Effect of a commercial organic acid product (pHorce) on performance of broiler chickens fed wheat-maize-soybean meal-based diet. Katharina Schuh1, Augustine Owusu-Aseodu2, Georg Dusel1, Aikaterini E. Konstantin2, Emma Graystone2, and Leon J. Broom2, 1University of Applied Sciences Bingen, Bingen, am Rhein, Germany; 2Anpario PLC, Worksop, Nottinghamshire, United Kingdom.

The current study evaluated the effect of a commercial wheat-maize-soybean meal based diet supplemented with an organic acid product containing a specific combination of formic and propionic acids (pHorce) on performance parameters in broiler chickens. One day-old broiler chickens (Ross 308) were randomly allotted to 2 treatments with 10 replicate cages/treatment and 2 birds/cage from d 1 to 21. From d 21 to 35, birds were reduced to one per cage. The dietary treatments were (1) a positive control basal diet containing wheat, corn, and soybean meal formulated to meet or exceed nutrient requirements of Ross 308 broilers; PCD, and (2) PCD + supplemented with pHorce (1.0, 0.7 and 0.5 kg/MT of feed in starter, grower and finisher, respectively; OAD. The diets were fed in 3 phases from d 1 to 7, d 8 to 21, and d 22 to 35 (starter, grower, finisher, respectively). Body weight (BW), feed intake (FI), average daily weight gain (ADG) and feed efficiency (feed conversion ratio, FCR) were determined. Data were analyzed as completely randomized design by GLM of SPSS using BW d 0 as covariate. Although overall ADG and FI were not affected (P > 0.05) by dietary treatment, final BW was numerically higher (P = 0.14) and FCR improved in the finisher phase (d 22–35; P < 0.001) and overall trial period (d 0–35; P = 0.004) for OAD fed birds. Overall feed efficiency improved (P < 0.05) by 6.8% in broilers fed OAD compared with PCD. In conclusion, the current study showed that addition of a commercial organic acid containing a blend of formic and propionic acid (pHorce), to a commercial diet improved feed utilization and performance in broiler chickens from d 0 to 35.

Key Words: organic acid, broiler, performance

Yeast as nucleotide source in turkey diets. Melina A. Bonato1, John Schliefer2, Glycon D. Santos3, Brett S. Lumpkins4, Greg F. Mathis2, and Frederic J. Hoerr3, 1ICC Industrial Comércio Exportação e Importação Ltda., São Paulo, SP, Brazil, 2Quality Technology International Inc., Elgin, IL, 3Southern Poultry Research Inc., Athens, GA, 4Veterinary Diagnostic Pathology LLC, Fort Valley, GA.

This study evaluated the effects of dietary supplementation of 3 levels of autolyzed yeast (with enzymatically hydrolyzed RNA) as a nucleotide source on turkey performance. For this, 256 one-day-old Nicolas turkeys poults were distributed in a completely randomized block design (battery pens), with 4 treatments and 8 blocks, being 8 cages of 8 poults each (0.19m²/bird). The treatments were as follows: T1 = control diet (no additive supplemented); T2 = diet with nucleotide source at 1 kg/MT; T3 = diet with nucleotide source at 3 kg/MT; T4 = diet with nucleotide source at 5 kg/MT. The source of nucleotide [YNU] was from Saccharomyces cerevisiae yeast product named Hilyse, included in diets from 0 to 21 d. Study criteria included body weight gain (BWG, kg), feed intake (FI, kg), feed/gain ratio (FGR), and mortality rate (%) at 21 d. Duodenum and jejunum samples were collected at 21 d for measurement of villus height (V, µm), crypt depth (C, µm), relationship between villus height and crypt depth (V:C ratio), and mucosal thickness (MT, µm). The data were analyzed using the SAS LSD test (P ≤ 0.05) to separate means when ANOVA F values are significant (P ≤ 0.05). The treatments had no effect (P > 0.05) on FI, BWG, or mortality rate at 21 d. Although there were no statistical differences (P > 0.05) between treatments for histomorphometry parameters, for each YNU inclusion level (1, 3 and 5 kg/MT, respectively), were numerically improved in duodenum (V +3.8, 8 and 8%; V:C +12.3, 16 and 8.3%; MT +1.8, 5.1 and 7%) and jejenum (V +28.3, 13.6 and 39%; MT +9, 8.3 and 16%) versus control. In summary, this study demonstrated that turkey diets supplemented with 1 kg/MT of YNU significantly improved feed/gain ratio from 0 to 21 d compared with control diets.

Key Words: intestinal integrity, performance, Saccharomyces cerevisiae

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Metabolism and Nutrition, Feed Additives I

Poult. Sci. 95(E-Suppl. 1)
181 Performance enhancer complex on pullet growth and hen production parameters with and without Salmonella vaccination. Amanda Luoma*, G. Raj Muraguesan2, Attila Kovacs3, Revathi Shanmugasundaram1, Ashley Markazi1, and Ramesh Selvaraj1
1Department of Animal Sciences, The Ohio State University, Columbus, OH, 2Biomin America Inc., San Antonio, TX, 3Biomin Holding GmbH, Getzersdorf, Austria.

This experiment studied the effects of a unique blend of performance enhancer complex (Biotoric Top3) consisting of formic, propionic, and acetic acids combined with cinnamondehyde and a permeabilizing complex on pullet growth and hen egg production parameters with and without Salmonella vaccination. The performance enhancer was added to the feed at a rate of 1 g/kg from day-of-hatch until the end of the project at 23 wk of age. At 14 wk of age, birds were vaccinated with 0.3 mL of Poulvac SE (Salmonella Enteritidis bacterin; phase types 4, 8 and 13a) subcutaneously and were given a booster at wk 17. At 18 wk of age, birds were brought into production by increasing light hours to 18 h/d. Body weights were collected every 2 wk and egg count was collected every day following first egg. An one-way ANOVA (JMP, SAS Institute Inc., Cary, NC) was used to examine the effect of supplementation on dependent variables and interaction effects and main effects were determined by Tukey’s least squares means comparison and effect of supplementation in addition to vaccination by contrast analysis. Supplementation of enhancer increased BW (P < 0.05) from day-of-hatch through wk 23. Birds which received diets supplemented with performance enhancer on top of the vaccination had increased (P < 0.05) BW after the vaccination through wk 23 as well as BW gain from vaccination through wk 22. Supplementation of enhancer decreased (P < 0.05) age of bird at first egg as well as increased (P < 0.05) weekly and total egg counts. We concluded that supplementing pullet and layer diets with the performance enhancer can increase production performance.

Key Words: pullet, body weight gain, egg production, salmonella, permeabilizing complex

182 Performance and necrotic enteritis lesion scores of broilers fed diets containing Avi-Lution or BMD and challenged with Clostridium perfringens. Michael D. Sims*, David A. Spangler2, and Lucas A. Krueger*, 1Virginia Diversified Research Corp., Harrisonburg, VA, 2Agri-King Inc., Fulton, IL.

A 42-d broiler floor pen study was conducted to determine the response in body weight (BWT), feed conversion ratio (FCR), mortality (MRT), and necrotic enteritis intestinal lesion scores (LSC) of Clostridium perfringens ( Cp)-challenged broilers on diets supplemented with Avi-Lution 2 lb/t (AvL2), Avi-Lution 4 lb/t (AvL4) or BMD 50 g/t (BMD). Cobb 500 SR broiler chicks (1,250 birds) were randomly allotted to 50 pens (25/pen). Each pen contained 1 water fountain and a 50-lb capacity feed tube. Each pen had ~3 inches of new wood shavings at 0 d with 4 lb of (25/pen). Each pen contained 1 water fountain and a 50-lb capacity feed tube. Each pen had ~3 inches of new wood shavings at 0 d with 4 lb of

1.0 g/kg Avi-Lution (56.4 ± 7.5% and 57.7 ± 8.0% of 16S abundance, respectively). Conversely, α-toxin was identified in only 8.0% of cecal samples at 0.0015 ± 0.0006% of 16S abundance. We thus conclude that Cp was a source of BcrD to cecal bacteria and the gene was abundant in the commensal population.

Key Words: bacitracin resistance, antibiotic resistance, Clostridium perfringens, BcrABD, BcrD

184 Chemistry curtailing bacterial enteritis in poultry. Jeroen Baeyens1, Tina Rogge1, Jan Anmm1, Wael Gad2, and Maarten De Gussem1, 1Proviron, Flanders, Belgium, 2TGD – Tiergesundheitsdienst, Fellbach, Germany, 3Yetworks, Flanders, Belgium.

The poultry industry is facing huge changes in how antibiotics (AB) are being used. Several pressures affect resistance in bacteria of importance to animal and human health. The acknowledgment that AB must be used responsibly, leads to an increasing need for alternatives. Therefore, between AvL2 (1.892 and 1.865) and AvL4 (1.863 and 1.847) while AvL4 was less (P < 0.10) at each time than BMD (1.939 and 1.865). The 42-d MRT of BMD (2.00%) was less (P < 0.10) than AvL2 (6.4%) and IC (10.0%). The UC birds were indirectly infected as indicated by 14-d LSC of 0.867 and 42-d LSC of 1.433, both of which were lower (P < 0.10) than all other groups at each time point. The 14-d LSC of the 4 challenged groups were not different while 42-d LSC of AvL4 was higher (P < 0.10) than BMD and IC. Final weight and FCR of this study suggests that AvL2 and AvL4 may provide broilers with optimal non-antibiotic related nutrition to sustain adequate performance during a NE challenge.

Key Words: Avi-Lution, BMD, necrotic enteritis, Clostridium perfringens, lesion score
the US poultry industry aims to follow the European Union’s model on poultry production free of AB growth promoters. It is known that over 50% of AB treatments are directly related to enteric diseases as dysbacteriosis and bacterial enteritis. These affect the intestinal health and are provoked by C. perfringens. They cause serious economic losses through reduced performance, higher FCR, wet litter problems and morphological and functional alterations in the gut. To try to curtail this, Proviron developed the feed ingredient Providied Optigut, a well-selected combination of esterified fatty acids, to improve gut health by stimulating gut development and modulating gut flora. The efficacy was evaluated in field trials in Europe. Over more than 1 yr, Optigut was mixed in the feed of 300,000 turkeys in Germany until 12 wk of age. Performance was compared with monthly averages obtained from slaughterhouses. Likewise, Optigut was tested in industrial broiler conditions (600,000 heavy and 500,000 light broilers; slaughtered at 41 and 30 d of age, respectively). Technical performance was evaluated by end weight (EW), mortality and FCR. Health parameters were monitored by macroscopic lesion scoring and tracking of the AB use. All data were close to a normal distribution, determined by univariate statistics. A 2-way ANOVA was performed on all data, followed by a 2-sided t-test. P-values <0.05 were considered significant. In turkeys, the return on investment (ROI) based on the increased EW and reduced mortality and AB cost was ≥8. The AB cost dropped €0.5 per turkey. Broilers showed ROI ≥3 combined with a 2-d-AB reduction. This work proved that Providied Optigut could be used to reduce the antibiotic use and improve technical performance in poultry.

### Table 1.

<table>
<thead>
<tr>
<th>Tom turkey</th>
<th>Hen turkey</th>
<th>Heavy broiler</th>
<th>Light turkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>EW (kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+1.0*</td>
<td>+0.4*</td>
<td>+0.1*</td>
<td>+0.1*</td>
</tr>
<tr>
<td>FCR (points)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>−3*</td>
<td>−2*</td>
<td>−4*</td>
<td>−2*</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>−1.7*</td>
<td>−2.5*</td>
<td>−0.4*</td>
<td>−1.1*</td>
</tr>
</tbody>
</table>

*Significantly different.

**Key Words:** feed ingredient, gut health, nutrition, bacterial enteritis, metabolism

### 185 Susceptibility of broiler chickens fed fumonisin-contaminated diet and efficacy of an enzyme for gastrointestinal fumonisin hydrolysis.

Bertrand Grenier*1,2, Heidi Elisabeth Schwartz-Zimmermann2, Markus Aleschko1, Gerd Schatzmayr1, Wulf-Dieter Moll1, and Todd J. Applegate2,4, 1Biomin Research Center, Tulln, Austria, 2Department of Animal Sciences, Purdue University, West Lafayette, IN; 3Christian Doppler Laboratory for Mycotoxin Metabolism and Center for Analytical Chemistry, Department for Agrobionotechnology (IFA-Tulln), Tulln, Austria, 4Department of Poultry Science, University of Georgia, Athens, GA.

Emerging data show that mycotoxins from Fusarium species, such as deoxynivalenol and fumonisins (FB), may affect intestinal functions of broiler chickens and render them more susceptible to intestinal pathogens (e.g., Clostridium perfringens, Eimeria spp.), at concentrations close to field incidences and below the US and European Union guidelines. This is most likely attributed to the poor intestinal absorption of these mycotoxins, implying that a substantial portion of non-absorbed toxins remains in the lumen of the gastrointestinal tract (GIT). Thus, the present study determined the efficacy of an enzyme, fumonisin esterase FumD (FUMzyme), to hydrolyze FB in the GIT of broiler chickens. Male broilers were fed 3 different diets for 14 d (6 birds/cage, 6 cages/diet): (1) control feed, (2) feed contaminated with 10 mg FB/kg, and (3) feed contaminated with 10 mg FB/kg and supplemented with 100 U/kg of the fumonisin esterase. The biomarker of effect, Sa/So ratio, was evaluated in both serum and liver. FB ingestion typically results in a greater increase of the sphingoid base, sphinganine (Sa) than of sphingosine (So), and establishing the Sa/So ratio is very common to assess the exposure of animals to FB. In addition, the intestinal concentration of FB and its hydrolyzed form (metabolite produced by the enzyme) was evaluated in 3 different parts of the GIT, and in the excreta. Results showed that supplementation of feed with the fumonisin esterase is very effective in reducing the exposure of birds to FB, as observed for Sa/So ratios in the serum and liver. Disappearance of the parent mycotoxin by 71%, along with appearance of its hydrolyzed form, was observed regarding the analysis of the metabolite content in the GIT. The upregulation of inflammatory cytokine (mRNA) expression seen in the jejunum of birds fed FB was fully prevented by the addition of fumonisin esterase. In conclusion, diet supplementation with fumonisin esterase substantially detoxified FB in birds and neutralized the potential adverse effects on gut functions.

**Key Words:** mycotoxin, gastrointestinal tract, biotransformation, biomarker, cytokine

### 186 Biotransformation of deoxynivalenol to de-epoxy-deoxynivalenol in turkeys by Biomin BBSH 797.

Simone Schaumberger*1, Barbara Doupovec2, and Dian Schatzmayr2, 1Biomin Holding GmbH, Getzersdorf, Austria, 2Biomin Research Center, Tulln, Austria.

The feed additive Biomin BBSH 797 contains the bacterial strain BBSH 797 affiliated with the family Coriobacteriaceae. This bacterium catalyzes the cleavage of the 12,13-epoxy group of trichothecenes, which results in the formation of de-epoxy metabolites of no toxicological concern. The deoxynivalenol (DON) metabolite produced by BBSH 797 is epoxy-deoxynivalenol (DOM-1). In poultry excreta, both DON and DOM-1 are mostly present as sulfates (i.e., DON-3-sulfate and DOM-3-sulfate, respectively). The aim of this study was to investigate the capability of BBSH 797 to detoxify DON in the digestive tract of turkeys by using DON-3-sulfate and DOM-3-sulfate as biomarkers in excreta. Fifteen female turkeys (Hybrid Converter) approximately 10 wk of age were randomly assigned to 3 experimental groups. One group received feed naturally contaminated with 1.5 mg/kg DON (toxin group), a second group received feed containing 1.5 mg/kg DON and 1.7 × 10⁶ cfu BBSH 797/kg (BBSH 797 group), and a third group received feed without DON or BBSH 797 (control group). During the experimental phase of 3 d, turkeys were fed restrictively twice a day. Excreta samples of each bird were collected 7 times a day at fixed intervals for 2 consecutive days. Concentrations of DON-3-sulfate and DOM-3-sulfate in excreta were determined by LC/MS-MS analysis. At both sampling days, a significant decrease of DON-3-sulfate was observed in excreta of the experimental group with BBSH 797 compared with the toxin group. Concomitantly, DOM-3-sulfate significantly increased in the experimental group with BBSH 797 compared with the toxin group. Low levels of DON-3-sulfate and DOM-3-sulfate were detected in excreta of the control group. These findings indicate the effective biotransformation of DON to DOM-1 by BBSH 797 in the digestive tract of turkeys.

**Key Words:** turkey, mycotoxin, deoxynivalenol, biotransformation, Biomin BBSH 797

The antinutritional effect of phytic acid in feed ingredients is well documented. However, the nature and specific mechanisms for many of these interactions are not yet well defined. In this in vitro study, we investigated the effect of phytic acid on starch hydrolysis and provide mechanistic insights of the interactions. A spectrophotometric starch hydrolysis assay was used to quantify the effects phytic acid on starch hydrolysis. Saturation transfer difference NMR (STD-NMR) and internal tryptophan fluorescence were used to investigate ligand binding and conformational changes to amylase enzyme structure. There was complete hydrolysis of 250 μg of starch by 5 μg of amylase. Phytic acid inhibited starch hydrolysis, with almost complete inhibition achieved at 5 mM phytic acid concentration. The effect was driven through interactions between phytic acid and both starch and amylase. STD-NMR demonstrated that phytic acid was able to bind corn starch, wheat starch but not to a purified starch, maltodextrin. There was no binding of corn starch by phytic acid in the presence of phytase or protease. This could suggest that phytic acid is binding to proteins-associated with starch from grains preventing hydrolysis by amylase. The fluorescence assay showed there were conformational changes to amylase enzyme caused by phytic acid addition. These results suggest that phytic acid causes an unfolding of the amylase enzyme and rendering it catalytically inactive. Addition of phytase to the mixture can mitigate the effects, suggesting the interaction is reversible. In conclusion, this work identifies novel mechanistic insights to the way phytic acid inhibits starch hydrolysis and demonstrates that phytase is effective in alleviating the negative effects.

Key Words: phytase, phytic acid, starch, amylase, in vitro

Influence of initial body weight, beak trimming, and inclusion of Na-butyrate in the diet on growth performance, body weight uniformity, and digestive tract traits of brown pullets from hatching to 16 wk of age. Nuria Nuñez1, Guillermo Fondevila1, Pilar Guzmán1, Beatrix Saldaña1, Andrés Ortiz2, Raúl Rodríguez3, and Gonzalo G. Mateos*1, Departamento de Producción Agraria, Universidad Politécnica de Madrid, Madrid, Spain, 2Nutega S. L., Coslada, Madrid, Spain, 3Ibertec S. A. U., Boecillo, Valladolid, Spain.

The influence of initial BW and beak trimming on growth performance, BW uniformity, and gastrointestinal tract (GIT) traits was studied in brown pullets fed diets supplemented or not with 0.3% Na-butyrate (Butirex C4; Novation 2002 S. L.) from hatching to 16 wk of age. The GIT traits studied were the pH, relative weight (RW, g/kg BW), and fresh contents of the GIT organs and the relative length (cm/kg BW) of the small intestine and cecum, at 5, 10, and 16 wk of age. There were 12 treatments organized as a 2 × 2 × 3 factorial, with the initial BW of the pullets at hatching (34.2 vs. 37.9 g), beak trimming procedure [low (L-0) or high (H-0) intensity of infrared treatment applied at the hatchery, and traditional beak trimming at 8 d of age (F-8)], and inclusion of Na-butyrate in the diet (0 vs. 0.3%) as main effects. No interactions among main effects were detected for any of the variables studied and therefore, only main effects are presented. Growth performance was not affected by the initial BW of the pullets in any of the periods considered. From 0 to 7 wk of age, H-0 pullets had greater ADFI (P < 0.01) and ADG (P < 0.05) than F-8 pullets with L-0 pullets being intermediate. Also, F-8 pullets showed reduced ADFI (P < 0.05) from 0 to 16 wk of age as compared with H-0 pullets, with L-0 pullets being intermediate. Cumulatively (0–16 wk), no differences in ADG or FCR were detected. In general, the inclusion of Na-butyrate improved BW gain of the pullets but the benefits were significant only from 0 to 2 wk of age (P < 0.005). Treatment did not affect pullet uniformity or any of the GIT traits studied at any age. In summary, neither initial BW nor beak trimming methods affected pullet weight or GIT development. Supplementation of the diet with Na-butyrate improved pullet growth at the early stages of growth but not thereafter.

Key Words: beak trimming, gastrointestinal tract, initial body weight, Na-butyrate, pullet