Evaluation of Topmax (ractopamine) on performance in tom and hen turkeys: a meta-analysis. K. Hanford1 and J. S. Bridges2, University of Nebraska, Lincoln, 2Elanco Animal Health, Greenfield, IN.

A meta-analysis of the effect of Topmax (ractopamine HCl) on the performance of hen and tom turkeys when administered the last 14 d of finishing was conducted. Summary data from 18 studies were included. PROC GLIMMIX (SAS Inst.) was used with a model including fixed effects of linear and quadratic Topmax, sex, breed and their interactions and a random study effect. Any non-significant (α > 0.05) terms were dropped from the final model. Meta-analytical methods that weight responses by study precision of results were used. There was a significant linear relationship between level of Topmax and ADG kg/day. For each unit change in mg/head/d (mg/bird/d) Topmax, there was a 0.002 kg/d increase in ADG. There were significant linear and quadratic relationships between level of Topmax and F:G and G:F ratios. For each unit change in mg/bird/d Topmax, there was a linear 0.065 decrease in amount of feed needed for the same amount of gain and a linear 0.009 increase in gain for the same amount of feed consumed. Both F:G and G:F ratios had a value which had a significant influence on the results. When this outlier was removed, there were no longer significant quadratic relationships between level of Topmax and F:G and G:F ratios. Without the outlier, for each unit change in mg/bird/d Topmax, the linear decrease in the amount of feed needed for the same amount of gain was −0.021 and the linear increase in the gain for the same amount of feed consumed was 0.007. The results of these analyses support the conclusion that feeding elevated levels of Topmax the last 14 d of finishing improves both hen and tom turkey production efficiency with expected outcomes of 0.068, 0.132 and 0.20 kg gain in toms and 0.064, 0.132, and 0.195 kg gain in hens fed 2.0, 4.0 or 6.0 mg/bird/d (respectively) relative to controls.

Key Words: meta-analysis, turkey, ractopamine, finishing

Effect of yeast cell product (CitriStim) supplementation on immune cell properties in chickens with an experimental coccidial infection. R. Shannugasundaram1, M. Sifrit2, and R. K. Selvaraj1, 1OARDCT/The Ohio State University, Wooster, 2Archers Daniels Midland ANI, Quincy, IL.

This experiment studied the effect of CitriStim (Pichia Guillermondii), a commercial killed whole yeast cell bioprotect, on broiler performance, fecal coccidial oocyst count, regulatory T cells (Tregs), macrophage, CD4+, CD8+ percentages and macrophage nitric oxide production during an experimental coccidial infection. A total of 90 one-day-old broiler chicks were fed a corn and soybean meal based diet supplemented with 0, 0.1 or 0.2% whole yeast cell product for 21 d in 5 pens per treatment (n = 5). At 21 d of age, birds were challenged with 1.2 × 10⁶ live coccidia oocysts. Supplementation with whole yeast cell product increased body weight gain between 0 and 12 d (P = 0.01) post-coccidial challenge. Birds supplemented with 0.2% whole yeast cell product had better (P = 0.01) feed efficiency between 0 and 12 d post-coccidial infection. Supplementation with whole yeast cell product decreased (P = 0.01) the fecal coccidial oocyst count at 7 d post-coccidial challenge. Coccidial infection increased the Treg percentage and decreased the macrophage nitric oxide production. Supplementation with whole yeast cell product reversed the coccidial infection induced increase in Treg percentage and decrease in macrophage nitric oxide production at both 5 (P = 0.04) and 12 d (P = 0.01) post-coccidial challenge. Supplementation of whole yeast cell product did not significantly change the macrophage, CD4+, and CD8+ percentages in the cecal tonsils post-coccidial infection. It could be concluded that feeding whole yeast cell product improved production performances and increased macrophage nitric oxide production post-coccidial challenge.

Key Words: Tregs, yeast cell product, coccidial infection

Reducing medication use in broiler chicken diets through nucleotide supplementation. R. Patterson1, G. Mathis2, B. A. Slo­minski3, and R. O. Jones1, 1Canadian Bio-Systems Inc., Calgary, AB, Canada. 2Southern Poultry Research, Athens, GA, 3University of Man­itoba, Winnipeg, MB, Canada.

The potential of a yeast product rich in nucleotides to reduce medication use in broiler chicken diets was evaluated using 1600 male Cobb × Cobb broiler chickens, placed at 1 d of age, in a completely randomized experimental design. The test article, Maxi-GenPlus, is a nucleotide-rich yeast product (NP) containing a mixture of mono-nucleotides. Birds were randomly assigned to the following dietary treatments: Positive control (PC) containing 110 ppm bacitracin methylene disalicylate (BMD), Negative control (NC; no medication), and NP + 0.05% NP, and NP + 0.05% NP + 55 ppm BMD. Diets were fed ad libitum for 42 d. Growth performance was not affected by dietary treatment on d 21 (P > 0.05). On d 35, NP+BMD birds had greater BWG than NC birds (1.80 vs. 1.72 kg, P < 0.05) but did not differ from NP (1.76 kg) or PC birds (1.77 kg). On d 35, feed intake of PC birds (3.06 kg/bird) did not differ from other dietary treatments, while feed intake was greater in NP birds (3.12 kg/bird) and NP+BMD birds (3.13 kg/bird) compared with NC birds (3.03 kg/bird). Day 35 FCR for NP+BMD birds was the same as PC birds (1.73 vs. 1.74) and lower than NC birds (1.78). On d 42, birds fed NP+BMD had the same BWG as PC birds (2.35 vs. 2.33 kg) and both treatments had greater BWG than NP (2.28 kg) and NC (2.20 kg) birds, respectively. Feed intake was significantly greater in NP (4.23 kg/bird) and NP+BMD birds (4.25 kg/bird) than in NC birds (4.09 kg/bird) and did not differ (4.20 kg/bird) compared with PC birds at d 42. On d 42, there was no difference in FCR between NP+BMD and PC birds (1.81 vs. 1.83) and NP+BMD birds had lower FCR than both NP (1.85) and NC birds (1.90), respectively. Mortality was lower in NP birds than NC birds (1.75 vs. 5.25%) and did not differ compared with NP+BMD (2.50%) or PC (4.25%) birds. This study suggests that feeding broiler chickens a yeast product rich in nucleotides can assist in reducing dietary medication usage.

Key Words: nucleotide, broiler chicken, medication reduction

Effects of feeding original XPC and salinomycin during a coccidia challenge in broilers. D. McIntyre*1, I. N. Broomhead1, G. F. Mathis2, and B. Lumpkins3, 1Diamond V, Cedar Rapids, IA, 2Southern Poultry Research Inc., Athens, GA.

Research was conducted investigating the individual and combined effects of feeding Diamond V Original XPC (a Saccharomyces cerevi­siae fermentation product) and salinomycin (an anticoccidial) during a coccidia challenge. Three hundred twenty Cobb chicks were divided into 5 treatments at 1 d of age, with 8 replicate pens per treatment and 8 birds per pen. The treatments included: (1) non-treated, non-infected (NC), (2) non-treated, infected (PC), (3) salinomycin treated, infected...
(SAL), 4) Original XPC treated, infected (XPC), and 5) salinomycin plus XPC treated, infected (SAL-XPC). Additives were fed from 1 to 27 d, with dietary inclusion of salinomycin at 66 g/metric ton and XPC at 1.25 kg/metric ton. At 21 d, birds were weighed and infected birds inoculated with a mixed *Eimeria* culture containing *E. acervulina* (EA), *E. maxima* (EM), and *E. tenella* (ET). Birds were weighed and lesion scored in the upper, middle, and cecal regions of the intestine 6 d post inoculation. Body weight gain (BWG) and feed conversion (FCR) were significantly (*P < 0.05) improved in all treated, infected groups compared with PC during the coccidia challenge. Of the infected treatment groups, SAL-XPC had the highest BWG and lowest FCR, followed by SAL, and then XPC. A similar response was observed for lesion scoring in all treated, infected groups that had significantly (*P < 0.05) lower EA, EM, and ET lesion scores compared with PC. No difference (*P > 0.05) in EM lesion score was observed between the 3 treated, infected groups. Birds receiving SAL or SAL-XPC had significantly (*P < 0.05) lower EA and ET lesion scores than XPC. Overall, salinomycin or Original XPC reduced coccidia lesions and the negative performance effects of the *Eimeria* challenge. The combination of both treatments resulted in the best improvement in performance during the challenge.

**Key Words:** broiler, Original XPC, salinomycin, coccidiosis, *Eimeria*

### 173 Effect of phenyllactic acid supplementation as an alternative to antibiotics on growth performance, immune response, and cecal microbial population of broiler chickens. H. M. Salim1,2, H. K. Kang3, J. H. Kim2, J. C. Na2, H. C. Choi2, O. S. Suh3, and W. K. Kim1,1Department of Animal Science, University of Manitoba, Winnipeg, MB, Canada, 2National Institute of Animal Science, Rural Development Administration, Cheonan-si, South Korea, 3Department of Livestock Services, Khamar Bari, Dhaka, Bangladesh.

A study was conducted to investigate the supplementation of phenyllactic acid (PLA) on growth performance, immune response, and cecal microbial population of broiler chickens. A total of 750 1-d-old male broiler chicks were randomly placed in 5 dietary treatments with 5 replicate pens per treatment (30 birds/replicate pen). The 5 dietary treatments fed for 42 d were: a corn-soybean meal basal diet (Control); a mixture of avilamycin 10 ppm + salinomycin 60 ppm as antibiotics growth promoters (AGP); 0.1% phenyllactic acid (PLA 1); 0.2% phenyllactic acid (PLA 2); and 0.4% phenyllactic acid (PLA 3). No significant difference was observed between the treatments in feed intake and livability of broilers; however, the body weight (BW) gain and feed efficiency were significantly (*P < 0.05) improved in AGP and PLA groups compared with control group. The white blood cell and heterophil were significantly higher in PLA supplemented groups compared with AGP and control groups, but the heterophil/lymphocyte ratio was lower in control group than other groups. The plasma IgG concentration was significantly increased (*P < 0.05) in birds fed PLA supplemented diet, but the plasma IgA and IgM concentrations were not different among the treatment groups. In addition, the antibody titer against Newcastle disease virus was significantly higher in PLA compared with control and AGP, but the antibody titer against infectious bronchitis virus was not affected by dietary supplementation of PLA and AGP. Neither PLA nor AGP treatments affected the cecal aerobes and *Salmonella* content; however, cecal *Lactobacillus* population increased in chickens fed PLA 1, and total coliform bacteria population significantly decreased in chickens fed PLA and AGP. It is concluded that dietary PLA supplementation increases the growth performance, immune characteristics and the number of lactic acid bacteria, and decreases the number of coliform bacteria of broiler chickens. Thus, dietary PLA could be a viable alternative to antibiotics in the commercial broiler diets.

**Key Words:** phenyllactic acid, growth performance, microbial population, broiler

### 174 Dose responses to dietary *Bacillus subtilis* C-3102 (Calsporin) spores when broiler chicks were challenged with *Eimeria maxima* and *Clostridium perfringens*. T. T. Lohrmann1, N. Otomo2, T. Hamaoka3, G. F. Mathis3, B. Lumpkins3, and D. M. Hooge4, 1Quality Technology International Inc., Elgin, IL, 2Calpis USA Inc., Mt Prospect, IL, 3Southern Poultry Research Inc., Athens, GA, 4Hooge Consulting Service LLC, Eagle Mountain, UT.

A battery trial from 0 to 28 d of age used Cobb male broiler chicks challenged with 0 or 5,000 oocysts of *Eimeria maxima* on d 14 and with 0 or 1 × 10⁸ cfu of *Clostridium perfringens* per bird on d 19, 20, and 21. There were 8 cages of 8 birds each per treatment. Five treatments were: (1) Non-infected chicks, non-medicated diets; (2) infected chicks, non-medicated diets; (3) infected chicks, Calsporin 1x (300,000 cfu/g) diets; (4) infected chicks, Calsporin 2x diets; and (5) infected chicks, Calsporin 3x diets. Necrotic enteritis (NE) intestinal lesion scoring (0 to 3) was done on 3 birds/cage on d 21. One-way ANOVA and Tukey’s HSD test (*P ≤ 0.05*) were used. The 14–21 d BW gain was lower (*P = 0.015) and feed/gain (F/G) higher (*P < 0.001) for T2 than T1, with groups T3 to T5 intermediate. For 0–21 d F/G, T1 was lower (*P < 0.001) than T2, T4, and T5, with T3 intermediate. Calsporin diets gave benefits in 14–21 and 0–28 d F/G during coccidial-clostridial challenge. The 2x and 3x Calsporin diets had lower NE mortality, and 3x Calsporin diets had lower NE lesion scores, than infected birds on nonmedicated diets.

**Table 1.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>BW gain, g</th>
<th>Feed/ gain</th>
<th>Mort- Adj F/G</th>
<th>NE Mort, %</th>
<th>NE Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 NonInf, Nonmed</td>
<td>802</td>
<td>1.93</td>
<td>1.93</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>T2 Inf, Nonmed</td>
<td>722</td>
<td>2.30</td>
<td>2.13</td>
<td>12.50</td>
<td>1.04</td>
</tr>
<tr>
<td>T3 Inf, Calsporin 1x</td>
<td>778</td>
<td>2.11</td>
<td>2.06</td>
<td>4.69</td>
<td>0.67</td>
</tr>
<tr>
<td>T4 Inf, Calsporin 2x</td>
<td>767</td>
<td>2.14</td>
<td>2.08</td>
<td>3.13</td>
<td>0.67</td>
</tr>
<tr>
<td>T5 Inf, Calsporin 3x</td>
<td>777</td>
<td>2.12</td>
<td>2.09</td>
<td>3.13</td>
<td>0.17</td>
</tr>
</tbody>
</table>

**Key Words:** *Bacillus subtilis* C-3102, broiler, Calsporin, coccidiosis, necrotic enteritis

### 175 Impact of a proprietary blend (PB) of *Quillaja saponaria* and *Yucca schidigera* and commercially available direct fed microbials (DFM) on performance of commercial broilers. D. F. Calabotta1, R. Otero2, W. Knehans1, W. K. Kang3, D. F. Calabotta1, R. Otero2, W. Knehans1, 1Prince Agri Products Inc., Quincy, IL, 2Desert King International Inc., San Diego, CA.

Sixteen replicate pens (2 birds/replicate) of 6 treatments (T) were utilized to assess the impact of a PB of *Quillaja saponaria* and *Yucca schidigera* and 2 commercially available direct fed microbial (DFM) preparations on growing broilers. T1 was a Positive Control (PC) standard commercial diet containing *Bacillus subtilis* (BS) at 1lb/ton and 25 g/ton of BMD in the starter and grower diets and 15 g/ton of virginiamycin in finisher 1 and 2 diets. T2 was a Negative Control (NC) that contained T1 minus BS; T3 was comprised of T1 plus 125 ppm of PB; T4 was comprised of T2 plus 125 ppm of PB; T5 was comprised of T2 plus 7.5 g/ton of *Bacillus coagulans*; T6 was comprised of T2 plus 125 ppm of PB and 7.5 g/ton of *Bacillus coagulans*. All diets contained *Niacin-Bio* 25% and Maxiban for coccidiosis control. Performance measures included mortality, feed consumption, processing weight, feed conversion (actual and mortality corrected), and bird
weights on d 0, 7, 14, 28, 42, and at end of trial (Day 48). Also at d 20 litter samples were taken for subsequent analysis of oocyst counts. No differences among treatments were observed in body weight at d 48. Feed conversion measurements observed at d 48 for T1, T2, T3, T4, T5, and T6 were 1.859, 1.836, 1.833, 1.835, 1.833, and 1.773, respectively. T6 feed conversion performance was significantly improved ($P < 0.01$) versus all other diets suggesting a possible synergistic benefit associated with PB and Bacillus coagulans. These results demonstrated the potential performance benefits associated with Quillaja-based saponin and DFM blends. Additional research is warranted to further delineate improvements of these blends under various commercial feeding scenarios.

**Key Words:** saponin, broiler, Quillaja, Bacillus, DFM


A single battery study was conducted to evaluate the effect of a synthetic 1:1 thymol carvacrol blend (Next Enhance 150; Carotenoid Technologies, S.A.) on growth performance and gut health of broilers fed a rye and wheat based diet and challenged with 3 mixed species of Eimeria on d 0. A rye, wheat and soybean meal based diet was formulated to meet or exceed nutrient requirements of broilers. To this basal diet, the essential oil blend was added at 0, 30, 60, or 120 g/ton to provide 0, 15, 30, or 60 g/ton essential oils, in which half was thymol and half was carvacrol. BMD at 50 g/ton and a nonstarch polysaccharides (NSP) degrading enzyme blend consisting of a proprietary xylanase, β-glucanase, and α-galactosidase; Cibenza CSM, Novus International, Inc.) at 500 g/ton served as positive controls. Each of the 6 test diets was fed to 8 replicate pens of 8 male broilers from 0 to 31 d of age. Growth performance was measured at d 7, 14, 21, and 29. Gut health parameters measured were serum uric acid and α-1 acid glycoprotein on d 7, ileal *Clostridium perfringens* on d 15, ileal lactobacilli on d 30, and digesta viscosity on d 31. Data were analyzed by one-way ANOVA and statements of significance were based on $P < 0.05$. Essential oil blend at 60 g/ton significantly improved overall body weight by 14% (1012 g versus 886 g) and FCR by 15 points (1.869 versus 2.019) and its effect was not significantly different from BMD. The NSP enzyme blend significantly increased body weight, feed intake and improved FCR and the effect was greater than BMD or essential oil blend. Only the NSP enzyme blend significantly reduced digesta viscosity. Serum α-1 acid glycoprotein and uric acid concentrations, and ileal *Clostridium perfringens* and lactobacilli counts were not significantly affected by dietary treatments. The study demonstrated that an essential oil blend delivered a similar improvement in performance to BMD in broilers under gut health challenge and could be an effective tool in antibiotic free broiler production.

**Key Words:** broiler, gut health, essential oil

177 Improving growth performance, livability and modifying cecum microbiota in broilers with natural feed additives. A. Kovács*1,2, R. Urbaityte1, N. Roth1, and S. Weidong2, 1Biomin Holding GmbH, Herzogenburg, Lower Austria, Austria, 2Clinical Center of Veterinary Medicine, Damanhour University, Damanhour, Behria, Egypt.

The objective of this work was to compare the effect of bee pollen (BP) and/or propolis (Pro) as alternative feed supplements to well-known prebiotics mannann oligosaccharides (MOS) when given continuously or intermittently on productive and physiological performance of broiler chicks. Thus, a total of 324 unsexed one-day-old Arbor Acres broilers were randomly distributed into 9 treatment groups, each replicated 6 times of 6 birds per replicate. The chicks were kept in wire cages fed the same basal diet and were submitted to the following treatments: control without supplementation (control), or supplemented with BP at 300 mg, Pro at 300 mg, BP+Pro at 300 mg and MOS at 0.5 g/1 water. Each supplemented group was subdivided into 2 subgroups in which the additives were administrated continuously or intermittently. Thus, there were 4 additives each given by 2 administration ways plus the control group (un-supplemented). In the continuous supplemented groups, supplements were given from one till 36 d of age, and in the intermittent supplemented groups, the administration was only 3 d before, on the day of and day after vaccination. Results showed that BP and/or Pro either by continuous or intermittent treatment was equally effective for improving productive performance, increasing percentage of dressed carcass weight and was similar to MOS. There was no synergistic effect of BP and Pro on growth performance indicating that either of them is adequate depending on the relative supplementation cost. These natural growth promoters improved hematomal criteria, lipid metabolism,
liver and renal functions of broilers. Thus, the intermittent supplementation way decreased supplementation cost by 40%.

**Key Words:** feed additive, broiler, continuous, intermittent, growth


The objective of this study was to investigate the effects of canthaxanthin and 25-OH-D3, on broiler breeder production. In total, 80 breeder hens (Cobb 500) were randomly divided into 2 treatments consisting of 40 birds each (10 replicates of 4). The breeder hens were fed either a basal diet (negative control, NC) or the basal diet supplemented with 1kg of MaxiChick (DSM Nutritional Products, Switzerland; containing 6 g of canthaxanthin and 69 mg of 25-OH-D3)/ton of feed from 25 to 62 weeks. At the end of the 35, 45, and 62 weeks, all hatching eggs laid were incubated. The parameters evaluated were: egg production (%), fertility (%), hatchability (%), fertile hatched eggs (%), mortality, and specific gravity. ANOVA of data were performed using GLM procedure of SAS, considering 5% of significance. Canthaxanthin and 25-OH-D3 supplementation resulted significant improvements ($P < 0.05$) in the following parameters compared with NC, on wk 35: egg production (85.3 vs. 86.6%), fertility (95.5 vs. 96.6%), hatchability (85.6 vs. 86.7%), fertile hatched (86.1 vs. 87.4), and reduction on mortality at first wk (5.6 vs. 2.9); at 45 wk: egg production (74.2 vs. 77.0%), fertility (94.2 vs. 97.2%), hatchability (85.4 vs. 86.8%), fertile hatched (88.3 vs. 90.2), and reduction on mortality at first wk (4.6 vs. 1.1); at 62 wk: egg production (64.8 vs. 68.3%), fertility (83.3 vs. 86.6%), hatchability (74.2 vs. 77.2%), fertile hatched (82.3 vs. 86.2), specific gravity (1.075 vs. 1.084), and reduction on mortality at first week (4.3 vs. 0.00). Results suggest that the combination of canthaxanthin and 25-OH-D3 enhance the maternal capabilities, which might be beneficial for poultry producers.

**Key Words:** carotenoid, vitamin D3, fertility, egg production, hatchability