Evaluation of Novel Enzyme Blend on Nursery Pig Performance[1]

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Summary

Two experiments were conducted to determine the effects of a dietary enzyme blend and diet complexity on weanling pig performance. In Exp. 1, 180 pigs (initially 12.7 lb BW and 21 d of age) were used in an 18-d growth trial. Pigs were blocked by weight and randomly allotted to 1 of 3 dietary treatments with 5 pigs per pen and 12 pens per treatment. The 3 dietary treatments included (1) a high-complexity positive control, (2) a low-complexity negative control, and (3) a treatment with an added proprietary enzyme blend (Engrain LLC, Manhattan, KS). All diets were fed in 2 phases, with pigs fed a Phase 1 pelleted diet from d 0 to 8 and a Phase 2 diet in meal form from d 9 to 18. From d 0 to 8, pigs fed the high-complexity diet had improved ($P < 0.05$) ADG and F/G compared with pigs fed the low-complexity diet without enzymes. Also, pigs fed the low-complexity diet with enzymes tended to have increased ($P < 0.10$) ADG and improved ($P < 0.05$) F/G compared with pigs fed the low-complexity diet without enzymes. From d 9 to 18, no differences were observed in growth among pigs fed any of the dietary treatments. Overall (d 0 to 18), pigs fed the high-complexity diet had improved ($P < 0.05$) F/G compared with pigs fed the low-complexity diet with or without enzymes, but ADG and ADFI did not differ among the 3 dietary treatments.

In Exp. 2, 360 pigs (initially 12.4 lb BW and 21 d of age) were used in an 18-d growth trial. Pigs were blocked by weight and allotted to 1 of 6 dietary treatments with 5 pigs per pen and 12 pens per treatment. Dietary treatments were arranged in a 2 × 3 factorial with main effects of diet complexity (low, medium, or high) with or without the enzyme blend. Diets were fed in 2 phases, with pigs fed a Phase 1 pelleted diet from d 0 to 8 and a Phase 2 diet in meal form from d 9 to 18. Overall (d 0 to 18), pigs fed increasingly complex diets had improved ADG, ADFI, and F/G (linear, $P < 0.02$). Added dietary enzyme blend had no effects on pig growth performance. Thus, we conclude that diet complexity for the newly weaned pig is essential for improved performance postweaning; however, the enzyme blend evaluated in these experiments did not affect overall growth performance.

Key words: diet complexity, enzyme, nursery pig

Introduction

The use of dietary enzymes as a means of improving nutrient digestibility in weanling pigs continues to receive attention because of the increased price of feed ingredients. The majority of the research has focused on the use of enzymes in diets containing low-energy, high-fiber ingredients such as dried distillers grains with solubles and wheat

1 Appreciation is expressed to Engrain, LLC (Manhattan, KS) for partial funding of the experiments.
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middlings. These ingredients have a high concentration of non-starch polysaccharides that serve as substrates for the added dietary enzymes to break down.

Because weanling pigs have a relatively immature digestive system, adding enzymes to diets may make the diet more digestible. If added enzymes improve digestibility of the diet, the amount of specialty protein sources used in these diets could be reduced; thus, the objective of this study was to evaluate a novel proprietary enzyme blend fed in diets of varying complexity on weanling pig performance.

Procedures

All experimental procedures were approved by the Kansas State University Institutional Animal Care and Use Committee.

Experiment 1

A total of 180 pigs (PIC 1050; initially 12.7 lb and 21 d of age) were used in an 18-d growth trial. Pigs were blocked by weight and randomly allotted to 1 of 3 dietary treatments with 5 pigs per pen and 12 pens per treatment. Each pen (5 ft × 5 ft) contained a 4-hole dry self-feeder and a 1-cup waterer to provide ad libitum access to feed and water. The study was conducted at the Kansas State University Segregated Early Weaning Facility, Manhattan, KS.

The 3 dietary treatments included: (1) a high-complexity positive control diet, (2) a low-complexity negative control diet, and (3) the low-complexity diet (treatment 2) with an added enzyme blend (Engrain LLC, Manhattan, KS). All diets were fed in 2 phases with pigs fed a pelleted Phase 1 diet from d 0 to 8 and a Phase 2 diet in meal form from d 9 to 18 (Table 1). All diets contained 20% and 5% spray-dried whey for Phases 1 and 2, respectively. The highly complex diet included 6% spray-dried animal plasma, 1.25% spray-dried blood cells, and 1.25% select menhaden fish meal in Phase 1 and 1.25% spray-dried blood cells and 1.25% select menhaden fish meal in Phase 2; the low-complexity diets were not supplemented with these ingredients. All diets were manufactured at the Kansas State University Grain Science Feed Mill. Pigs were weighed and feed disappearance was measured on d 8 and 18 of the trial to determine ADG, ADFI, and F/G.

Experiment 2

A total of 360 pigs (PIC 1050; initially 12.4 lb and 21 d of age) were used in an 18-d growth trial. Pigs were housed in the same facility as Exp. 1.

At weaning, pigs were fed 1 of 6 dietary treatments arranged in a 2 × 3 factorial. Main effects included diet complexity (low, medium, or high) and presence or absence of enzyme blend (Engrain LLC, Manhattan, KS). All diets were fed in 2 phases, with pigs fed a Phase 1 pelleted diet from d 0 to 8 and a Phase 2 diet in meal form from d 9 to 18 (Tables 2 and 3). The high-complexity diet contained similar levels of specialty protein sources as in Exp. 1, with the medium-complexity diets containing half the amount of each specialty ingredient. The low-complexity diet contained no animal specialty protein sources in either phase. Similar to Exp. 1, all diets contained 20% and 5% spray-dried whey for Phases 1 and 2, respectively. All diets were manufactured at the K-State

Grain Science Feed Mill. Pigs were weighed and feed disappearance was measured on d 8 and 18 of the trial to determine ADG, ADFI, and F/G.

Data were analyzed as a randomized complete block design with pen as the experimental unit. Data were analyzed using an analysis of variance using the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.) with the weight block as a random effect and the treatments as fixed effects with linear and quadratic polynomials used to determine the effect of complexity in Exp. 2. Results were considered significant at $P \leq 0.05$ and were considered a trend at $P \leq 0.10$.

Results and Discussion

Experiment 1

From d 0 to 8, pigs fed the high-complexity diet had improved ($P < 0.05$) ADG compared with pigs fed the negative control diet, with pigs fed the negative control diet with added enzymes intermediate. No differences ($P > 0.10$) were observed in ADFI among treatments. No differences ($P > 0.10$) were observed in F/G between pigs fed the negative control diet with enzymes and pigs fed the high-complexity positive control diet, both of which were better than the negative control, low-complexity, diet. From d 9 to 18, ADG, ADFI, and F/G did not differ ($P > 0.10$) among treatments. Overall (d 0 to 18), there were no differences among pigs fed any of the dietary treatments; however, pigs fed the positive control diet had improved ($P < 0.05$) F/G compared with pigs fed the negative control diet with or without enzymes.

Experiment 2

From d 0 to 8, pigs fed increasingly complex diets had improved (linear, $P < 0.001$) ADG, ADFI, and F/G (Table 4). Adding the enzyme blend to any of the diets had no effect on pig performance ($P > 0.10$). From d 9 to 18, neither diet complexity nor added enzyme had an effect ($P > 0.10$). Overall (d 0 to 18), pigs fed increasingly complex diets had improved (linear, $P < 0.02$) ADG, ADFI, and F/G; again, adding an enzyme blend to any of the diets did not affect pig growth performance

Addition of the enzyme blend to low-complexity diets tended to improve ADG in Exp. 1, but not in Exp. 2. The reason for the inconsistency is unknown, because the facilities, pig source, health, and initial pig weight were similar for both experiments; however, these data demonstrate the importance of diet complexity immediately after weaning on nursery pig growth performance.

Table 1. Composition of diets, Exp. 1 (as-fed basis)[1]

	Phase 1		Phase 2	
Item	Low complexity	High complexity	Low complexity	High complexity
Ingredient, %				
Corn	31.58	45.73	49.70	60.53
Soybean meal (46.5% CP)	40.00	17.51	38.75	25.01
Spray-dried animal plasma	-	6.00	-	.
Select menhaden fish meal	-	1.25	-	1.25
Spray-dried blood cells	-	1.25	-	1.25
Spray dried whey	20.00	20.00	5.00	5.00
Soybean oil	3.00	3.00	1.00	1.00
Monocalcium phosphate (21% P)	1.60	1.08	1.70	1.58
Limestone	0.70	0.95	0.85	0.85
Salt	0.30	0.30	0.30	0.30
Vitamin premix	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15
L-lysine HCl	0.18	0.23	0.15	0.40
DL-methionine	0.17	0.18	0.10	0.20
L-threonine	0.08	0.07	0.06	0.19
L-tryptophan	-	-	-	0.02
L-isoleucine	-	0.06	-	0.04
Lactic acid	2.00	2.00	2.00	2.00
Engrain enzyme blend[2]	-	-	-	-
Total	100.0	100.0	100.0	100.0
Standard ileal digestible (SID) amino acids, %				
Lysine, %	1.45	1.45	1.32	1.32
Isoleucine:lysine, %	66%	55%	68%	55%
Methionine:lysine, %	34%	31%	32%	36%
Met & Cys:lysine, %	58%	58%	58%	58%
Threonine:lysine, %	63%	63%	63%	63%
Tryptophan:lysine, %	19%	17.6%	20%	17.1%
Valine:lysine, %	69%	69%	74%	66%
ME, kcal/lb	1,547	1,564	1,513	1,516
DE, kcal/lb	1,636	1,639	1,596	1,591
SID lysine:ME, g/Mcal	4.25	4.21	3.94	3.95
Total lysine, %	1.61	1.59	1.47	1.45
CP, %	24.2	21.6	23.3	20.1
Ca, %	0.86	0.86	0.82	0.82
P, %	0.85	0.77	0.81	0.76
Available P, %	0.55	0.55	0.47	0.47

[1] Pigs were fed Phase 1 diets from d 0 to 8 and Phase 2 diets from d 9 to 18.

[2] Added at a rate of 0.11% in low-complexity diets in Phase 1 and Phase 2.

Table 2. Composition of diets, Exp. 2 (as-fed basis)[1]

	Phase 1			Phase 2		
Item Diet complexity:	Low	Medium	High	Low	Medium	High
Ingredient, %						
Corn	32.56	39.55	46.71	50.69	56.11	61.51
Soybean meal (46.5% CP)	40.01	28.87	17.52	38.75	31.88	25.02
Spray-dried animal plasma	-	3.00	6.00	-	-	-
Select menhaden fish meal	-	0.63	1.25	-	0.63	1.25
Spray-dried blood cells	-	0.63	1.25	-	0.63	1.25
Spray dried whey	20.00	20.00	20.00	5.00	5.00	5.00
Soybean oil	3.00	3.00	3.00	1.00	1.00	1.00
Monocalcium phosphate (21% P)	1.60	1.35	1.08	1.70	1.65	1.58
Limestone	0.70	0.83	0.95	0.85	0.85	0.85
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15
L-lysine HCl	0.18	0.20	0.23	0.15	0.29	0.41
DL-methionine	0.17	0.17	0.18	0.10	0.15	0.20
L-threonine	0.08	0.08	0.07	0.05	0.13	0.19
L-tryptophan	-	-	-	-	-	0.02
L-isoleucine	-	-	0.07	-	-	0.04
Lactic acid	1.00	1.00	1.00	1.00	1.00	1.00
Engrain enzyme blend[2]	-	-	-	-	-	-
Total	100.0	100.0	100.0	100.0	100.0	100.0
Standard ileal digestible (SID) amino acids, %						
Lysine, %	1.45	1.45	1.45	1.32	1.32	1.32
Isoleucine:lysine, %	65	58	55	68	60	55
Methionine:lysine, %	34	32	31	32	34	36
Met & Cys:lysine, %	58	58	58	58	58	58
Threonine:lysine, %	63	63	63	63	63	63
Tryptophan:lysine, %	19	18	18	20	18	17
Valine:lysine, %	69	69	69	73	69	65
ME, kcal/lb	1,516	1,525	1,533	1,482	1,483	1,484
DE, kcal/lb	1,604	1,606	1,607	1,564	1,561	1,558
SID lysine:ME, g/Mcal	4.34	4.31	4.29	4.03	4.04	4.03
Total lysine, %	1.61	1.60	1.59	1.47	1.46	1.45
CP, %	24.0	22.8	21.4	23.1	21.5	20.0
Ca, %	0.86	0.86	0.86	0.82	0.82	0.82
P, %	0.84	0.81	0.76	0.80	0.78	0.75
Available P, %	0.55	0.55	0.55	0.47	0.47	0.47

[1] Pigs were fed Phase 1 diets from d 0 to 8 postweaning and phase 2 diets from d 8 to 18 postweaning.

[2] Included at a rate of 0.10% in each diet combination for a total of 6 treatments.

Table 3. Effects of Engrain enzyme on nursery pig growth performance (Exp. 1)[1]

	Low complexity	Low complexity + enzyme	High complexity	SEM
d 0 to 8				
ADG, lb	0.28[bx]	0.33[bcy]	0.37[cy]	0.020
ADFI, lb	0.33	0.34	0.36	0.017
F/G	1.25[b]	1.05[c]	0.99[c]	0.057
d 9 to 18				
ADG, lb	0.73	0.69	0.69	0.024
ADFI, lb	0.97	0.95	0.91	0.026
F/G	1.34	1.39	1.33	0.025
d 0 to 18				
ADG, lb	0.53	0.53	0.54	0.019
ADFI, lb	0.68	0.68	0.67	0.019
F/G	1.30[c]	1.29[c]	1.23[b]	0.023

[1] A total of 180 pigs (21 d of age and 12.7 lb) with 5 pigs per pen and 12 pens per treatment.
[b,c] Within a row, means without a common superscript differ ($P < 0.05$).
[x,y] Within a row, means without a common superscript differ ($0.05 < P < 0.10$).

Table 4. Effects of diet complexity and Engrain enzyme on growth performance of nursery pigs (Exp. 2)[1]

	Diet complexity:	Low		Medium		High			Probability, $P<$		
									Complexity		
Item	Enzyme:	No	Yes	No	Yes	No	Yes	SEM	Linear	Quadratic	Enzyme
d 0 to 8											
ADG, lb		0.30	0.30	0.35	0.37	0.38	0.38	0.019	0.0001	0.29	0.81
ADFI, lb		0.36	0.36	0.40	0.40	0.42	0.43	0.019	0.001	0.53	0.86
F/G		1.21	1.22	1.15	1.10	1.09	1.12	0.035	0.001	0.33	0.92
d 9 to 18											
ADG, lb		0.64	0.61	0.67	0.65	0.67	0.66	0.032	0.18	0.55	0.29
ADFI, lb		0.96	0.94	0.97	0.97	1.00	0.97	0.030	0.26	0.96	0.47
F/G		1.54	1.56	1.46	1.52	1.50	1.49	0.041	0.19	0.31	0.32
d 0 to 18											
ADG, lb		0.49	0.47	0.53	0.52	0.54	0.54	0.023	0.01	0.38	0.44
ADFI, lb		0.70	0.68	0.72	0.72	0.74	0.73	0.021	0.02	0.76	0.59
F/G		1.44	1.46	1.36	1.39	1.37	1.37	0.030	0.01	0.17	0.39

[1]A total of 360 pigs (21 d of age and 12.7 lb) were used, with 5 pigs per pen and 12 pens per treatment.