175 Effects of dietary supplementation with xylanase and probiotics on growth performance and gut health of newly weaned pigs challenged with enterotoxigenic E. coli on d 7 post weaned.

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This study was to investigate the effect of dietary supplementation with xylanase and probiotic on growth performance, and gut health of nursery pigs challenged with ETEC. Sixty-four weaned pigs (7.9 ± 0.4 kg) were allotted in a RCBD (2 x 2 factorial). ETEC (0, and ETEC, 6 x 10^9 CFU/mL) and synbiotic (0, and xylanase 10,000 XU/kg combined with Bacillus sp. 6 x 10^8 CFU/kg) were the factors. ETEC was orally inoculated on d 7. Growth performance were measured on d 7, 10, 15, and 21. On d 21, 48 pigs were euthanized for sampling to measure gut health parameters. Synbiotic increased ($P < 0.05$) ADG in P1 (53.5 to 96.0 g). Overall, ETEC reduced ($P < 0.05$) ADG (387.5 to 322.5 g) and G:F (0.810 to 0.706). ETEC increased ($P < 0.05$) fecal score from d 7 to 13, whereas synbiotic reduced ($P < 0.05$) it at d 9 and 11 in challenged pigs. ETEC increased ($P < 0.05$) MDA (0.259 to 0.818 μmol/mg), IL6 (2.96 to 4.30 pg/mg), ki-67^+ (29.1 to 33.9%), and crypt depth (260 to 290 μm), whereas synbiotic tended to reduce TNF-α (1.05 to 0.87 pg/mg), protein carbonyl (3.13 to 2.51 nmol/mg), and IL6 (4.07 to 3.19 pg/mg); reduced ($P < 0.05$) crypt depth (290 to 260 μm), and ki-67^+ (32.7 to 30.3%) and increased ($P < 0.05$) villus height (368.5 to 421.4 μm). ETEC reduced ($P < 0.05$) abundance of Veillonellaceae (7.11 to 3.02%), tended to reduce ($P = 0.067$) Clostridiaceae (1.1 to 0.55%), and Prevotellaceae (38.0 to 27.2%) and tended ($P = 0.063$) to increase Helicobacteraceae (34.5 to 49.5%). Collectively, ETEC reduced growth performance by affecting the microbiome, oxidative stress, and immune response. Synbiotic improve growth performance by enhancing gut health regardless of the challenge, whereas it reduced fecal score in challenged pigs.

Keywords: Escherichia coli, gut health, newly weaned pigs

178 Efficacy of commercial products on growth performance of nursery pigs fed diets with fumonisin-contaminated corn.

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Two experiments were conducted to determine the efficacy of commercial products on growth performance of nursery pigs fed high fumonisin diets. In Exp. 1,350 pigs (241 × 600; DNA; initially 9.9 kg) were used with 5 pigs per pen and 14 pens per treatment. Five dietary treatments consisted of a positive control (low fumonisin, 4 ppm fumonisin; FB1 + FB2), negative control (50 ppm fumonisin;) and the negative control with one of three products (0.3% of Kallsil Dry, Kemin Industries Inc., Des Moines, IA; 0.3% of Feed Aid Wide Spectrum, NutriQuest, Mason City, IA; 0.17% of Biofix Select Pro, Biomin America Inc., Overland Park, KS). Diets were fed for 14 d. Pens were assigned to treatments in a randomized complete block design with initial weight as the blocking factor. Data were analyzed using nlme package in R program (version 3.5.2) with pen as experimental unit. Pigs fed the negative control, or diets with Kallsil Dry or Feed Aid had decreased ($P< 0.05$) ADG, ADFI, and G:F compared with those fed the positive control and diet with Biofix. Pigs fed the positive control diet had decreased ($P< 0.05$) d 14 serum sphinganine to sphingosine (Sa:So) ratio than those fed other diets. In Exp. 2, 300 pigs (241 × 600; initially 10.4 kg) were used and fed experimental diets for 28 d. Procedures were similar to Exp. 1 except there were 12 replicates per treatment and diets contained 30 ppm fumonisin. Pigs fed the negative control, or diets with Kallsil Dry or Feed Aid had decreased ($P< 0.05$) ADG and G:F, and greater ($P< 0.05$) d 14 and 28 Sa:So ratios compared with the positive control and diet with Biofix. In summary, adding Biofix to high fumonisin diets mitigated the negative effects of fumonisin while Kallsil Dry and Feed Aid did not.

Table 1. Efficacy of commercial products on growth performance and serum sphinganine to sphingosine ratio of nursery pig fed diets with fumonisin-contaminated corn[1,2,3]

Item	Positive control	Negative control	Negative control			SEM
			Kallsil Dry	Feed Aid	Biofix	
Exp. 1						
BW, kg						
d 0	9.9	9.9	9.9	9.9	9.8	<0.17[4]
d 14	16.7[a]	13.8[b]	13.2[b]	13.6[b]	16.2[a]	0.31
d 0 to 14						
ADG, g	483[a]	268[b]	228[b]	258[b]	454[a]	14.7
ADFI, g	717[a]	556[b]	506[b]	517[b]	690[a]	17.1
G:F	0.672[a]	0.480[b]	0.448[b]	0.492[b]	0.659[a]	<0.0250[5]
Sa:So						
d 14	0.26[b]	1.77[a]	2.15[a]	2.31[a]	1.62[a]	<0.241[6]
Exp. 2						
BW, kg						
d 0	10.4	10.5	10.4	10.5	10.4	0.18
d 28	28.4[a]	25.0[b]	25.9[b]	25.4[b]	28.3[a]	0.52
d 0 to 28						
ADG, g	624[a]	518[b]	546[b]	526[b]	626[a]	15.6
ADFI, g	909[ab]	844[b]	866[ab]	845[b]	934[a]	23.2
G:F	0.687[a]	0.613[b]	0.631[b]	0.623[b]	0.671[a]	0.0068
Sa:So						
d 14	0.46[b]	1.68[a]	2.02[a]	1.36[a]	0.53[b]	<0.293[7]
d 28	0.50[b]	1.51[a]	1.46[a]	1.48[a]	0.54[b]	<0.144[8]

[a,b,c] Means within a row with different superscripts differ (*P*<0.05).
[1]Average daily gain (ADG); average daily feed intake (ADFI); gain to feed ratio (G:F); body weight (BW); sphinganine (Sa); sphingosine (So); sphinganine to sphingosine ratio (Sa:So).
[2]Inclusion rate: 0.3% of Kallsil Dry (Kemin Industries Inc., Des Moines, IA); 0.3% of Feed Aid Wide Spectrum (NutriQuest, Mason City, IA); 0.17% of Biofix Select Pro (Biomin America Inc., Overland Park, KS).
[3]Negative control contained 50 ppm of fumonisin in Exp. 1, and 30 ppm of fumonisin in Exp. 2.
[4]Heterogenous variance: Positive control (0.15), negative control (0.15), Kallsil Dry (0.15), FeedAid (0.15), and Biofix (0.17).
[5]Heterogenous variance: Positive control (0.0063), negative control (0.0148), Kallsil Dry (0.0146), Feed Aid (0.0250), and Biofix (0.0109).
[6]Heterogenous variance: Positive control (0.042), negative control (0.127), Kallsil Dry (0.225), Feed Aid (0.241), and Biofix (0.198).
[7]Heterogenous variance: Positive control (0.062), negative control (0.161), Kallsil Dry (0.293), Feed Aid (0.160), and Biofix (0.079).
[8]Heterogenous variance: Positive control (0.063), negative control (0.144), Kallsil Dry (0.048), Feed Aid (0.121), and Biofix (0.055).

Keywords: corn, fumonisin, nursery pigs

174 The effect of a microbial Muramidase on peptidoglycan content in the gut of swine using in-vitro and in-vivo measures. Ursula M. McCormack[1], Mikkel Klausen[2], Lisa A. Laprade[1], Sonja Christian[2], Carsten Østergaard Frederiksen[2], Maria C. Walsh[1], Tsungcheng Tsai[3], Charles V. Maxwell[4], Casey L. Bradley[5], [1]*DSM Nutritional Products,* [2]*Novozymes A/S,* [3]*University of Arkansas,* [4]*University of Arkansas-Fayetteville,* [5]*DSM Nutritional Products LLC*

Bacterial debris in the gastrointestinal tract (GIT) are continuously being produced by the microbiota present upon bacterial division and death. One of the most abundant components in bacterial debris are peptidoglycans (PGN), a structural cell wall component in gram- positive and negative bacteria. The objective of this work was to investigate if addition of a novel microbial muramidase (Muramidase 007; MUR) that hydrolyzes PGN, would reduce PGN adhesion to porcine intestinal cells in-vitro and hydrolyze PGN in the GIT of swine. Adhesion efficacy of intact and MUR hydrolyzed fluorescein-isothiocyanate (FITC)-labelled PGN were compared using fluorescence-microscopy (3 wells/condition). Catalytic performance of MUR on intact FITC-labelled PGN adhered to intestinal cells were also tested. In-vivo MUR-supplementation at 50,000 LSU/kg diet to gestating and lactating sows and/or their subsequent offspring for 42-d post-weaning was investigated. Mass-spectroscopy was used to quantify soluble and total muramic acid, which is only found in PGN, in the ileal and cecal digesta (8 piglets/treatment) to calculate percentage soluble-PGN. Cell-culture data were analyzed using GraphPad-Prism 8.0 and in-vivo data using mixed-models in JMP 14.0. MUR hydrolyzed PGN adhered 10x less to the IPEC-J2 cell line culture compared to intact-PGN (P< 0.05). In addition, data show that MUR hydrolyzed PGN attached to cell surfaces by 2x, as attached PGN were also reduced by 50% following MUR incubation (P< 0.05). Offering sows MUR-diets had no carryover effect on the percentage soluble PGN in their piglets' digesta, and there were no interactions observed for sow x piglet x tract neither (P >0.05). Percentage soluble-PGN increased in piglets fed MUR compared to control-piglets (47.18 vs. 29.84% SEM:1.624; P< 0.001) and was higher in cecal digesta compared to ileal digesta (49.91 vs. 27.11%; SEM:1.634; P< 0.001), irrespective of MUR-supplementation. These results suggest that MUR may reduce PGN adhesion to intestinal cells and may hydrolyze PGN found in the GIT.

Keywords: muramidase, swine, peptidoglycan