705 Effects of dietary supplementation of benzoic, formic, and lactic acids on nitrogen balance of pigs. B. J. Min*[1], D. A. Monson[2], J. O. Vaughn[3], and S. W. Kim[1], [1]*North Carolina State University*, *Raleigh*, [2]*Texas Tech University*, *Lubbock*, [3]*Emerald Performance Materials*, *Kalama, WA*.

A total of 384 pigs was used to evaluate the effects of benzoic acid supplementation on nitrogen balance of pigs compared to antibiotics and organic acids. Pigs were weaned at 21 d of age and fed 7 diets for 5 wk based on 3 phase feeding program following nutrient requirements from NRC. There were 8 replicates per treatment and 8 pigs per pen. Treatments were **NC**: negative control without any supplements; **PC**: positive control with Aureomycin during phase 1, 2, and 3 and Tylan during phase 4, 5, and 6; **BA**, and **BB**: benzoic acid supplementation groups with 0.5 and 1.0% benzoic acid (Kalama™ BA Feed, Emerald Performance Materials, Kalama, OR), respectively; and **OA** and **OB**: organic acid supplementation groups with 0.5 and 1.0% organic acids at 1:1 ratio of formic acid and lactic acid. At the end of 5 wk feeding, each pig representing the average body weight of each pen was selected and housed individually in metabolism crates for 4 d adjustment period followed by 5 d collection periods of fecal and urine samples to measure nitrogen balance (n=8). Fecal samples were weighed, freeze dried, ground, and analyzed for nitrogen content. Urine samples were analyzed for nitrogen content. Nitrogen digestibility of PC (83.3%), BA (84.3%), BB (85.1%) was greater (P<0.05) than NC (79.3%). Nitrogen digestibility of OA (82.3%) and OB (82.5%) did not differ to other treatment groups. Nitrogen digestibility of PC, BA, and BB did not differ among each other. The percentages of nitrogen retained in the body were 52.4, 54.6, 61.1, 68.6, 66.8, and 55.7% for NC, PC, BA, BB, OA, and OB, respectively and did not differ among treatment groups. This study shows that dietary benzoic acid supplementation improves the digestion of proteins by pigs.

Key Words: Benzoic Acid, Organic Acid, Pigs

706 Dietary energy density affects response to a dry organic acid blend in late nursery pigs. R. J. Harrell*, B. V. Lawrence, R. Anderson, F. Navarro, and C. D. Knight, *Novus International Inc.*, *St. Charles, MO*.

Meeting dietary energy requirements has become more difficult for swine producers due to ingredient availability and increased cereal grain costs. Organic acids have successfully improved performance of early nursery pigs, especially in non-medicated diets. Previously, we reported improvements in gain by increased feed intake in grow-finish pigs fed a dry organic acid blend (DOAB, ACTIVATE®DA). The present trial evaluated the interaction of DOAB and dietary energy density. Forty pens of pigs with an initial weight of 11.5±0.22 kg (21 days post-weaning) were randomly assigned in a 2 x 2 factorial (n = 10 pens/treatment) to energy density (3460 vs. 3280 kcal ME/kg) and DOAB (0 vs. 0.3%) for a period of 21 days. Diets medicated with Carbadox 25 g/ton were formulated to provide a similar level of nutrients other than energy. High energy diets were a corn-SBM diet with 4% choice white grease. Low energy diets contained 10% wheat midds and 1% choice white grease. Ending bodyweights (24.21 vs. 24.12±0.51 kg; P > 0.90), ADG (602 vs. 597±9 g/d; P> 0.69), or ADFI (922 vs. 929±16 g/d; P> 0.74) were not different for high vs. low energy, respectively. High energy diets had 1.5% greater GF than low energy diets (0.653 vs. 0.643±0.003; P < 0.01). The DOAB did not affect final bodyweights (24.18 vs. 24.15±0.51 kg; P > 0.95), ADG (601 vs. 598±9 g/d; P > 0.84), or ADFI (935 vs. 917±15 g/d; P > 0.41), but increased GF by 1.6% (0.643 vs. 0.653±0.003; P < 0.01), for 0 vs. 0.3% DOAB, respectively. The DOAB tended to interact with dietary energy density in GF (P = 0.11) with a greater improvement in GF in low (2.5%), but not in high energy diets (0.5%). These results indicate that DOAB improves GF and can mitigate the loss of performance associated with feeding lower energy dense diets.

Key Words: Energy, Organic Acids, Swine

707 Effect of phytobiotics and acidifiers on the performance of post-weaning piglets. Y. Acosta Aragón*[1], T. Steiner[1], R. Castillo[2], and M. Lopez[3], [1]*Biomin GmbH*, *Herzogenburg, Lower Austria, Austria*, [2]*Universidad Zamorano*, *Tegucigalpa, Honduras*, [3]*Biomin America Inc*, *Guatemala City, Guatemala*.

The aim of this study was to investigate the effects of a an acidifier (blend of propionic and formic acid) and phytogenics (blend of essential oils) as well as their combination on feed intake (FI), average daily weight gain (ADWG), feed conversion ratio (FCR) and incidence of diarrhea. 262 piglets (Duroc × Landrace × Yorkshire), weaned at 21 days of age, were distributed to 5 treatments: I- negative control (without additive), II- positive control (combination of tiamulin + chlortetracycline, 2 kg/t), III- acidifier (3 kg/t), IV- phytogenic (1 kg/t), and V- acidifier and phytogenic (3 and 1 kg/t, respectively). Feed was offered ad libitum. A completely randomized design was used with 5 replicates per treatment. The study was divided in two phases: Phase 1 (28th to 42nd day), phase 2 (43rd to 70th day).

In phase 1, significant (p<0.05) differences were obtained in overall weight gain. The best treatments were I, III and V (3.1, 2.1 and 2.6 kg). Also, ADWG in phase 1 differed significantly (p<0.05) between treatments, with 216 and 176 g/day for the treatments I and V. Overall weight gain was numerically higher in the treatments III, IV and V (16.3, 16.0 and 16.4 kg) compared to treatments I and II (15.3 and 15.4 kg); as well as in the final BW (22.9, 23.2 and 23.6 vs. 22.6 and 22.1 kg, respectively). Overall FI was 713, 684, 731, 651 and 744 g/d (p>0.05) in treatments I through V, respectively, and overall FCR was 2.0, 1.9, 1.9, 1.7, and 1.9 (p>0.05), respectively.

In conclusion, the use of adequately designed phytogenics and acidifiers represents an alternative to the use of antibiotic growth promoters.

Key Words: Piglets, Phytobiotic, Acidifier

708 Gut environment modifier × lactose interaction in weaned pigs. J. Lampe[1], B. V. Lawrence*[2], R. J. Harrell[2], G. Gourley[1], R. A. Anderson[2], and F. Navarro[2], [1]*Swine Graphics Enterprises*, *Webster City, IA*, [2]*NOVUS International Inc*, *St. Louis, MO*.

ACIDOMATRIX™ LowLac (LowLac), a blend of gut environment modifiers including organic acids, MOS, esters of butyrate, and ethoxyquin, was evaluated in low lactose nursery diets fed for 14-d. Pigs (350) were blocked by weight (5.47±0.24 kg) and sex to pen (11 pigs/pen). Pens were assigned to one of 4 treatments (8 reps/trt) fed

from day 0-14 postweaning in two budget phases (1.36 kg/pig Phase 1 (7-d); 2.27 kg/pig Phase 2 (7-d)). Treatments were 1) Ctrl (19.2/12.2% lactose) 2) Neg1 (5 and 2.5% lactose) 3) LowLac (10/2.5% lactose + 0.69% Low-Lac, 4) Neg2 (10/2.5% lactose). Lactose replaced was from whey permeate. Diets contained 100 g/ton CTC. Zn from ZnO was supplemented at 3,240 ppm Phase 1 and 2,160 ppm Phase 2. CuSO4 was added at 0.05% Phase 1 and 0.075% Phase 2. LowLac gain (178 g/d) day 0-7 postweaning tended (P<0.10) to be greater than both Neg1 (147 g/d) and Neg2 (161 g/d) gains and was similar to Ctrl (163 g/d). Day 0-7 intake was not different (P>0.10) among treatments. LowLac gain/feed day 0-7 (0.97) tended (P<0.10) to be greater than Neg1 (0.84), Ctrl (0.89) and Neg2 (0.89) gain/feed. Ctrl gain (339 g/d) day 7-14 was greater (P<0.001) than LowLac (291 g/d) which was greater (P<0.01) than Neg1 (251 g/d). Neg2 gain (269 g/d) was intermediate to LowLac and Neg1. Day 7-14 gain/feed was poorer (P<0.05) for Neg1 (0.78) and Neg2 (0.79) than for Ctrl (0.91). LowLac gain/feed was intermediate (0.84). Intake day 7-14 followed a similar pattern to gain. Over the 14-d feeding period, Neg1 and Neg2 gains were similar (199 and 215 g/d) and were lower (P<0.01) than LowLac gains (236 g/d) which were lower (P<0.01) than Ctrl gains (258 g/d). Neg1 and Neg2 pigs day 0-14 gain/feed (0.81 and 0.83 respectively) was lower (P<0.05) than gain/feed for LowLac (0.88) and Ctrl (0.90) pigs. Day 0-7 feed cost/kg gain (FCKG) was $0.15 - $0.17/kg higher (P<0.01) for Ctrl vs. other treatments. Day 7-14, FCKG for Ctrl ($0.55/kg) was higher (P<0.05) than for Neg2 ($0.50/kg) with Neg1 ($0.54) and LowLac ($0.51/kg) being intermediate. These results demonstrate that low lactose diets may be economically fed when accompanied by ACIDOMATRIX LowLac.

Key Words: Lactose, Pigs, Organic Acids

709 Effect of antimicrobial growth-promoters in diets of nursery pigs on growth performance and the development of antibiotic resistant bacteria. J. P. Holt*, E. van Heugten, A. K. Graves, M. T. See, and W. E. M. Morrow, *North Carolina State University*, *Raleigh*.

A study was conducted with 40 weaned pigs (BW = 5.0 ± 0.8 kg), from a herd kept antibiotic-free for 33 years, to determine the effect of growth-promoting antimicrobials on performance and antibiotic resistance. Pigs were assigned by weight to one of four diets (10 pigs per diet) consisting of a control (CON), or diets containing high levels of zinc (ZN) from ZnO (3000 ppm for 2 wk, 1500 ppm for 3 wk), 240 ppm copper (CU) from $CuSO_4$, or 110 mg/kg (AB) each of tylosin (TYL) and sulfamethazine (SUL). Feces was collected from 16 pigs (4 per diet) from d 0 to d 7, and on d 14, 24, 31 and 38 for isolation of *E. coli* and *Enterococcus* (ENT). Resistance to TYL, SUL, erythromycin (ERY) and neomycin (NEO) was tested. Performance was unaffected by diet ($P > 0.05$). On d 7, ENT resistant to TYL was greater for AB (23%) than CON (5.8%), CU (0%), or ZN (3.7%; $P < 0.05$). On d 14, ENT resistance to TYL and ERY, respectively, was greater for AB (39, 37%), CU (50, 50%), and ZN (41, 40%) than CON (4.7, 6.6%; $P < 0.05$). On d 14, NEO resistance in ENT was greater for CU (50%) and ZN (45%) than CON (5.3%) and AB (0.9%; $P < 0.05$). On d 38, ENT resistance to TYL and SUL, respectively, was greater for AB (73, 76%) than CON (6.3, 52%) and CU (9.3, 50%; $P < 0.05$). On d 38, ENT resistance to ERY was greater for AB (69%) than CON (9.4%) and CU (12%; $P < 0.05$). *E. coli* resistance to TYL was greater for AB (55%) than CON (26%), CU (20%), or ZN (8.5%) at d 4 ($P < 0.05$), but on d 38, resistance was greater for CU (60%) than CON (34%), AB (28%), or ZN (28%; $P < 0.05$). *E. coli* resistance to SUL was greater for AB (33%) than CON (12%) at d 1 ($P < 0.05$) but on d 7, resistance was lower for AB (5.5%) than CON (32%). NEO-resistant *E. coli* were isolated only from pigs fed AB (6.3%). Development of antibiotic resistant bacteria can be increased by feeding antimicrobial growth-promoters, but resistant bacteria are present regardless of their use.

Key Words: Antibiotic Resistance, *Enterococcus*, *E. coli*

710 Kinetics of glucose absorption is affected by dietary oat β-glucans in portal-vein catheterized grower pigs. S. Hooda*[1], J. J. Matte[2], T. Vasanthan[1], and R. T. Zijlstra[1], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lennoxville, QC, Canada*.

Kinetics of nutrient digestion and absorption may impact intestine health and metabolic status and has, unlike nutrient digestibility, not been studied thoroughly in swine. A catheterized grower pig model was used to study effects of dietary β-glucans on net glucose absorption, which excludes glucose utilization by the gut. Three 35-kg pigs were surgically modified with catheters in the hepatic portal vein and carotid artery and an ultrasonic blood flow probe around the portal vein. Catheters were flushed daily with heparinized saline (200 IU/L). After 10 d, pigs were fed 3 wheat and soybean-based diets containing 0 (control), 3, and 6% concentrated oat β-glucans for 6 consecutive 7-d periods in a double Latin square design. Feed was offered twice daily at 12 h-intervals. On d 7 of each period, serial blood samples were taken for 12 h postprandially: every 15 min from -15 to 60 min, then every 30 min to 240 min, 60 min to 480 min, and at 600 and 720 min; blood flow was measured simultaneously. Plasma was analyzed for glucose. Glucose absorption rate was calculated from blood (via plasma and hematocrit) portal-arterial differences x blood flow. Carotid artery glucose and portal blood flow were not affected by diet, but changed with time (P<0.001). Preprandial portal glucose was 8 mmol/L and increased postprandially to 16 mmol/L, with highest peak for the control diet (P<0.05). Diet influenced (P<0.05) glucose absorption rate at 15, 30, and 60 min postprandial, and was highest for the control diet. Net glucose absorption during first h after feeding was reduced (P<0.05) by β-glucans; 3 and 6% β-glucans did not differ. Diet did not affect daily net glucose absorption (3464, control; 3216, 3% β-glucans; and 3357 mmol/d 6% β-glucans). The impact of reduced elevations of portal blood glucose on systemic utilization of nutrients requires further study; however, oat β-glucans clearly affect the kinetics of glucose absorption, but not daily net glucose absorption.

Key Words: β-Glucans, Glucose Absorption, Pig

711 Evaluation of ractopamine dose and feeding duration on growth performance and carcass characteristics of late finishing market pigs. R. B. Hinson*[1], G. L. Allee[1], M. J. Ritter[2], C. W. Parks[2], and S. N. Carr[2], [1]*University of Missouri*, *Columbia*, [2]*Elanco Animal Health*, *Greenfield, IN*.

The study objective was to compare various doses and durations of ractopamine hydrochloride (RAC; Paylean®, ELANCO Animal Health, Greenfield, IN) on growth performance and carcass characteristics. Late finishing pigs with an average starting weight of 93 kg were allotted to 12 treatments. Treatments consisted of two control diets: negative control (NEG; 13.13 % CP, 0.64 TID Lys), positive control (POS; 17.77

% CP, 0.94 TID Lys); two RAC diets 5 ppm or 7.4 ppm with pigs receiving RAC for 7, 14, 21, 28, or 35 d prior to market. Durations intended for RAC were fed the NEG diet until initiation of RAC when CP was increased to POS in order to comply with label requirements. All diets met or exceeded NRC nutrient recommendations. Pen weights and feed disappearance were recorded weekly. This study was conducted during June and July. At d 35, pigs were marketed by intact pen to a commercial slaughter facility. No differences ($P > 0.05$) were observed between the two RAC doses, therefore only the main effects of RAC and duration will be discussed. The feeding of RAC increased ($P < 0.001$) final BW (119.1 vs. 116.2 kg), overall ADG (0.76 vs. 0.68 kg), and improved F:G (2.99 vs. 3.39) when compared to the NEG with no difference ($P > 0.05$) in ADFI. Average daily gain (7.4 ppm RAC) was linearly increased ($P < 0.007$) and F:G (5 and 7.4 ppm RAC) was linearly improved ($P < 0.001$) with increased feeding duration of RAC. Feeding RAC increased ($P < 0.05$) carcass weight (89.7 vs. 87.3 kg), loin depth (7.01 vs. 6.77 cm), and % lean (55.6 vs. 54.98%) while reducing ($P < 0.05$) BF depth (1.74 vs. 1.85 cm) compared to the NEG diet. Carcass weight (7.4 ppm RAC) and loin depth and % lean (5 ppm RAC) linearly increased ($P < 0.05$) with increased duration and BF depth (5 ppm RAC) was linearly reduced with increased duration. From this data, the feeding of RAC and the increased feeding duration resulted in improved growth performance and carcass characteristics compared to the NEG.

Key Words: Ractopamine, Pigs, Duration

712 Effects of EcoCare® feed on growth performance and nutrient excretion of finishing pigs. T. Walraven*[1], S. Carter[1], M. Lachmann[1], J. Bundy[1], J. Jarrett[1], and B. De Rodas[2], [1]*Oklahoma State University*, *Stillwater*, [2]*Land O'Lakes Purina Feed*, *Gray Summit, MO*.

Eighty crossbred (D x LY) pigs (30.2 kg BW)were used to determine the effects of EcoCare® Feed (Land O'Lakes Purina Feed) on growth performance, pit characteristics, and DM, N, and P excretion during a 122-d finishing period. Pigs were blocked by BW and sex, and allotted randomly to 2 dietary treatments. Pigs were housed in an environmentally-controlled building divided into 4 identical rooms (20 pigs/room; 2 rooms/trt) with each having a shallow pit, pull-plug system. A fortified corn-soybean meal-based diet served as the control (20.1, 19.3, 17.9, 16.5, 15.1, and 13.7% CP; 0.37, 0.34, 0.31, 0.29, 0.27 and 0.25% available P for Phases 1 - 6, respectively). The experimental diet (EcoCare, EC) was similar to the control diet with the exceptions that CP was reduced by 2.6% units, available P by 0.11% units, with additions of Lys, Thr, Met, EC Pak (containing phytase) and EC premix. Both diets were formulated on true dig. Lys (1.02, 0.92, 0.83, 0.74, 0.65, and 0.56% for Phases 1 to 6), and Thr and Met were added to EC on an ideal basis. Pigs and feeders were weighed at each phase change, and pit volume and pH were measured. Feed and pit samples were collected for DM, N, and P analysis. Dietary treatment did not affect ($P > 0.10$) ADG (875 g), ADFI (2,370 g), G:F (0.37), or final weight (130 kg). Water disappearance (L/d) and pit volume decreased ($P < 0.05$) for pigs fed EC. Pit pH tended to decrease ($P < 0.06$) with EC. The avg concentration of DM in the pit was similar ($P > 0.10$), but N and P were reduced ($P < 0.01$) for pigs fed EC. Daily DM intake was similar for both diets, but N and P intakes were reduced ($P < 0.05$) for pigs fed EC. Daily DM excreted was similar ($P > 0.10$) between diets. However, daily N and P excretion for pigs fed EC was decreased ($P < 0.05$). Cumulative N and P excreted for the entire 122-d period was reduced ($P < 0.05$) for pigs fed EC. Based on these results, the EC diet did not affect pig growth performance, but reduced daily and total N and P excreted during a 122-d finishing period.

Key Words: Pigs, Diet, Nutrient Excretion