
Canthaxanthin (Cxn) is a fat-soluble red carotenoid pigment and is reported to be immunomodulatory. Broiler breeder hens were fed 0 ppm (Control), 6 ppm or 12 ppm Cxn to determine the effect of maternal dietary Cxn on chicks hatched from hens at 31 (Early), 45 (Mid) and 57 (Late) wk of age. Whole blood was obtained at 1 and 4 d of age to assess the number of cells capable of engulfing at least one Escherichia coli (% phagocytosis), average number of E. coli/cell (phagocytic capacity), and E. coli bactericidal capacity ex vivo. Egg and chick liver Cxn were determined. Eggs from 12 ppm hens had 40% more Cxn than eggs from 6 ppm hens, which in turn had 30% more Cxn than eggs from Control hens (P < 0.0001). Liver Cxn of 12 ppm chicks was 126% greater (P < 0.0001) than 6 ppm chicks; 6 ppm chicks had 67% more Cxn than Control chicks. Chick liver Cxn content decreased by 37% in 6 ppm chicks and 22% in 12 ppm chicks (P < 0.01) from Early to Mid with no subsequent changes; there was no age effect in Control chicks. There was a 22% reduction (P < 0.03) in phagocytic capacity at 1 d in 6 ppm chicks relative to Control and 12 ppm chicks. At 4 d of age, 12 ppm chicks had 20% lower (P < 0.03) E. coli bactericidal capacity than 0 or 6 ppm chicks. E. coli bactericidal capacity increased from 1 to 4 d in Control and 6 ppm chicks, but not in 12 ppm chicks (P < 0.02). Chicks from 6 ppm hens had the greatest E. coli bactericidal capacity among chicks hatched from Mid hens, even though they had the lowest E. coli bactericidal capacity among chicks from Early hens. Among Late hens, Control chicks had the greatest E. coli bactericidal capacity, while 12 ppm chicks had the lowest E. coli bactericidal capacity. Greater levels of dietary Cxn increased egg and chick liver Cxn, although liver Cxn content decreased as hens aged. Feeding hens 6 ppm Cxn appeared to increase early chick E. coli bactericidal capacity in d-old chicks, in spite of decreased phagocyte capacity, indicating an overall increase in innate immune function. However, this effect was dependent on hen age.

Key Words: canthaxanthin, broiler breeder, innate immunity, phagocytosis, egg

Effects of feeding functional oils on performance and jejunum morphology in turkey poults. R. D. Malheiros*1, P. R. Ferket1, J. L. Grimes1, V. M. B. Moraes2, I. B. Barasch1, and J. Torrent2, 1North Carolina State University, Raleigh, 2Sao Paulo State University, Jaba- ticabal, Brazil. 3Oligo Basics, Wilmington, DE.

Functional oils from botanicals have been shown to have antimicrobial, anti-inflammatory or antioxidant activities, and may be used as alternatives to prophylactic or therapeutic pharmaceuticals to control gut health in animals. The feed additive Essential (Oligo Basics USA, Wilmington, DE), a blend of functional oils from cashews and castor bean, was evaluated as an alternative to monensin on the early performance and gut morphology of turkey poults. Male poults were randomly assigned to 3 treatments with 15 pens/treatment and 13 poults/pen. The 3 treatments consisted of a non-medicated control (Ct), dietary inclusion of 0.15% Essential (Es), and 66 ppm Monensin (Mn).

Day-old poults were placed in a floor pens with soft-pine shavings contaminated with used litter from a previous flock to provide a natural microbial challenge. Feed and water were provided for ad libitum consumption. Body weights (BW) and feed intake (FI) were determined at 14, 28, and 42 d and feed/gain (FCR) was calculated. At 4, 11, and 21 d, 6 poults/treatment were sampled for jejunum histomorphometric analysis. Significant treatment effects were observed throughout the experiment. In comparison to Ct, Es and Mn significantly increased BW at 14d (353 vs. 381 and 373 g, P < 0.01), 28 d, and 42 d 2.127 vs. 2.226 and 2.317, P < 0.01), respectively. FCR from 1 to 42 d was 1.62, 1.68, and 1.50 for Ct, ES, and Mn, respectively (P < 0.001). In comparison to Ct at 21 d, jejunum villi height and crypt depth was greater among Es poults, whereas villi surface area was greater among Mn poults. Es yields similar positive growth performance and mucosal development of starting turkey poults as Mn, indicating that it could be a potential non-pharmaceutical alternative to an ionophore like monensin.

Key Words: cashew functional oil, monensin, growth performance, gut morphology, turkeys

Feeding plant extract to chickens reared on previously used litter: Effects on growth performance, metabolizable energy and nutrient digestibility. V. Pirgozliev*1 and D. Bravo2, 1SAC, Ayr, Scotland, UK, 2Pancosma S.A., Geneva, Switzerland.

A study was conducted to investigate the response of 21-d old male Ross 308 broiler chicks to dietary supplementation of a mixture of carvacrol, cinnamaldehyde and capsaicin (XT, Pancosma S.A.) using growth performance, apparent metabolizable energy corrected for N retention (AMEn) and the coefficients of dietary dry matter (DMD), nitrogen (ND) and fat digestibility (FD) as response criteria. There were 4 treatments (including 2 wheat- (WC) or corn-based (MC) control diets formulated to be adequate in protein (215 g/kg diet) but marginal in AME (2890 kcal/kg) and slightly high in non-starch polysaccharides than the breeder’s recommendation and the control diets supplemented with XT (100 g/tonne). The diets were provided in mash form ad libitum throughout the experiment. The treatments were allocated in a randomized complete block design with each treatment having 10 replicate floor pens with 10 birds per pen. The pens were bedded with used litter. Birds on maize-based diets had higher (P < 0.05) AMEn, feed intake (P < 0.001) and feed conversion ratio (P < 0.05). Irrespective of cereal type, XT supplementation improved (P < 0.05) daily feed intake and weight gain (P < 0.001) and reduced (P < 0.05) feed conversion ratio. There was also improvement in (P < 0.05) in dietary AMEn and FD in response to XT supplementation whereas the supplement tended (P < 0.10) to increase DMD. The lack (P > 0.05) of cereal source by XT interaction suggests that similar responses may be expected when XT is added to maize or wheat based diets. It is concluded that supplementing CP-adequate, marginally low-ME corn-or wheat-based diet with XT to chicks reared on previously used litter improves the nutritive value of the diets.

Key Words: plant extract, AME, digestibility, broilers

The effects of whole or large particle grains, Grobipotic-P, and lactose on Eimeria acervulina infection, growth performance, nutrient digestibility, and microbial populations in young chicks. C. M. Jacobs*1, E. Jimenez-Moreno2, M. C. Jenkins3, P. L. Utterback1, and C. M. Parsons1, 1University of Illinois, Urbana, 2Universidad Politecnica de Madrid, Spain, 3USDA, Beltsville, MD.

An experiment was conducted to evaluate the effects of fine and large particle corn, whole sorghum, and whole wheat in the presence and
absence of an acute *Eimeria acervulina* (EA) infection in chicks fed a corn–soybean meal diet. A second experiment was also conducted using Grobiotic (GB), Dairylac–80 (International Ingredient Corporation, St. Louis, MO), and lactose in the presence of an EA infection. Male commercial Ross 308 broiler chicks were orally gavaged with 1 × 10⁸ sporulated oocysts at 8 d of age and growth performance was measured from 8 to 22 d of age. Metabolizable energy (MEₘ), amino acid (AA) digestibility, and cecal microbial populations were also measured at 22 d of age. The EA infection significantly reduced chick growth performance, MEₘ, and AA digestibility (P ≤ 0.05). However, the addition of large ground corn, whole sorghum or wheat, GB, Dairylac–80, or lactose to the diet had no consistent effects on growth performance and did not ameliorate the negative effects of the coccidiosis infection. Chicks fed diets containing large ground corn, whole sorghum, or whole wheat had significantly increased (P ≤ 0.05) relative gizzard weights when compared with chicks fed the fine ground corn. The addition of GB resulted in a significant increase (P ≤ 0.01) in cecal lactobacilli populations, while the addition of the whole wheat, whole sorghum, and large ground corn and the presence of the EA infection all decreased (P ≤ 0.05) *E. coli* populations. The results of this study indicated that feeding large ground corn, whole sorghum, or whole wheat in the presence or absence of a coccidiosis infection significantly increased relative gizzard weights and decreased *E. coli* populations, but none of the dietary feed additives had a consistent effect on overall growth performance or responses to the EA infection.

**Key Words:** whole grains, coccidiosis, lactose, chick, growth

43 Water plantain (*Alisma canaliculatum*) probiotics as an alternative feed additive for broiler. M. E. Hossain¹, S. Y. Ko¹, G. M. Kim¹, J. D. Firman², and C. J. Yang¹, ¹Department of Animal Science and Technology, Sunchon National University, Suncheon, Jeonnam, Korea, ²Department of Animal Sciences, University of Missouri, Columbia.

The present study was conducted to select proper probiotic strains for making water plantain (*Alisma canaliculatum*) probiotics and examine their effect on broiler performances. Sixteen strains of *L. acidophilus*, *L. plantarum*, *E. faecium*, *B. subtilis*, *B. coagulans* and *S. cerevisiae* from Korean Collection for Type Cultures (KCTC) were used in this experiment. The strains were first tested for acid and bile tolerance, then the higher tolerance strains were selected for heat tolerance. Among the tested strains, *L. acidophilus* KCTC 3111, *E. faecium* KCTC 2022, *B. subtilis* KCTC 3239 and *S. cerevisiae* KCTC 7928 which had higher tolerance in acid, bile and heat were selected for making fermented *A. canaliculatum* probiotics. Associative inoculation of *A. canaliculatum* probiotics with *E. coli* S93 F5 and S99 LT showed that the numbers of *E. coli* were gradually decreased after 6 h of inoculation. In the in vivo trial, one hundred 40 Ross broiler chicks had been arranged for a period of 5 weeks to 4 dietary groups: NC (basal diet), PC (basal diet+0.005% oxytetraacycline), AC (basal diet+0.5% *A. canaliculatum* powder) and ACP (basal diet+0.5% *A. canaliculatum* probiotics). The results indicated that growth performances were not affected by the addition of AC or ACP into feed. Higher crude protein and lower crude fat content of breast meat were found in the ACP group whereas; additive groups showed lower crude protein content in thigh meat. Thio-barbiteric acid value of breast meat in d 3 and thigh meat in d 5 were higher in the ACP group, but after 1 week of preservation no changes were observed. Among the fatty acid composition of breast and thigh meat, PUFA and n3 fatty acid were increased resulting in lower n6/ n3 ratio in the ACP group. Proventriculus and kidney weight were decreased, and cecal *E. coli* numbers were reduced in the ACP group as same as in the PC group. It is concluded that *A. canaliculatum* probiotics exhibited a high tolerance to acid, bile and heat, inhibition effect on *E. coli* proliferation, no adverse effect on broiler performances, and would be incorporated to broiler diet as an alternative to antibiotics.

**Key Words:** water plantain, probiotics, *E. coli*, feed additive, broiler

44 Effect of *Bacillus subtilis* C-3102 on morphological characteristics and microbial status of 14-d-old chicks in conventional and germ-free environments. T. Hamaoka¹, N. Otomo¹, B. Y. Lee¹, Y. Tadanou,² T. Marubashi², J. Marshall³, and A. Van Kessel³, ¹Calpis U.S.A. Inc., Mt. Prospect, IL, ²Calpis Co. Ltd., Tokyo, Japan, ³University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

*Bacillus subtilis* C-3102 (BSC) is utilized in a direct-fed microbial or probiotic product Calsporin (Calpis Co. Ltd., Japan) and made available worldwide. To study mechanisms of action of BSC, a study was conducted using gnotobiotic birds. All birds (Ross308) were hatched as germ-free chicks in 4 gnotobiotic isolators (10 chicks/isolator) according to methods developed at the University of Saskatchewan. After hatching, birds in 2 isolators were conventionalized by mixing 2 g of fecal material into drinking water. All birds were fed *ad libitum* from day of hatch a diet sterilized by gamma irradiation and meeting nutrient requirements. In one of the germ-free and one of the conventionalized isolators, the diets were supplemented with 3 × 10⁶ cfu/g of BSC throughout the trial. Results were analyzed employing a 2 × 2 factorial design of 4 treatments, germfree, BSC monoassociated, conventionalized and conventionalized plus BSC supplemented. At 14-d of age, all the birds were killed and organs, tissues and intestinal contents were collected for analyses. Microbial status was investigated by culture based methods and qPCR. Tissues were fixed and stained (H&E) for morphometric analyses. Culture based analysis indicated BSC reduced (P < 0.05) counts (log cfu/g) of total anaerobes and enterobacteria. Molecular enumeration demonstrated the same trends. Conventionalization resulted in several significant changes. Relative bursa weight (P < 0.001) and relative length of small intestine (P < 0.08), duodenum (P < 0.001) and cecum (P < 0.05) were less in conventionalized groups compared with the other treatment groups. Villus length and crypt depth in ileum were increased in conventionalized birds (P < 0.0001, P < 0.05). Supplementation with the BSC did not affect mucosal morphology but increased (P < 0.05) the thickness of muscularis. In conclusion, supplementation with the BSC increased the thickness of muscularis mucosa in both conventionalized and germ-free monoassociated birds, suggesting a direct host response to BSC, possibly a mechanism not mediated by a change in ideal microbiota.

**Key Words:** *Bacillus subtilis* C-3102, germ-free, muscularis mucosa

45 Evaluation of Tasco-supplemented broiler diets as a candidate prebiotic. M. Arata¹, D. Anderson¹, B. Rathgeber¹, and F. Evans², ¹Nova Scotia Agricultural College, Truro, NS, Canada, ²Aca- dian Seaplants Ltd., Dartmouth, NS, Canada.

Tasco, made of dried brown seaweed (*Asophyllum nodosum*) by Aca- dian Seaplants Ltd., is a candidate prebiotic. This study sought optimal levels of Tasco and compared its effects with Inulin, a known prebiotic. Male broiler chickens were studied in 2 trials. In trial 1 each room contained either pens with a 2:1 mix of previously used and new litter or pens with all new litter. Birds were raised to 35 d and fed 5 diets; 0, 0.5, 1.75, and 3% Tasco, and 2.5% Inulin. In trial 2 birds were raised to 45 d and fed 8 diets; 0%, 0% with ATB, 0.25, 0.5, 1, and 2% Tasco,
2% Tasco pulse fed for the first 2 weeks, and 2.5% Inulin. In both trials pH of the ceca and jejunum and weights of the ileum, ceca, bursa, and spleen were recorded on d 7, 21, and 35, and d 45 in trial 2. In trial 1, 1.75 and 0.5% Tasco increased body weight (BW) and gain (G) in g/bird over Inulin (P < 0.05)(1210 ± 7.1, 1191 ± 7.1, and 1117 ± 7.1 BW respectively (resp.) and 680 ± 5.5, 671 ± 5.5, and 630 ± 5.5 G resp.). Tasco at 1.75% improved feed intake (FI) in g/bird over Inulin (P < 0.05)(1199 ± 12.7 and 1131 ± 12.8 resp.). For Feedincrease 0.5% Tasco clean litter outperformed 0% Tasco clean litter and 2.5% Inulin clean and dirty litter on d 24 (P < 0.05)1.5 ± 0.03, 1.8 ± 0.03, 1.8 ± 0.03, and 1.8 ± 0.03 resp.) and 1.75 and 0% Tasco, 2.5% Inulin dirty litter and 0.5% Tasco clean and dirty litter outperformed 2.5% Inulin clean litter on d 35 (P < 0.05) (2.0 ± 0.03, 1.9 ± 0.03, 2.0 ± 0.03, 2.0 ± 0.03, and 2.0 ± 0.03 resp.). In trial 2 2% BO 0.5% Tasco improved over 2 and 0% Tasco on d 35 (P < 0.05)(2331 ± 45.7, 1854 ± 45.7, and 2080 ± 45.7 resp.) and 0.25% Tasco improved over 2, 2 pulse, and 0% Tasco on d 45 (P < 0.05)(3511 ± 45.8, 2965 ± 45.6, 3140 ± 45.6, and 3253 ± 45.6 resp.). For FI 1% Tasco outperformed 0.5%, 0, and 0% ATB Tasco on d 35 (P < 0.05) (2224 ± 55.6, 1875 ± 55.6, 1740 ± 55.5, and 1813 ± 55.5 resp.) and 2.5% Inulin and 0% Tasco on d 45 (P < 0.05) (2479 ± 55.5, 2158 ± 55.5, and 2118 ± 55.5 resp.). Tasco at 0.25, 1, and 2% pulse showed increased G over 0% (P < 0.05)(649 ± 19.0, 835 ± 19.0, 823 ± 19.0, and 723 ± 19.0 resp.). Tasco was effective at levels as low as 0.25% and 0.5% and showed improvement over the control and inulin diets.

Key Words: Tasco, seaweed, prebiotic, broiler, inulin

46 Improving the production economics of broiler production by using Bacillus based growth promoter either on top of diet or by use of matrix value. I. Knap, A. B. Kehlet*, and A. M. Michelsen, Chr. Hansen, Hørsholm, Denmark.

Bacillus subtilis has been used as direct feed microbial (DFM) in broiler feed to improve intestinal health through microflora modulation and improving production performance (Knapreborg et al., 2008). Addition of B. subtilis to broilers diet improves ileal nutrient digestibility resulting in increased metabolizable energy by 70-110 kcal/kg dry matter (Knap et al., 2010). To evaluate the consistency of GalliPro (Bacillus subtilis) performance in relation to diet composition and bird breed as well as the effect on FCR compared with breeders performance guideline, 30 production studies were investigated. The 30 trials were performed at independent trial facilities or research institutes using 2 treatments - a control group and control plus GalliPro 500 g/ton feed. The groups were compared with regards to effect on FCR measured at slaughter. Twenty-four of the 30 (80%) trials resulted in reduced FCR in the group added GalliPro compared with the control group (on average FCR was decreased by 2.6%). The effect of GalliPro was independent of breed (Ross vs. Cobb) and diet energy source (wheat vs. corn based diets). Based on 16 trials evaluated at d 42, (production trials running until d 42) comparing the FCR performance of the control birds with recommended FCR values given in breeders performance guideline, a clear pattern was seen; If control birds performed less efficient (higher FCR than breeders guideline) the effect of adding Bacillus subtilis was highest. If the control birds performed in accordance with or better (lower FCR) than the breeders guideline the effect of adding GalliPro was low. To be able to utilize the performance improving and increased nutrient utilization of adding GalliPro to broiler diets it is recommended for broiler producers at an elevated FCR level (FCR > breeders guideline at a given age) to add GalliPro on top of the diet, and if the broiler producers have a FCR equal or lower than the breeders guideline to use a matrix value to gain optimal economic out of the Bacillus based growth promoter.

Key Words: Bacillus subtilis, FCR, breed, matrix value, production economics

47 Effect of feeding diets containing a probiotic or antibiotic on broiler performance and litter water-soluble phosphorus. A. M. Amerah*, C. Jansen van Rensburg2, and P. W. Plumshead1, 1Danisco Animal Nutrition, Marlborough, UK, 2University of Pretoria, South Africa.

The aim of the present experiment was to examine the influence of feeding diets containing a probiotic (Enviva Pro 202 GT) based on 3 Bacillus subtilis strains or antibiotic (Zinc Bacitracin) on the performance, intestinal morphology and litter water-soluble phosphorus (WSP) of broilers fed corn based diets. Three treatments were employed: Control diet (C); Control diet supplemented with the probiotic at 7.5 × 10^8 cfu/g diet (T1); and Control diet supplemented with the zinc Bacitracin (50 g/t of feed) (T2). Diets were pelleted and fed ad libitum to 7 pens of 50 male broilers, each from d 1 to 35. Data were subjected to one way ANOVA using the JMP 8.0 software and means were separated by Student’s t-test. Feed intake and weight gain were not influenced (P > 0.05) by dietary treatments. However, T1 improved (P < 0.05) FCR compared with control and T2 (1.40, 1.45 and 1.48 g/g; T1, T2 and C, respectively). Similarly, T1 improved (P < 0.05) production efficiency factor compared with control and T2 (466, 443 and 421; T1, T2 and C, respectively). Villus height and crypt depth in duodenum and jejunum were not influenced by dietary treatment. Probiotic and antibiotic supplementation had no effect (P > 0.05) on litter total P. However, T2 reduced (P < 0.05) litter WSP compared with control and T1 (0.69, 0.78 and 0.77 g/ 100g DM; T2, T1 and C, respectively). This reduction in litter WSP in T2 may be explained by the effects of antibiotics on microbial population, reducing the degradation of phytate with concomitant reductions in WSP. In conclusion, probiotic supplementation had no effect on intestinal morphology or WSP but improved broiler performance compared with control or antibiotic supplemented diet.

Key Words: Bacillus subtilis, probiotic, antibiotic, water-soluble phosphorus, broilers

48 Potential of multispecies probiotic to reduce Necrotic enteritis and Gangrenous dermatitis in broilers. A. Jordan*, M. Mohlf, and G. Schatznayr, 1Biomin USA, San Antonio, TX, 2Biomin Holding GmbH, Herzogenburg, Austria, 3Biomin Research Center, Tulln, Austria.

Global animal production is ever changing, creating the necessity to conform to the needs and wants of the consumer. One product on the market is based on a well-defined, multispecies probiotic consisting of intestinal bacteria derived from the chicken gut belonging to the genera Enterococcus, Pediococcus, Lactobacillus and Bifidobacterium combined with a nutrient ingredient Fructooligosaccharide source. Using a co-cultivation in vitro model, each strain was evaluated for its ability to inhibit the growth of Clostridium perfringens. Necrotic enteritis (NE) is caused by the pathogen C. perfringens and continues to be a concern. Gangrenous dermatitis (GD) is also associated with this pathogen; thus, it was decided to evaluate the effect of the product in the course of a series of in vivo experiments. Study 1: The experimental group received the probiotic via drinking water (20g / 1000 birds /day), the birds of the probiotic group and the positive control

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group were orally gavaged with *C. perfringens* once daily for 3 consecutive days starting on d 17 (10^6 cfu/mL in Exp 1 and 10^7 cfu/mL in Exp 2). Lesion scores and bacterial counts showed the probiotic was able to maintain lesion scores, mortality and bacterial counts to the level of the negative control birds or statistically below (*P < 0.05*) the positive control group. On both farms the probiotic treated house had (*P < 0.05*) lower mortality at disease onset, as well as an increase (*P < 0.05*) in body weight gain. Study 2: A subclinical necrotic enteritis model was used to reproduce the disease. The birds of the probiotic group (0.1% of product in feed) and the positive control group were challenged orally 3 times a day with approximately 4 × 10^8 cfu *C. perfringens* at d 17, 18, 19 and 20. Results showed that the probiotic group had a significant (*P < 0.05*) lower amount of birds with necrotic lesions compared with the positive control group. In conclusion these studies suggest that the multispecies probiotic may be beneficial in the control of poultry diseases which are related to *C. perfringens* like NE and GD.

**Key Words:** probiotic, multispecies, necrotic enteritis, gangrenous dermatitis, *Clostridium perfringens*

### 49 Effect of conditioning temperature and probiotic supplementation on growth performance of broilers fed corn/soy-based diets

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The aim of the present experiment was to examine the effect of conditioning temperature and a probiotic (Enviva Pro 202 GT) supplementation based on 3 *Bacillus subtilis* strains on growth performance of broilers fed corn/soy-based diets. The experimental design was a 3 × 2 factorial arrangement of treatments evaluating 3 conditioning temperatures (75, 85 and 95°C) and 2 levels of probiotic supplementation (without or with 1.5 × 10^5 cfu/g feed). Each treatment was fed ad libitum and was weighed back every 28 d by replicate group and feed intake was calculated. Data was analyzed separately for white and brown strains using a SPLIT-PLOT design and PROC MIXED procedure of SAS. For white and brown strains, hen day production, average egg weight and percentage of extra large plus large eggs was greater (*P < 0.05*) for hens supplemented with Original XPC. Percentage of medium size eggs were lower (*P < 0.05*) for white and brown hens supplemented with Original XPC. White strain hens supplemented with Original XPC had greater (*P < 0.05*) feed intake per bird per day and lower (*P < 0.05*) percentage of check eggs than the controls. When Original XPC was supplemented to the diets, brown strain hens had significantly greater (*P < 0.05*) hen housed production and percentage of grade A eggs. The white strain hens had numerically greater hen housed production (*P > 0.06*) and percentage of grade A eggs (*P < 0.09*). The results indicate that supplementation of Original XPC can improve egg production, size and quality in white and brown strains of laying hens.

**Key Words:** layers, *Saccharomyces cerevisiae* fermentation product, egg production, egg quality, egg size

### 51 Minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of oregano essential oil for common livestock and poultry pathogens


Enteric health plays a key role in disease control, efficient feed utilization and maturation of the immune system. The poultry industry is investigating phytonutrients including oregano essential oil (OEO) because they exert potent antimicrobial and antioxidant activity in the gut. The antimicrobial and antioxidant activity of OEO is attributed to its most abundant polyphenols, carvacrol and thymol. Carvacrol and thymol have been shown to permeabilize and depolarize the bacterial cytoplasmic membrane, resulting in cell death. The objective of this study was to quantify the antimicrobial and antioxidant activities of OEO. Antibacterial activity was determined by testing for the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of OEO for common livestock and poultry pathogens. A standardized microtiter protocol was used. Several bacteria were tested including *Escherichia coli*, *Salmonella enteritidis*, *S. typhimurium*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*. Antioxidant activity for OEO and vitamin E (positive control) was determined by the oxygen radical absorption capacity (ORAC) value against 5 oxygen radicals: peroxyl radical, hydroxyl radical, peroxyxtrite, superoxide anion, and singlet oxygen. Results showed that MICs and MBCs for both gram-positive and gram-negative bacteria ranged from 1.25 to 10.0 μg/mL. MICs were all equal to the MIC in all cases, demonstrating bactericidal activity. Antioxidant testing showed that OEO had much higher level of total antioxidant activity (2,520,600 μmol/g) than natural vitamin E (48,200) and several other common antioxidants. These results demonstrate that OEO has high antimicrobial activity for pathogens that cause enteric disease.
in poultry. The very high level of antioxidant activity of OEO may protect enterocytes against inflammatory damage caused by reactive oxygen molecules that are released during immune system activation.

**Key Words:** oregano essential oil, antimicrobial, gut health, antibiotic alternative, antioxidant


Two hundred and seventy, day-old Arbor Acre strain of broiler chicks were used for this research. The basal diet contained 23.00% crude protein and 3,000 kcal/kg metabolizable energy. The premix used was a normal commercial broiler starter premix that contained 0.08kg Vit E/kg of premix. The basal diet was therefore supplemented with the different levels of Vit E (α-Tocopherol) to have the different diets (Treatment 1 contained 10 birds/m² without additional Vit E supplementation, Treatment 2 had 20 birds/m² without Vit E supplementation, Treatment 3 had 20 birds/m² but with additional 50.00 mg/kg Vit E supplementation, Treatment 4 contained 20 birds/m² with 100.00mg/kg Vit E supplementation, while Treatment 5 had 20 birds/m² with 150.00mg/kg Vit E supplementation). The experimental design was a completely randomized design. While significant means were separated at 95% level of significance (P < 0.05). All treatments were replicated 3 times. At the end of the 4 weeks of experiment, carcass characteristics (Cold shortening (CS), Thermal shortening (TS), Cooking loss (CL), Shear force (SF) and Water Holding Capacity (WHC)) of the birds were determined. There were no significant changes in the weight gain and final weight of the birds fed the different dietary treatments. However, the feed conversion ratio (FCR) revealed that birds on dietary treatment 2 had the highest significant value of 3.29 compared with those on Vit E supplemented diets. No significant difference was observed in the WCH of both raw (58.43% to 59.43%) and the cooked meat (59.02% to 59.51%) for all the treatments. Birds fed dietary treatment 2 (negative control) had the highest significant (P < 0.05) CS value of 3.50% compared with its counterparts on Vit E supplemented diets. No significant different was observed in the SF of the birds in all the treatment with mean value ranging from 3.35% to 3.60%. In conclusion, broiler chicks could be stocked up to 20 birds/m² only if the diet is supplemented with 100mg/kg Vit E.

**Key Words:** stock density, vitamin E, carcass quality, broilers