22  Influence of zinc oxide nanoparticles on growth performance, carcass quality and growth index of immune organs of broiler chickens. Y. Ebrahimnezhad, J. Gheiasi1, N. Maheri Sis, M. Mohammadi Khâh, and F. Ahmadi*, Islamic Azad University, Shabestar, Iran.

This research was carried out to investigate the effects of zinc oxide nanoparticles (nano-ZnO) on growth performance, carcass quality and growth index of immune organs of broilers. A total of 300 one-day old male broilers (Ross 308) were randomly allotted to 5 treatments and 5 replicates in a completely randomized design. Experimental diets were: T1) control (basal diet without Nano-ZnO) and T2, T3, T4 and T5 basal diet supplemented with 30, 60, 90, and 120 ppm nano-ZnO per kg, respectively. Birds had ad libitum access to feed and water throughout study (1–42 d). At 21 and 42 d, live body weight, feed intake and feed conversion ratio were evaluated. At 42 d of age, 5 birds (one bird per replicate) were selected based on proximity to mean treatment weight and then slaughtered. Visceral and immune organs were removed and relative weight calculated. Edible parts of carcass such as breast and thigh were removed and evaluation was performed at 42 d of study period. Results indicated that nano-ZnO had significantly affected on the live body weight and feed conversion ratio compared with control group (P < 0.05). Weights of edible parts of carcass were statistically (P < 0.05) improved by increasing organic Zn levels in the diet. Highest weights observed in birds fed diets contain 90 ppm nano-ZnO per kg. Growth index of bursa and thymus had significantly increased in birds fed 90 ppm nano-ZnO per kg (P < 0.05) in comparison with control and other treatments. In conclusion, these data indicated that in comparison to the control group 60 and 90 ppm nano-ZO/kg fed birds were resulted in significantly increased performance traits, breast and thigh weight, as well as increased growth index of bursa of Fabricius and thymus.

Key Words: broiler, carcass yield, zinc oxide nanoparticle, immune organ

23  Impact of aflatoxin B1 on broiler chicks and efficiency of an aluminosilicate binder to ameliorate adverse effects. X. Chen*, N. Horn, and T. J. Applegate1, Purdue University, West Lafayette, IN, 2JBS United, Sheridan, IN.

A 3-wk study was conducted to evaluate the effects of graded levels of purified aflatoxin B1 (AFB1) source and an aluminosilicate binder, Engage-M, on the performance, serum biochemistry, and hepatic functions in broiler chicks. A total of 384 male broiler chicks were randomly allocated to 8 treatments, with 8 cages/treatment (6 birds/cage). Dietary treatments were arranged as 4 × 2 factorial with 4 concentrations of AFB1 (0, 0.5, 1, and 2 mg/kg) and 2 concentrations of Engage-M (0 and 0.5 g/kg). There was no significant interaction between AFB1 and Engage-M for growth performance. With regards to main effects, diets containing 2 mg/kg AFB1 reduced chick BW by 15.4% and 23.6% at 14 and 21 d of age, respectively (P < 0.001). Engage-M improved d 14 to 21 BW gain (P < 0.001), and showed a trend to improve d 0 to 21 BW gain (P = 0.061). Relative liver weight was increased by 2mg/kg AFB1 (P < 0.001), which was reduced by Engage-M (P = 0.019); and there was a significant interaction between Engage-M and AFB1 (P = 0.031). No significant interactions between AFB1 and Engage-M were found for serum biochemistry and liver anti-oxidant status parameters except for serum albumin and serum P (P < 0.05). With regards to main effects, supplementation of 1 and 2 mg/kg AFB1 to broiler chicks negatively affected major serum measures including albumin, total protein, globulin, glucose, P, alkaline phosphatase, and creatine phosphokinase (CPK); Engage-M ameliorated the AFB1-induced increase of CPK concentrations (P = 0.039). The activity of liver superoxide dismutase activity was decreased by AFB1 at 2 mg/kg, which was ameliorated by supplementation of Engage-M (P = 0.046). Results from this study indicate that AFB1 contamination at 2 mg/kg negatively affects the growth performance, serum biochemistry, and hepatic functions of growing broilers, and supplementation of Engage-M partially ameliorated in the impact of aflatoxicosis.

Key Words: aflatoxin B1, broiler, performance, antioxidant, serum

24  The effect of calcium lignosulfonate, mixer-added fat, and feed form on true amino acid digestibility and digesta viscosity. A. M. Corey*,1 K. G. S. Wamsley2, T. S. Winowski3, and J. S. Moritz1,1West Virginia University, Morgantown, 2Mississippi State University, Mississippi State, 3LignoTech, Rothschild, WI.

Increased ingredient price may prompt poultry integrators to use pellet binders to improve pellet quality and enhance broiler performance. Calcium lignosulfonate (CalLS) has been shown to increase pellet durability and improve energy efficiency during manufacture of pellets. Additional related industrial uses of CalLS include decreasing viscosity of pourable concrete and stabilization of emulsions by preventing agglomeration. Previous studies have documented decreased feed passage rate and improved true amino acid digestibility (TAAD) with CalLS. The objectives of the current study were to evaluate the effect of CalLS, mixer added fat (MAF), and feed form on TAAD and digesta viscosity. Treatments were arranged in a 3 × 2 factorial randomized complete block design consisting of CalLS (0, 0.5, or 1%), MAF (1 or 3%), and feed form (pellet or ground pellet). Data for TAAD and digesta viscosity were determined using 4 replications of cecctomized roosters and 8 replications of 23 mixed-sex broilers, respectively. A 3-way interaction of main effects (P < 0.05) demonstrated that pelleted diets had a negative effect on digestibility of several tested amino acids in diets manufactured with 1% MAF + 0% CalLS and 3% MAF + 1% CalLS. An interaction between CalLS and MAF regarding digesta viscosity (P < 0.05) was demonstrated by the combination of 0.5% CalLS + 3% MAF increasing viscosity compared with other treatments. These data corroborate past benefits demonstrated with CalLS in pelleted diets; however, the ratio of CalLS and MAF may determine the extent of benefit. The authors speculate that fat emulsions are formed by mechanical sheer when feed is extruded during pelleting. A 0.5:3 ratio of CalLS to MAF may stabilize the emulsion, effectively increasing the number of oil droplets in feed, increasing digesta viscosity and optimizing TAAD. Levels of CalLS and MAF that exceeded this ratio may have fluidized the digesta and decreased viscosity to a degree detrimental to digestibility.

Key Words: calcium lignosulfonate, mixer-added fat, digesta viscosity, amino acid digestibility, broiler performance

25  Efficiency of supplementing nettle for the intensification of egg yolk yellowness. Y. Loetscher*, M. Kreuzer, and R. E. Messikomer, ETH Zürich, Switzerland.

Yolk color is an important quality trait of eggs. Plant-derived additives like tagetes petals are an interesting alternative to synthetic pigmentation,
especially in organic production. Unexpected coloring effects of nettle on broiler skin suggest that this plant could be a cost-efficient coloring agent as well. Natural additives often have effects on lipid oxidation. In this experiment, the effect of nettle addition to feed on yolk yellowness and oxidative stability was investigated in laying hens. A wheat-based, balanced diet was fed to forty 70-wk-old H&N Brown Nick layers. The exclusion of tocopherols and maize ensured low dietary antioxidant and pigment levels. All hens were fed the basal diet plus pigmentation (25ppm Carophyll Yellow and 15 ppm Carophyll Red) for 2 wk. In the 4-wk experimental period, the effect of 3 nettle (N) dosages (A: 6.25, B: 12.5, C: 25 g/kg) from 2 batches (1, 2) was compared with a negative control (CO, basal diet only) and a positive control (PO, pigmentation and 40 ppm α-tocopherylacetate). Egg quality traits and yolk color (L*ab* color space) were measured. Susceptibility to oxidation (TBARS) was evaluated in lyophilized yolk powder stored at 20°C in wk 0, 4, 8, and 12 of storage. ANOVA was conducted using SAS. Experimental feeding had no effect on the egg quality traits such as shell stability, egg weight, and Haugh units. Yolk yellowness (b*) was lowest (P > 0.05) with CO (18.3). All N treatments (ø 30.3) caused b* values equal to PO (29.4). Batch differences were only detected between N1B (24.6) and N2B (31.6). In wk 12, lipid oxidation (TBARS, mg MDA/kg) in egg yolk powder was highest (P > 0.05) for N1B (29.5) and lowest (P > 0.05) in PO (7.9) compared with CO (18.3) and intermediate values for all other groups (ø 17.2). Even the lowest dosage of nettle addition to layers feed was sufficient to intensify yolk yellowness equal to, or better than, synthetic pigmentation. No adverse effect on egg quality and lipid oxidation (except for N1B) was observed, either. Therefore, nettle is a suitable alternative for natural yellow pigmentation of the yolk.

Key Words: laying hen, egg yolk, natural pigment, nettle, TBARS


Aflatoxins (AF) are toxic metabolites produced by molds, including Aspergillus flavus and Aspergillus parasiticus. Contamination of poultry feeds with AF is a major concern for the poultry industry, due to serious economic losses stemming from reduced feed efficiency, egg production and hatchability. Additionally, owing to their carcinogenic and hepatotoxic effects, AF residues in meat poses a potential public health hazard. We investigated the inhibitory effect of 2 GRAS-status plant derived compounds, carvacrol (CR) and trans-cinnamaldehyde (TC), on A. flavus and A. parasiticus growth, and AF production in broth culture and chicken feed. In pure cultures, potato dextrose broth added with CR (0, 0.02, 0.04, and 0.08%) or TC (0, 0.05, 0.01, and 0.02%) was inoculated with A. flavus or A. parasiticus (~10^5 cfu/mL), and incubated at 25°C for 7 d. Samples were collected on d 0, 1, 3, 5, and 7 to determine mold counts and AF production. Similarly, 200 g samples of chicken feed supplemented with CR and TC (0, 0.4, 0.8, and 1.0%) and inoculated with A. flavus or A. parasiticus were incubated at 25°C for 7 d. The mold population and aflatoxin concentrations (total AF and N1B) were determined on d 0, 1, 5, and 7. All studies were replicated 3 times with duplicate samples. Carvacrol and TC substantially inhibited A. flavus and A. parasiticus growth and AF production in broth culture and chicken feed (P < 0.05). Carvacrol was found to be more effective in reducing AF production than TC (P < 0.05). The results suggest that CR and TC could potentially be used as feed additives to control aflatoxins in poultry feed.

Key Words: aflatoxin, carvacrol, trans-cinnamaldehyde, poultry feed, feed additive

27 Evaluation of yeast cell wall products on full-term broiler performance in birds subjected to ingredient-based dietary stress. J. Fowler*,1, M. Hashim1, A. U. Haq1, J. R. Corley2, and C. A. Bailey3, 1Texas A&M University, College Station, 2LeSaffre Feed Additives, Milwaukee, WI.

Microflora within the ceca of birds can vary significantly based on changes in the ingredient composition of the diet and can influence overall broiler performance. This experiment evaluates whether an ingredient-induced dietary stress can be ameliorated by including a yeast cell wall extract (YCW) prebiotic at 250 ppm. A total of 960 straight-run Cobb-500 broiler chicks were randomly distributed among 64 6' × 6 floor pens (15 birds per pen). Eight dietary treatments were assigned to 8 pen replicates such that each treatment had equal representation across the rearing facility. All birds underwent a 42-d, 3-phase rearing program over a 3-wk starter, 2-wk grower, and 1-wk withdrawal period. Treatments were assigned as a 2 × 4 factorial arrangement, with major, ingredient-based dietary changes made on a weekly basis compared with a more traditional corn-soy feeding program, both with and without 1 of 3 YCW prebiotics and a negative control. Nutrient composition was calculated to be the same across all treatments within each phase. Weekly body weight and feed consumption were collected, mortality was monitored daily, and a productivity index was calculated. Data were analyzed as a 2 × 4 full factorial with the 2 diet types and 1 of 3 YCW products or negative control, and means of the main effects of YCW type were separated using Duncan’s Multiple Range Tests. Main effects of dietary stress had significant (P ≤ 0.05) negative effects on broiler performance throughout the study. There were consistent ameliorative effects of the YCW treatments across both the control and the dietary-stress groups. Effectiveness of YCW on ameliorating dietary stress appeared most effective during the starter and grower phases, but appeared less significant during the sixth week.

Key Words: broiler, prebiotic, yeast cell wall

28 Influence of yeast cell wall on hind gut microflora and early production laying hen performance. M. Hashim*, 1, J. R. Corley2, J. Fowler1, A. Haq1, M. Hume1, J. Koenig1, and C. Bailey1, 1Texas A&M University System, College Station, 2LeSaffre Feed Additive, Milwaukee, WI, 3USDA-ARS, College Station, TX, 4Research and Testing Laboratories, Lubbock, TX.

To evaluate the effects of 2 levels of yeast cell wall (YCW) on lower intestine microflora and performance of phase-one laying hens, a total of 75 Lohmann W-36 replacement pullets (17 wk old) were distributed among 75 cages. Diets were prepared following the management guide for those birds and a single basal diet was divided into the 3 treatments. Treatments were control basal diet, basal diet supplemented with 250 ppm of YCW (YCW 250), and basal diet supplemented with 500 ppm of YCW (YCW 500). Individual birds per cage served as the experimental unit for this study. Feed and water were offered ad libitum. Data were collected when birds were 21 wk old and hen day egg production was >90%. At the end of the study cecal contents were collected from 18 birds (6 birds per treatment at 36 wk old). Denaturing gradient gel electrophoresis and pyrosequencing techniques were used to determine the gross and individual changes in the lower gut microflora. Egg weight was higher in YCW 250 at age 21–28 wk and higher than YCW 500 at age 29–32 wk with P-value ≤0.05. The DGGE dendrogram indicated that microflora populations of YCW 250 and control were different at 83.9% similarity coefficient (SC) and both treatments were different from YCW 500 at 80.0% SC. Pyrosequencing showed the level of Lactobacillus genus was 36.9, 29.6, and 14.4% of the bacterial community in YCW 250, 500, and control, respectively. Overall, feeding a
diet supplemented with YCW improved egg weight and YCW modified the population of microflora in the cecum.

Key Words: prebiotic, layer, microflora, DGGE, pyrosequencing


Yeast products are rich sources of mannan, β1,3- and β1,6-glucans, and nucleotides, which could function as prebiotics. Moreover, DDGS as co-products of brewer’s yeast fermentation contain a significant quantity of yeast biomass (i.e., 6%). The objective of this study was to investigate the effects of different yeast cell wall lytic enzymes on mannan and β1,3-glucans depolymerization so they become water-soluble and thus more bioactive. Different yeast products were incubated with single enzymes or enzyme combinations to determine the degree of cell wall polysaccharides degradation. None of the enzymes evaluated showed any activity toward yeast mannans. However, a significant difference in β1,3-glucans degradation of Yeast cell wall (from 303.8 to 61.2 mg/g), brewer’s yeast (from 178.4 to 60.7 mg/g), Torula yeast (from 100 to 13.2 mg/g), and DDGS (from 9.6 to 3 mg/g) was observed using β1,3-glucan laminaripentahydrolase. Based on the solubility in 80% EtOH and water, yeast β1,3-glucans were converted to simple glucose, glucooligosaccharides and low-molecular weight glucans while mannans stayed relatively intact, yet dissociated from the β-glucan structure and thus water-soluble. Based on this evaluation, different enzyme-pretreated yeast products, including a mixture of brewer’s and Torula yeasts, a commercial product Maxi-Gen Plus, and DDGS were produced and fed to broiler chickens from 4 to 20 d of age. No significant differences (P > 0.05) in BWG were observed. Regardless of the enzyme treatment, the decrease (P < 0.05) in FCR was observed for diets containing brewer’s and Torula yeasts (1.39 vs. 1.31), and Maxi-Gen Plus (1.39 vs. 1.32). A slight decrease (P = 0.068) in SCFA production (from 164.3 to 144.3 μMol/g) in the ceca of birds consuming diets containing enzyme-pretreated yeast products was noted, suggesting some shift in microbial population of the lower gut. Bacteria enumeration is currently underway to determine any potential changes resulting from feeding the enzyme-treated yeast products.

Key Words: yeast product, enzyme, broiler, SCFA

30 Effects of exogenous enzymes and direct-fed microbials on performance, energy utilization, and body composition of broiler chicks. G. R. Murugesan* and M. E. Persia, Iowa State University, Ames.

An experiment was conducted to examine the effects of exogenous enzymes (EE) and direct-fed microbials (DFM) on performance, energy utilization, and body composition in broiler chickens. Ross 308 chicks were fed one of 4 experimental diets (control (CON), CON + EE, CON + DFM and CON + EE + DFM) from hatch until d 21. Each group was comprised of 8 cages with 7 chicks per cage. One chick per cage was randomly euthanized for dual-energy x-ray absorptiometry analysis on d 7, 14 and 21. On d 21, blood, and liver samples as well as cecal contents were collected from one randomly selected chick per cage. Feed intake (P < 0.05) was reduced for chicks fed EE during d 1–7. Feed conversion ratio (FCR) was lowered by EE and or DFM during d 1–21 (P ≤ 0.01), while EE reduced FCR during d 1–14. Although either EE or DFM lowered FCR during d 1–21, the effect of the combination was higher (P = 0.04) than other groups. Cecal molar proportions of propionate and butyrate as well as total short-chain fatty acids were increased (P ≤ 0.01) with DFM addition. Serum nonesterified fatty acids were decreased (P ≤ 0.01) in treatment chicks compared with CON chicks, while triglyceride and cholesterol levels were lowered (P ≤ 0.01) by DFM. Liver glucose-6-phosphate dehydrogenase (G6PDH) activity was increased (P ≤ 0.01) with DFM supplementation while there were no significant differences in the activities of glyceraldehyde-3-phosphate dehydrogenase or fatty acid synthase. Liver glycogen concentration was increased (P ≤ 0.01) with both EE and DFM addition. Chick lean mass was increased (P = 0.01), while fat mass was reduced (P ≤ 0.01) by DFM on d 7, but not over the remaining period of the experiment. Elevated liver glycogen and G6PDH activity for DFM supplemented chicks indicate increased glucose-sparring which may be associated with the effect of butyrate. The combination of EE and DFM appear to result in an additive response for feed conversion from d 1–21 suggesting independent mechanisms involved in increasing energy utilization.

Key Words: dual-energy x-ray absorptiometry, short-chain fatty acid, serum cholesterol, glucose-6-phosphate dehydrogenase, glycogen

31 Administration of phytate-degrading Lactobacillus improves growth of broiler chicks. T. E. Askelson*, J. T. Lee, A. Campasino, and T. Duong, Texas A&M University, College Station.

Probiotics have been demonstrated to promote growth, stimulate immune responses, and improve the microbial food safety of poultry. While widely used, their effectiveness is mixed and the mechanisms through which they contribute to poultry production are not well understood. Phytases isolated from microorganisms are increasingly supplemented in feed to improve digestibility and reduce anti-nutritive effects of phytate. The microbial origin of these enzymes suggests a potentially important mechanism of probiotic functionality. Our objective was to investigate phytate degradation as a novel probiotic mechanism using recombinant Lactobacillus cultures expressing Bacillus subtilis phytase. B. subtilis phy was codon optimized for expression in Lactobacillus and cloned into the expression vector, pTRK882. The resulting plasmid, pTD003, was transformed into Lactobacillus acidophilus, Lactobacillus gallinarum, and Lactobacillus gasseri. SDS-PAGE revealed an approximately 44 kDa protein in the culture supernatants of Lactobacillus pTD003 transformants corresponding to the predicted molecular weight of B. subtilis phytase. The phytate degrading ability of these cultures was evaluated by determining the amount of inorganic phosphate released from sodium phytate. Expression of B. subtilis phytase increased phytate degradation of L. acidophilus, L. gasseri, and L. gallinarum 4-, 10-, and 18-fold over the background activity of empty vector transformants. The effect of administration of recombinant phytase-expressing L. gallinarum and L. gasseri was evaluated in broiler chicks fed a phosphorous deficient diet (0.25% aP). Phytase-expressing L. gasseri improved weight gain (P < 0.05) of broiler chickens to a level comparable to chickens fed a phosphorous adequate control diet (0.40% aP) demonstrating proof-of-principle that administration of phytate-degrading probiotic cultures can improve performance of livestock animals. Additionally, this will inform future studies investigating whether probiotic cultures are able to combine the performance benefits of feed enzymes with the animal health and food safety benefits traditionally associated with probiotics.

Key Words: Lactobacillus, probiotic, phytate, phytase

32 A commercial study comparing the effects of antibiotic and direct-fed microbial supplementation on gut lactic acid bacteria populations in turkeys. A. J. Madisen*, J. C. Remus², S. Dunham¹, E. Davis¹, and D. Periti¹, ¹Animal and Environmental Applications,
Lactic acid producing bacteria (LAB) such as *Lactobacillus* and *Enterococcus* can be beneficial for poultry. With the use of a specific 3-strain *Bacillus subtilis* based direct-fed microbial (DFM), the microbial ecosystem can be shifted toward these beneficial bacteria, especially those of the *Lactobacillus* genera, a commensal bacterial group with numerous beneficial species and no known pathogenic representative. A study was conducted with a commercial integrator to evaluate the differences in the gastrointestinal microbiota of commercially raised turkeys administered different feed additives. In a 2 × 2 arrangement of treatments, factor dietary treatments using a basal diet with either 0.05% *Bacillus subtilis*-based DFM or 0.002% virginiamycin (antibiotic growth promoter; AGP) were fed and compared over factor time during the starter and finisher/withdrawal (F/WD) phases. The basal diet included bacitracin methylene disalicylate at 0.005% during the starter phase. For the 2 feed phases, small intestine mucosa was collected from birds in both production phases, including 18 samples each between 2 and 6 wk of age (starter phase) and 11 and 15 wk of age (F/WD phase). Total LAB counts in the intestinal mucosae of birds did not differ (P > 0.40) between production phases or dietary additives. The proportion of *Lactobacillus* relative to the total LAB population was greater (P < 0.05) when birds were fed diets with DFM compared with birds fed diets containing AGP during the starter phase; however no differences were seen between dietary treatments during the F/WD phase (diet × phase interaction, P < 0.05). Inversely, the proportion of *Enterococcus* relative to the total LAB population was lower (P < 0.05) in birds fed the DFM compared with AGP in the starter phase, but no difference was observed during the F/WD phase (diet × phase interaction, P > 0.05). Results from this study indicate that the inclusion of the DFM shifted the gastrointestinal LAB population toward enhanced *Lactobacillus* populations and fewer *Enterococcus* during the starter phase of production.

**Key Words:** virginiamycin, *Bacillus* probiotic, *Lactobacillus*, turkey

### 33 Effects of exogenous enzymes and direct-fed microbials supplementation on first-cycle laying hen performance, energy digestibility, gut integrity and pathogen colonization.

G. R. Murugesan¹, I. V. Wesley², J. Remus³, P. W. Plumstead³, and M. E. Persia*¹, ¹Iowa State University, Ames, ²USDA-National Animal Disease Center, Ames, IA, ³DuPont Industrial Biosciences-Danisco Animal Nutrition, Marlborough, United Kingdom.

Corn-soybean meal (SBM)-dried distillers grains with solubles (DDGS) based diets were used to generate experimental diets including an industry type control (CON), the same diet with reduced energy (RE), RE + exogenous xylanase, amylase, and protease enzymes (XAP), and RE + XAP + a combination of spores from 3 *Bacillus* spp. direct-fed microbial strains (XAP+DFM) that were fed to Hy-Line W36 laying hens from 25 to 40 wk of age. The RE diet was formulated to contain an average of 116 kcal/kg. At the end of the experimental period, ileal *P* was fed to 8 replicate groups of 9 hens in a completely randomized design. Supplementation of XAP+DFM increased AMEn compared with the control. However, QST 713 (10¹⁰ cfu/g) plus Bacitracin (50 ppm), increased body weight gain (P < 0.05) compared with birds fed QST 713 alone. QST 713 improved FCR (P < 0.05) compared with the control, but was not significant (P > 0.05) compared with birds fed QST 713 plus Bacitracin or Tylosin. Overall, this study indicated that QST 713 alone or in combination with therapeutic levels of Bacitracin or Tylosin can help optimize the growth performance and FCR of broiler chickens infected with NE. QST 713 can therefore be used in conjunction with conventional antibiotics to help mitigate the adverse effects of NE in the production performance of broiler chickens.

**Key Words:** *Bacillus subtilis* (QST 713), bacitracin, tylosin, necrotic enteritis, broiler

### 34 The efficacy of *Bacillus subtilis* (QST 713) in broiler chickens when used in combination with bacitracin or tylosin for treatment of necrotic enteritis.


Oral antibiotic therapy can lower the number and growth of beneficial microbes in the digestive tract. When administered to animals, a certain proportion of beneficial microbes becomes disrupted leading to vulnerability of the gut to colonization of pathogenic microorganisms. The addition of probiotics in the diet can help assist in the replenishment of beneficial microbes and help bring the intestinal microflora to a balanced state. A study in broiler chickens was conducted to look at the efficacy of *Bacillus subtilis* (QST 713) when used in combination with Bacitracin or Tylosin for treatment of necrotic enteritis (NE). A total of 396 day-old male broiler chicks were randomly assigned to receive 1 of 6 treatments: 1) basal diet (control), 2) basal + Bacitracin (50 ppm), 3) basal + QST 713 (10⁶ cfu/g), 4) basal + Bacitracin (25 ppm) + QST 713 (5×10⁵ cfu/g), 5) basal + Bacitracin (50 ppm) + QST 713 (10⁶ cfu/g), 6) basal + Tylosin (200 ppm) + QST 713 (10⁶ cfu/g). A RCBD was used with 6 treatments in each of 11 blocks of pens with each pen consisting of 6 birds. Data were subjected to ANOVA using the PROC Mixed procedure of SAS. Feeding QST 713 alone or in combination with Bacitracin or Tylosin, increased (P < 0.05) body weight gain compared with the control. However, QST 713 (10¹⁰ cfu/g) plus Bacitracin (50 ppm), increased body weight gain (P < 0.05) compared with birds fed QST 713 alone. QST 713 improved FCR (P < 0.05) compared with the control, but was not significant (P > 0.05) compared with birds fed QST 713 plus Bacitracin or Tylosin. Oral antibiotic therapy can lower the number and growth of beneficial microbes in the digestive tract. When administered to animals, a certain proportion of beneficial microbes becomes disrupted leading to vulnerability of the gut to colonization of pathogenic microorganisms. The addition of probiotics in the diet can help assist in the replenishment of beneficial microbes and help bring the intestinal microflora to a balanced state. A study in broiler chickens was conducted to look at the efficacy of *Bacillus subtilis* (QST 713) when used in combination with Bacitracin or Tylosin for treatment of necrotic enteritis (NE). A total of 396 day-old male broiler chicks were randomly assigned to receive 1 of 6 treatments: 1) basal diet (control), 2) basal + Bacitracin (50 ppm), 3) basal + QST 713 (10⁶ cfu/g), 4) basal + Bacitracin (25 ppm) + QST 713 (5×10⁵ cfu/g), 5) basal + Bacitracin (50 ppm) + QST 713 (10⁶ cfu/g), 6) basal + Tylosin (200 ppm) + QST 713 (10⁶ cfu/g). A RCBD was used with 6 treatments in each of 11 blocks of pens with each pen consisting of 6 birds. Data were subjected to ANOVA using the PROC Mixed procedure of SAS. Feeding QST 713 alone or in combination with Bacitracin or Tylosin, increased (P < 0.05) body weight gain compared with the control. However, QST 713 (10¹⁰ cfu/g) plus Bacitracin (50 ppm), increased body weight gain (P < 0.05) compared with birds fed QST 713 alone. QST 713 improved FCR (P < 0.05) compared with the control, but was not significant (P > 0.05) compared with birds fed QST 713 plus Bacitracin or Tylosin. Overall, this study indicated that QST 713 alone or in combination with therapeutic levels of Bacitracin or Tylosin can help optimize the growth performance and FCR of broiler chickens infected with NE. QST 713 can therefore be used in conjunction with conventional antibiotics to help mitigate the adverse effects of NE in the production performance of broiler chickens.

**Key Words:** *Bacillus subtilis* (QST 713), bacitracin, tylosin, necrotic enteritis, broiler
salinomycin as feed additives on performance and coccidiosis control in male broilers raised to 42 d of age. The study consisted of 360 Cobb male broiler chickens randomly allocated to 4 groups each with 3 replicates. Group 1; untreated, unchallenged “control negative,” group 2; untreated, challenged “control positive,” group 3; salinomycin 66 PPM, challenged and group 4; probiotics, challenged. On d 15, all birds (except group 1) were challenged with *Eimeria acervulina, maxima,* and *tenella* that were mixed into the feed. FCR and mortality were recorded throughout the experiment. On d 21 and 42, coccidiosis lesions and litter conditions were scored. On days, 7, 14, 21, 28, 35, and 42, 10 fresh fecal samples were collected, pooled and oocyst counts per gram of fecal material were determined. The results showed that mortality, litter and lesion scores at d 21 and 42, and oocysts shedding at d 21 did not differ significantly ($P > 0.05$) between the probiotics and the salinomycin groups. However on d 28, oocyst shedding was significantly lower ($P < 0.05$) in the salinomycin group than the control positive but insignificantly lower than the probiotics group. Body weights of the probiotics group at d 42 were significantly lower ($P < 0.05$) than the salinomycin group; however, the FCR values were not significantly different between the 2 groups ($P > 0.05$). The results of this study showed that probiotics supplementation can be considered as a potential strategy to control coccidiosis in broiler chickens.

**Key Words:** probiotic, salinomycin, coccidiosis, broiler, performance