos), 3) BMD (Ctl + 0.005% BMD), 4) LVU (Ctl + 0.03% Vitamin U), and 5) HVU (Ctl + 0.3% Vitamin U). All birds were orally gavaged with 1 mL S. Typhimurium (10^8 cfu/mL) at placement. On a weekly basis cecal contents were obtained for derivation of colonization and liver samples collected to verify septicemia in 6 birds/trt. Intestinal samples were also gathered from the duodenum, jejunum, and ileum for measurement of villi length and crypt depth. Cecal colonization remained constant across all treatments throughout the experiment, except during week 3, where HVU birds were found to have lower colonization (P < 0.05) as compared with all other treatments. A greater number of birds (P < 0.05) exhibited septicemia for BMD, LVU, and HVU groups during week 2 when compared with Ctl and Mos birds. No differences were found during the prior or subsequent weeks. Mos birds were found to have greater jejunal and ileal length (P < 0.01) than HVU birds during the first week, though similar crypt depths were found in both treatments. During the second week, Mos provided improvements (P < 0.05) over BMD in duodenal villi length as well as duodenal and jejunal crypt depth. Week 3 intestinal differences were inconclusive for the measured tissue sections. During the final week, Mos birds showed deeper crypts (P < 0.05) in the duodenum and jejunum than HVU birds, while both BMD and LVU birds had greater duodenal villi length (P < 0.01) than HVU birds. Overall effects of Vitamin U on Salmonella colonization and septicemia were comparable to Bio-Mos and BMD. BMD and LVU treatments effected intestinal villi measures similarly, with Mos affecting the same measures to a different extent.

Key Words: vitamin U, Bio-Mos, BMD

173 Control of necrotic enteritis and reduction of environmental level of Salmonella with the natural feed additives NatuStat and Bio-Mos. G. Mathis*,1 C. Hofacre2, and S. Heintzelman3, 1Southern Poultry Research, Inc., Athens, GA, 2University of Georgia, Athens, 3Alltech, Inc, Lexington, KY.

The objective of the study was to determine if a NatuStat, starter/grower, Bio-Mos, finisher program would reduce Necteric Enteritis (NE) and Salmonella environmental contamination when fed to coccidial vaccinated broiler chickens. The treatments were nonmedicated (NM), no Clostridium perfringens (CP) challenge; nonmedicated, CP challenge; and NatuStat (2 kg/mt) in the starter/grower diets and Bio-Mos (1 kg/mt) in the finisher, CP challenged (NatuStat/Bio-Mos). A complete randomized block design was used with 6 replications of each treatment. Sixty male broiler chickens were placed into each pen. Prior to placement all birds were vaccinated with the coccidial vaccine, CocciVac-B. Half of the birds from each pen were tagged and dosed with Salmonella Heidelberg. On Days 20 and 21, NM CP challenged and NatuStat/Bio-Mos treatment birds were dosed with CP. On Day 22, ten birds per pen were Necrotic Enteritis lesion scored. The birds fed NatuStat/Bio-Mos had significantly lower NE lesion score and NE mortality compared to NM, CP challenged birds. NM, CP challenged birds had significantly poorer performance on Days 22 and 42 compared to the both NM, no CP challenge and NatuStat/Bio-Mos treatments. NatuStat/Bio-Mos birds’ performance, both feed conversions and weight gains, were not significantly different from the birds that were not dosed with CP. Salmonella drag swab samples on Day 14 showed that Salmonella was detectable in all pens, confirming the validity of the disease model. Salmonella drag swab samples on Day 42 showed significantly lower number of positive samples in the NatuStat/Bio-Mos compared to the both control treatment pens. This indicates a reduction in environmental Salmonella contamination. This study demonstrated the benefits of feeding NatuStat and Bio-Mos to coccidial vaccinated broilers exposed to Clostridium perfringens and Salmonella. The study showed a significant improvement in performance, less severe Necrotic Enteritis development, and a reduction in environmental contamination of Salmonella.

Key Words: necrotic enteritis, Bio-Mos, NatuStat
**174** Gene expression profiling within the spleen of *Clostridium perfringens*-infected Broilers fed antibiotic-medicated and nonmedicated diets. A. J. Sarson1, Y. Wang2, Z. Kang1, H. Yu1, Y. Han1, H. Zhou2, S. Sharif2, and J. Gong1, 1Guelph Food Research Centre, Agriculture and Agri-Food Canada, Guelph, ON, Canada, 2Texas A&M University, College Station, 3Nutreco Canada Agresearch, Guelph, ON, Canada, 4University of Guelph, Guelph, ON, Canada.

*Clostridium perfringens* (CP) is an anaerobic bacterium causing necrotic enteritis in chickens. It is a major target of dietary antibiotics to reduce flock mortality; however, this practice is facing a restriction worldwide. Thus, developing alternatives to improve immunity against CP has become important. Since little is known about molecular mechanisms of host response to CP infection, determination of mechanisms that may lead to such alternatives has been pursued by this study. Gene expression profiles were examined with a chicken 44K Agilent microarray, comparing RNA from spleen tissues of antibiotic-medicated (bacitracin, 55 ppm) and nonmedicated birds prior to, and following CP inoculation. At hatch, 600 Ross broilers were divided into 6 pens fed medicated Starter diets and 6 pens fed nonmedicated Starter diets. At 18 days of age, birds were challenged with CP. Spleens were collected from 12 birds per group at day 18 (before infection), 19, 20, and 22. cDNA was prepared from splenic total RNA for microarray hybridizations. LOWESS-normalized signal intensity was analyzed using a mixed model to identify significant differentially expressed genes between treatments and time points. Expression profiles indicated up-regulation of genes encoding members of the Toll-like receptor pathway, antibody response, T-cell markers, and inflammatory cytokines in nonmedicated, CP-infected chickens compared to infected chickens fed a medicated diet. Moreover, when expression profiles of day 19, 20, and 22 of CP infected, nonmedicated birds were compared to the day 18 baseline, the majority of immune-related genes were up-regulated. Overall, CP infection appeared to have a more robust effect on inducing gene expression in the spleen than did antibiotics; however, host response factors that were differentially expressed upon infection were very similar between the medicated and nonmedicated groups. Further analysis of the highlighted immune mechanism is underway to better understand the role of antibiotics in the host response to CP infection in chickens.

**Key Words:** *Clostridium perfringens*, necrotic enteritis, microarray

**175** *Bacillus licheniformis* (GalliPro Test) prevent necrotic enteritis in broiler chicken. I. Knap1, B. T. Lund1, and G. F. Mathis2, 1Chr. Hansen A/S, Hoersholm, Denmark, 2Southern Poultry Research Inc., GA.

Purpose of study: Evaluate the dose effect of *B. licheniformis* to prevent necrotic enteritis (NE) in *Clostridia perfringens* challenge studies and to understand mode of action of the NE preventing effect of *B. licheniformis*. 

Trial design: Three *Clostridium perfringens* challenge studies were carried out at Southern Poultry Research, Inc. Two studies were cage studies and one study was performed as floor pen study. In the studies were different doses of Bacillus spores tested from 8 × 105 CFU/G to 8 × 107 CFU/G. In all studies were a nonchallenged group, a negative control; challenged group without additive; and a positive control with Virgimycin 15 g/t. Unmedicated commercial chicken feeds commonly used in the United States were used in all studies. Feed and water were available ad libitum throughout all trials. The *Clostridium* challenge was made by fresh *C. perfringens* broth culture given to the birds daily in 2 or 3 days. Weight gain, feed consumption, feed conversion, lesion scores, and mortality were calculated.

Results: In all trials a significant effect was seen of using *B. licheniformis* with regards to lesion score, mortality, weight gain, and FCR. There was no significant difference between the *B. licheniformis* treatments and the Virginamycin treatment with regards to mortality and lesion score. A dose of 1.6 x 106 CFU/G feed seems to be optimal to prevent necrotic enteritis and gave the same performance (live weight, mortality) as the nonchallenged group

Conclusion: *B. licheniformis* used as a direct-fed microbial could prevent necrotic enteritis in broiler chicken.

**Key Words:** *B. licheniformis*, necrotic enteritis, *C. perfringens*

**176** Utility of probiotics as part of an integrated control strategy against coccidiosis in broiler chickens. J. L. McPherson Komorowski* and J. R. Barta, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada.

Coccidiosis is a major parasitic disease of poultry caused by protistan parasites that invade and inhabit the gut. Probiotics (defined or undefined commensal enteric bacteria, e.g., lactobacilli) could contribute to successful coccidiosis control because microflora are an important first line of defence against enteric infections. To assess this, groups of chickens were orally challenged with *E. tenella* and were either administered a probiotic or sham inoculated and/or vaccinated or not vaccinated. Growth rate and food conversion efficacy of the birds was calculated over the challenge period and lesions resulting from the parasite were scored blindly using a qualitative scale. Messenger RNA was isolated from cecal tonsils to detect differences in cytokine gene expression to characterize the nature and intensity of any immune response. Lastly, chickens were bled and ELISAs were performed to detect the level of antibodies against sporozoites to further characterize any immune response. These experiments examined the complex interactions among protistan pathogens, beneficial gut microflora and the immune system of the chicken and may lead to more successful and widespread use of live coccidiosis vaccines in the broiler industry, thereby reducing the industry’s reliance on in-feed prophylactic medications.

**Key Words:** coccidiosis, probiotics, broilers

**177** Effect of some chemical pollutants on the response of chickens to vaccination. A. A. El Meleigy*, S. E. Mesalhy1, M. M. El Hammany1, N. A. Shalaby2, and S. F. El Hadad2, 1Suez Canal University, Ismailia, Egypt, 2Animal Health Research Institute, Gharbia, Egypt.

Based on the water analyses in the field study, 180 one-day-old broiler chickens were used in the experiment and divided into 12 equal groups. All birds were vaccinated against Newcastle and Gumboro diseases except the negative control group (gp). The groups were treated daily at the age between 1 and 42 days; gp. 1 (potassium nitrate normal, 0.005 mg/L), gp. 2 (potassium nitrate high, 0.0083 mg/L), gp. 3 (potassium nitrite low, 0.003 mg/L), gp. 4 (potassium nitrite high with Bio-v-mix, 0.005 + 0.5 mL/L), gp. 5 (lead acetate normal, 0.1 mg/L), gp. 6 (lead acetate high, 0.381 mg/L), gp. 7 (lead acetate low, 0.05 mg/L), gp. 8 (lead acetate high + Bio-v-mix, 0.381 + 0.5 mg/L), gp. 9 (calcium hypochloride, 14 mg/L), and gp. 10 (calcium hypochloride + Bio-v-mix,

Recently, we have investigated the etiology and methods of immunoprophylaxis against common field gangrenous dermatitis (cellulitis), in commercial turkeys. In Exp. 1, 9 Clostridium isolates from cellulitis lesions were purified, grown to high titer, and evaluated for ability to produce lesions in apparently susceptible culls from young (10–16 week) breeder hens. Five C. perfringens (CP) isolates, and 3 C. septicum (CS) isolates did not induce cellulitis lesions following IV administration of ~10^8 cfu. One CS isolate consistently reproduced lesions, often associated with bruised areas, when administered IV as a single dose. CS and CP were isolated from turkeys that died acutely with the lesions of cellulitis. In Exp. 2, both isolates were grown in Cooked Meat Medium (CMM) and injected IV into turkeys (~10^8 cfu), singly, and in mixed culture. Turkeys receiving CP alone failed to develop clinical lesions of cellulitis. Turkeys inoculated with CS alone or mixed with CP developed lesions of cellulitis. CS was recovered again from the cellulitis lesions. In Exp. 3, CMM cultures of the CS isolate was centrifuged to remove cells. The supernatant was injected IV into turkeys. The turkeys became ill but survived. Lesions of cellulitis were not observed. In Exp. 4, an ELISA was developed for measuring antibody titer against the known CS etiology. This assay has allow to predict susceptibility to infection. When turkeys were selected from flocks without detectable antibody, they were susceptible and vice versa. In Exp. 5, an experimental formalin-killed bacterin was produced from the challenge strain of CS to yield maximum toxin and ~10^6 cells per mL. This bacterin (SQ, day of hatch) generates rapid and persistent antibody response against the homologous CS to the time of move (6 wk of age). The ability of this vaccine to protect birds in the field as well as the evaluation of unvaccinated flocks to establish the time frame for sera-conversion and the relationship to clinical disease is currently under evaluation.

Key Words: turkeys, cellulitis, bacterin

179 Antibiotic treatment, small group size and strict biosecurity as a method to eradicate Mycoplasma and Salmonella from novel turkey breeding stock. B. J. Wood*, N. Buddiger, H. van der Hoef, C. J. Kostal, and A. Ferenz, Hybrid Turkeys, Kitchener, ON, Canada.

The commercial turkey industry requires the supply of breeding stock guaranteed free of major pathogens. To maintain the supply of breeding stock, new genetic lines may occasionally be incorporated into a primary breeding program. The source of that material must be of comparable or higher health status than the current program. The Orloff Turkey Farms pure lines were acquired in 2005 with knowledge of the stock being positive for a number of Mycoplasma and Salmonella spp., consequently, a program was initiated to eradicate both types of pathogens from subsequent generations.

First generation eggs were temperature and pressure differential dipped and injected with a sensitive antibiotic solution. Treatment had a negative effect on hatchability with decreases of 20–45% depending on line. Male lines were more susceptible than female. Male lines were injected with larger amounts of total antibiotic to compensate for greater egg size but both had similar total egg concentration. An explanation for the greater susceptibility other than total dose and line were not identified. First generation poults were mass placed with fortnightly screening (cloacal and tracheal swab) for pathogens with all but M. meleagridis eradicated in generation one. Second generation eggs were again dipped and injected with a sensitive antibiotic but in this generation poults were placed into small brooding groups of between 250 and 300 birds. Converted tractor-trailers proved suitable brooding areas with each having positive ventilation and individual bio-secure entry points. Brooding groups returning positive cultures were removed leaving other brooding groups uncontaminated. Generation 3 remained negative for both pathogens. M. meleagridis appears less susceptible to egg treatment than other pathogens with the key to eradication, the identification of an effective antibiotic, biosecurity and the use of small groups in the anticipation that the pathogen will remain viable in a select number of eggs.

Key Words: disease eradication, mycoplasma, turkeys


Bordetellosis is a highly infectious respiratory disease that causes millions of dollars in annual losses to the turkey industry. The disease is caused by the bacterium Bordetella avium, frequently in combination with other opportunistic pathogens. Commercially available vaccines are thought by some to have marginal efficacy, possibly due to vaccine delivery or strain specificity. B. avium isolated from a turkey farm

Key Words: turkeys, Bordetella avium, vaccine
persistent clinical bordetellosis in sequential flocks was used to develop an autogenous vaccine. Day-of-hatch poults were vaccinated subcutaneously with decreasing concentrations of this bacterin. Vaccinated turkeys had significantly higher antibody levels (sample to positive ratios, S/P ratio) compared to controls. Since B. avium tends to persist on infected premises, poults raised in a typical turkey farm would probably be continuously exposed to B. avium. Potentially, continuously exposed vaccinated poults would experience an anamnestic response. To test this hypothesis, we vaccinated poults delivered to a farm with a history consistent with a diagnosis of bordetellosis (60–80%) in sequential flocks. Poults were subcutaneously vaccinated on day-of-hatch with B. avium bacterin inactivated with formaldehyde and aluminum hydroxide was added as an adjuvant. This vaccinated flock had an antibody response twice the level found in a facility that had no history of outbreaks of bordetellosis. Continual exposure to B. avium on this premise may have stimulated an anamnestic response to the Bordetella. Not only did the vaccinated birds have an elevated immune response, the turkeys did not break with bordetellosis. Although not evaluated in the present study, day-of-hatch bacterin administration may have reduced shedding of B. avium, thereby reducing challenge, while accelerating the acquired secondary immune response. Ongoing studies will evaluate the potential for day-of-hatch autogenous B. avium bacterin administration for reducing the incidence and severity of bordetellosis in commercial turkey flocks.

Key Words: turkey, vaccine, Bordetella avium

182 Leg defects and gait patterns on turkey bone biomechanical properties. E. O. Oviedo-Rondón1, P. L. Mente2, B. D. X. Lascelles3, J. Grimes1, P. Ferket1, and A. Mitchell1, 1Department of Poultry Science, CALS, North Carolina State University, Raleigh, 2Biomedical Program, COE, North Carolina State University, Raleigh, 3Department of Clinical Sciences, CVM, North Carolina State University, Raleigh, 4USDA-ARS, BARC, Beltsville, MD.

Bone fractures have become more frequent in fast growing turkeys. It has been difficult to determine the origin of these spontaneous fractures. Bone strength has been related to bone mineral density (BMD) and forces applied to bone during daily physical activity. The objective of this experiment was to evaluate the effects of common leg defects and gait patterns on bone biomechanical properties. Sixty male-Nicholas turkeys were selected from a large flock raised in floor pens. Turkeys were clustered into 4 categories: normal (N) valgus (V), crooked toes (C) and shaky legs (S) according to visual evaluations performed between 9 and 12 wk of age. Turkeys were trained to walk on a force plate walkway. Data of gait analyses were collected at 13, 16, and 20 wk of age. Data from the pressure sensitive mat was analyzed to obtain the peak vertical force, vertical impulse, peak contact area, foot contact time, and stride length. At 20 wk of age, all turkeys were euthanized, legs collected and frozen for analyses. Weights and morphologic measurements of femur, tibia and shanks were recorded. The BMD and bone mineral content (BMC) were obtained with Dexe. Tibia strength was evaluated by 4-point bending test. There were no significant differences for morphological measurements or bone strength of tibias among the 4 groups evaluated. The BMD and BMC of both tibias from C turkeys were lower (P < 0.07) than in the other groups. The tarso-metatarsus BMC in C and S turkeys was lower (P < 0.05) than in the N and V groups. There were no differences (P > 0.05) on femora BMD and BMC among groups. The BMD of proximal tibia epiphyses varied between medial and lateral sections. No significant differences were observed in femur lengths, diameters and the diaphyseal curvature. However, the relative asymmetry of femur length was lower (P < 0.05) in N and V turkeys than in C and S turkeys. Differences observed in gait parameters and effects on bone biomechanics will be discussed. In summary, leg defects such C and S that occur during early development affect the BMD of turkey bones at 20 wk of age and this may affect fracture incidence.

Key Words: leg problems, bone strength, gait