

first 2 wks of this 4 wk study. A seeder model was used for challenge with an F18 positive enterotoxigenic *E. coli* (ETEC) strain previously isolated from piglets with PWD. Two animals, paired by body weight, and exhibiting severe diarrhea 2 days after oral inoculation, were placed into pens of piglets that were either fed a diet containing 20mg/kg diet Col E1 (n=10) or a basal diet (n=9) with no addition. All animals were determined to be genetically susceptible to ETEC infections prior to their selection for this study and at the start of the study the average body weight was 5.4 kg (± 0.17).

In the first week after the seeder pigs were added, 4 of the control animals lost weight and two pigs lost more than 10% of their initial body weight. Body weight gain was greater in the Col E1 fed animals at week 1 ($P \leq 0.05$) and a trend existed for lower body weight in the control animals at weeks 2, 3, and 4 ($P \leq 0.1$). Final body weight was 14.2 kg in the controls and 16.3 kg in the E1 fed pigs. 80% of the control animals exhibited ETEC diarrhea within the first week compared to 30% of the Col E1 fed pigs. Of the 3 Col E1 animals that showed signs, the duration was less than 3 days for 2 of the animals compared to 6 days for the controls. Despite not showing diarrheal signs for over 10 d prior to the end of the study, higher levels ($P \leq 0.05$) of TNF α mRNA were seen in the ileal mucosa of pigs which did not receive the Col E1. The ileal mucosa of pigs fed the Col E1 diet had higher levels ($P \leq 0.05$) of message for COX2 and PGHS compared to the controls. This could suggest a lower ETEC challenge to these animals coupled to an upregulation of intestinal prostaglandins to preserve membrane integrity. The addition of 20 mg/kg Colicin E1 to the post-weaning swine diet prevented F18 ETEC caused PWD in piglets exposed to a natural route of infection.

Key Words: Colicin E1, Post weaning diarrhea, Pigs

148 Effects of chitooligosaccharide supplementation on growth performance, nutrient digestibility, blood characteristics, and immune responses after lipopolysaccharide challenge in weanling pigs. Y. J. Chen^{*1}, J. H. Cho¹, J. S. Yoo¹, Y. Wang¹, Y. Huang¹, H. J. Kim¹, S. O. Shin¹, K. Y. Whang², I. H. Kim¹, S. Y. Ji³, and S. D. Lee³, ¹Dankook University, Cheonan, Choongnam, Korea, ²Korea University, Seoul, Korea, ³National Institute of Animal Science, Seonghwan, Choongnam, Korea.

The objective of this study was to evaluate the effects of chitooligosaccharide (COS) on growth performance, nutrient digestibility, blood characteristics, and immune response in lipopolysaccharide (LPS) challenged weanling pigs. Ninety weanling pigs (5.44 ± 0.50 kg BW) were used in Exp. 1. Three dietary treatments were basal diets supplemented with 0, 0.25, and 0.5% COS, and fed for 28 d (6 replications and 5 pigs per pen). The ADG (394, 406 and 420 g) and ADFI (543, 567 and 582 g) tended to increase linearly with the increasing levels of COS addition ($P < 0.10$). Digestibilities of DM (71.1, 73.6 and 75.8%; $P < 0.05$) and N (70.8, 73.4 and 76.9%; $P < 0.10$) were also improved linearly by COS supplementation. Albumin, total protein, IgG, WBC, RBC and lymphocyte concentrations were not influenced by COS supplementation. In Exp. 2, 20 pigs (5.22 ± 0.31 kg BW) were assigned to two dietary treatments and fed on a diet supplemented with 0 or 0.5% COS for 28 d. Thereafter, half of the pigs in each treatment (n=5) were injected i.p. with either LPS or sterile saline solution (100 μ g/kg of BW), resulting a 2×2 factorial arrangement. Blood sample and rectal temperature data were collected at 0, 2, 4 and 12 h post-challenge. Rectal temperatures (4 and 12 h), cortisol (2 and 4 h) and TNF- α (2, 4 and 12 h) concentra-

tions were increased while IGF-1 (12 h) concentration was decreased by LPS challenge ($P < 0.05$). Rectal temperature tended to be decreased (39.7 vs 39.1 °C) by COS addition ($P < 0.10$). The COS treatments resulted in lower cortisol concentrations (11.4 vs 8.6 μ g/dl) at 2 h and higher IGF-1 concentrations (208 vs 264 ng/ml) at 4 h post-challenge ($P < 0.05$). In conclusion, dietary supplementation with COS could increase DM and N digestibilities and improve immune response under inflammatory challenge conditions.

Key Words: Chitooligosaccharide, Immune response, LPS

149 Effect of ACIDOMATRIX™ LowLac in low lactose nursery pig diets. R. J. Harrell^{*}, B. V. Lawrence, F. Navarro, R. Anderson, and C. D. Knight, *Novus International, St Charles, MO.*

Early nursery diets contain sources of lactose to optimize pig performance and the cost of these sources has risen dramatically in the past year. The trial was conducted to determine if ACIDOMATRIX™ LowLac (LowLac), a blend of organic acids, mannanoligosaccharide, esters of butyrate, and ethoxyquin could alleviate reduced pig performance fed low lactose diets. Approximately 550 pigs (5.92 ± 0.32 kg) were blocked by size and sex to a pen (23 pigs/pen) and randomly assigned to 1 of 4 treatments (6 pens/treatment). Treatments were implemented from 0 to 21 days postweaning in two phases (0 to 10 and 11 to 21 days). Treatments were 1) HL (20 and 10% lactose) 2) LL (5 and 2.5% lactose) 3) LL + LowLac (0.69%), 4) LL + LowLac (0.69 and 0.48%, for phase I and II, respectively). Lactose was supplied from whey permeate and all diets contained Mecadox (50 g/ton) and ZnO (2500 ppm). No differences in BW or GF were detected among treatments ($P > 0.05$). Pigs fed HL had greater ADG than pigs fed LL or LowLac from 0 to 10 days (183 vs 153 vs 160 vs 157 ± 7.7 g/d; $P < 0.05$). Pigs fed HL had greater ADFI than pigs fed LL or LowLac from 0 to 10 days (205 vs 177 vs 185 vs 183 ± 6.9 g/d; $P < 0.05$). No differences were detected in ADG among treatments from 11 to 21 days ($P > 0.15$). Pigs fed HL had greater ADFI than pigs fed LL (454 vs 395 ± 19.6 g/d; $P < 0.05$), but similar to pigs fed LowLac from 11 to 21 days (437 and 409 ± 19.6 g/d; $P > 0.05$). Overall, from 0 to 21 days, pigs fed LowLac had similar ADG ($P > 0.25$) compared to pigs fed HL. Pigs fed HL had greater ADG than pigs fed LL (275 vs 240 ± 12.4 g/d; $P < 0.05$) from 0 to 21 days. Pigs fed HL had higher ADFI than pigs fed LL (335 vs 291 ± 12.4 g/d; $P < 0.05$) and pigs fed the reduced dose of LowLac from 0 to 21 days (301 ± 12.8 g/d; $P < 0.05$). Pigs fed the full dose of LowLac had similar ADFI as pigs fed HL ($P > 0.20$). Feed cost per unit gain was 27% higher for HL ($P < 0.05$) than LL or LowLac. In summary, reductions in lactose content reduced pig performance from 0 to 10 days, but data suggests the loss in performance was mitigated from 11 to 21 days and overall from 0 to 21 days postweaning with ACIDOMATRIX™ LowLac.

Key Words: Lactose, Nursery, Swine

150 Evaluation of an enzyme blend (Natuzyne®) in diets for weanling pigs. J. R. Bergstrom^{*}, M. D. Tokach, J. L. Nelssen, S. S. Dritz, J. M. DeRouchey, and R. D. Goodband, *Kansas State University, Manhattan.*

Two experiments were conducted to evaluate an enzyme blend (Natuzyne®) in nursery diets. In Exp. 1, 210 pigs (6.2 kg) were used in a factorial to evaluate increasing levels of enzyme (0, 0.035, and 0.05%)

in a negative control (NC) diet with 12.5% soy hulls and no antibiotic; or a positive control (PC) without soy hulls, but with antibiotic (154 ppm of neomycin and 154 ppm of oxytetracycline). Pigs were blocked by BW and allotted to treatment at weaning, with 7 pigs/pen and 5 pens/treatment. For d 0 to 14, ADG (213 vs 191 g/d) and d 14 wt (9.2 vs 8.8 kg) tended to improve ($P < 0.08$) by feeding the PC diets. There were trends for improved (quadratic, $P < 0.09$) ADG (186, 222, and 200 g/d), ADFI (204, 245, and 218 g/d), and d 14 wt (8.8, 9.3, and 9.0 kg) with increasing enzyme. Overall (d 0 to 35), ADG and d 35 wt tended (linear, $P < 0.09$; and quadratic, $P < 0.07$; respectively) to increase for pigs fed increasing enzyme or PC diets ($P < 0.07$ and $P < 0.08$, respectively). In Exp. 2, 180 pigs (6.4 kg) were used in a 2×3 factorial to evaluate increasing enzyme (0, 0.035, and 0.05%) in NC and PC diets. The NC diet contained no soy hulls or antibiotic. The PC was identical to that used in Exp. 1. Pigs were blocked by BW and allotted to treatment at weaning with 5 pigs/pen and 6 pens/treatments. From d 0 to 14, pigs fed the PC diet had improved ($P < 0.01$) ADG (150 vs 118 g/d), G/F (0.80 vs 0.69), and d 14 wt (8.45 vs 8.0 kg), and tended ($P < 0.06$) to have increased ADFI (181 vs 163 g/d) compared to the NC. Pigs fed increasing enzyme had improved (linear, $P < 0.05$) ADG (118, 141, and 145 g/d), G/F (0.68, 0.78, and 0.77), and d 14 wt (8.0, 8.3, and 8.4 kg). From d 14 to 35, pigs fed increasing enzyme had poorer (linear, $P < 0.05$) G/F. Overall (d 0 to 35), ADG, ADFI, and d 35 wt improved ($P < 0.01$) for pigs fed the PC diets. When data of the PC diets in both experiments were combined, overall (d 0 to 35) ADG, ADFI, and d 35 wt were improved (linear and quadratic, $P < 0.05$) with increasing enzyme levels, with 0.035% Natuzyme[®] resulting in the best performance.

Key Words: Pig, Enzymes, Antibiotic

151 Effect of individual or combined xylanase and phytase supplementation on site of nutrient digestion of a diet with reduced nutrient specifications containing wheat and millrun fed to weaned pigs. T. Nortey^{*1}, J. Sands², and R. Zijlstra³, ¹*Shur-Gain/Nutreco, St. Mary's, ON, Canada*, ²*Danisco Animal Nutrition, Marlborough, U.K.*, ³*Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Alberta, Canada*.

Millrun can partially replace wheat in diets with a reduced nutrient specification for weaned pigs if enough improvement is provided by xylanase (Xyl) and phytase (Phy). The effects of Xyl (4375 U/kg of feed) and Phy (500 FTU/kg of feed) supplementation on energy, site of nutrient digestibility, and pH in the gut, and on performance were studied in a 2×2 factorial arrangement together with a positive control diet (3.50 Mcal DE/kg, 3.25 g true digestible Lys/Mcal DE, 0.65% total P, and 0.80% Ca). The contents of Lys, P, and Ca were reduced by 10% and DE by 150 kcal/kg in the other 4 diets. Weaned pigs (8.6 ± 0.5 kg) had free access to feed for 21 d. Feces were collected on d 19. On d 20 and 21, pigs were euthanized and gut contents was collected. Feeding a nutrient reduced diet reduced ($P < 0.01$) total tract energy digestibility. Xyl and Phy interacted to improve ($P < 0.05$) the total tract DE content of the negative control (NC) diet from 3.58 to 3.82 Mcal/kg. Xyl improved ($P < 0.01$) energy digestibility of the NC diet in the mid jejunum and over the total tract by 6.3 and 4.6% to 59.5 and 85.7% respectively. Phy addition improved ($P < 0.05$) the DE content of the NC by 160 kcal/kg to 3.74 Mcal/kg. Phy raised ($P < 0.01$) the pH of the upper mid small intestine (SI). Xyl improved ($P < 0.05$) BW, ADG, and G:F of the NC diet at d 21 by 1.7 kg, 0.18 kg/d, and 0.06, to 20.8 kg, 0.59 kg/d, and 0.69 respectively. On d 21, Phy improved BW ($P < 0.01$) and ADG ($P < 0.05$) of the NC diet by 11.0 and 31.0% respectively. Xyl

and Phy improved total tract DE content and performance of weaned pigs fed nutrient reduced diets. Phy accelerated the return to alkaline conditions in the upper part of the SI. Exogenous enzymes can be used to improve the digestibility of diets based on wheat and millrun with reduced nutrient specification for weaned pigs.

Key Words: Pigs, Millrun, Phytase

152 Effects of mannanase addition to copra meal and palm kernel meal diets on growth performance and nutrient digestibility of growing-finishing pigs. Y. D. Jang^{*}, J. H. Yun, D. H. Kim, J. H. Lee, W. S. Ju, and Y. Y. Kim, *Seoul National University, Seoul, Korea*.

This study was investigated to evaluate the copra meal and palm kernel meal with mannanase on growth performance, nutrients digestibility, blood urea nitrogen (BUN) and microflora of large intestine in growing-finishing pigs. The experiment was conducted during 13 weeks. A total of 80 crossbred pigs, averaging 20.04 kg body weight, were allotted to treatments in four replicates with four pigs per pen. Treatments included: 1) CON (basal diet - corn-soy bean meal based); 2) CM5 (copra meal 5% + 0.1% mannanase(800IU)), 3) CM10 (copra meal 10% + 0.1% mannanase(800IU)), 4) PKM5 (palm kernel meal 5% + 0.1% mannanase(800IU)), 5) PKM10 (palm kernel meal 10% + 0.1% mannanase(800IU)). During the whole experimental period, pigs fed PKM5 diet showed higher average daily gain (ADG). But pigs fed diet of CM10 had lower body weight (104.26, 105.47, 100.28, 108.37, 105.04, $P < 0.05$ for CON, CM5, CM10, PKM5, PKM10, respectively) and ADG (924, 939, 882, 968, 934, $P = 0.080$ for CON, CM5, CM10, PKM5, PKM10, respectively) than other treatments. There were not significantly different in ADFI and G/F among all dietary treatments. The supplementation of copra meal and palm kernel meal with mannanase had no significant difference in nutrients digestibility. But the digestibility of crude fiber in pigs fed diets supplemented copra meal and palm kernel meal was lower compared to CON. At the end of experiment, BUN concentration was the highest in pigs fed diets of PKM10 and CM10 and was the lowest in pigs fed diets of PKM5 and CM5 (8.95, 11.62, 10.60, 12.93 mg/dl, $P < 0.05$ for CM5, CM10, PKM5, PKM10, respectively). There were no significant differences on the count of E.coli and Salmonella in rectum of the pigs at the end of experiments. These results may suggest that copra meal and palm kernel meal with mannanase could be possible alternatives to corn in pigs' diets with minor detrimental influence on growth performance and nutrients digestibility.

Key Words: Pig mannanase, Copra meal, Growth performance

153 Feeding distillers dried grains with solubles (DDGS) to pigs. H. H. Stein^{*}, *University of Illinois, Urbana*.

The digestibility of energy and nutrients in distillers dried grains with solubles (DDGS) has been measured and performance of pigs fed diets containing DDGS has been reported from many experiments. Seven experiments in which diets containing corn or sorghum DDGS were fed to weaning pigs from 2 weeks post-weaning were completed. Improvements in G:F were reported from 2 experiments, whereas no change in performance was reported from the remaining experiments. Results of 17 experiments in which performance of growing finishing pigs fed diets containing corn DDGS were compared with performance of pigs fed diets containing no DDGS have been reported. The ADG was