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Alan J. Warner
Kansas State University

Jason C. Woodworth
Kansas State University, jwoodworth@k-state.edu

Joel M. DeRouchey
Kansas State University, jderouch@k-state.edu

See next page for additional authors

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Summary

A total of 360 barrows (DNA 200 × 400; initially 13.4 ± 0.12 lb) were used in a 38-d study to evaluate the effects of increasing levels of a modified corn protein product on nursery pig growth performance and fecal dry matter. Upon arrival to the nursery research facility, pigs were randomly assigned to pens (5 pigs per pen) and pens were allotted to 1 of 6 dietary treatments with 12 pens per treatment. Experimental diets were fed in two phases with phase 1 fed from d 0 to 10 and phase 2 fed from d 10 to 25. Phase 1 diets were formulated with 3, 6, 9, 12, and 15% of a modified corn protein or 6% enzymatically treated soybean meal (ESBM). The inclusion level of the test protein source and ESBM for the phase 2 diets were: 1.5, 3, 4.5, 6, 7.5, and 3%, respectively. A common phase 3 diet was fed from d 25 to 38. Phase 1 treatment diets were fed in pellet form, with phases 2 and 3 fed in meal form. During the phase 1 period, there was no evidence ($P > 0.10$) for differences in ADG, ADFI, or F/G. There was a tendency (linear, $P = 0.092$) for increased d 10 BW as the level of the modified corn protein increased. From d 10 to 25 (phase 2 period), increasing the level of modified corn protein increased (quadratic, $P = 0.037$) d 25 BW, ADG (quadratic, $P = 0.026$) and ADFI (quadratic, $P = 0.034$). Feed efficiency worsened (linear, $P = 0.063$) with increasing levels of modified corn protein source. From d 0 to 25 (experimental period), ADG (quadratic, $P = 0.030$) and ADFI (quadratic, $P = 0.036$) increased, and F/G worsened (linear, $P = 0.006$). From d 25 to 38 (common period), there was no evidence ($P > 0.10$) for differences in growth performance. For the overall experiment, ADG (quadratic, $P = 0.028$) and ADFI (quadratic, $P = 0.032$) increased then decreased, with pigs fed the intermediate inclusion of modified corn protein (6.0 and 3.0% in phases 1 and 2, respectively) having the best performance. There was also evidence (linear, $P = 0.066$) for F/G to worsen as the inclusion level of modified corn protein increased and this may be reflective of lower energy diets and/or overestimation of the energy value of the modified corn protein product. Fecal DM on d 25 tended to increase (quadratic, $P = 0.051$) as the level of the modified corn protein was increased, although

[1] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.
[2] Cargill, Inc., Blaire, NE.

no evidence of a difference ($P > 0.10$) was observed between treatments on d 10. There was greater ($P = 0.004$) fecal DM on d 25 compared to d 10. These data suggest that the modified corn protein tested in this trial may be an alternative protein source to consider for nursery pig diets, when fed up to 12% in phase 1 and 6% in phase 2. Additional research should be conducted to confirm the energy value of the modified corn protein product utilized in this study.

Introduction

Highly digestible protein sources are important in diet formulation for weanling pigs. In commercial swine nursery diets, including protein sources such as fish meal or enzymatically treated soybean meal (ESBM) in diets of weaned pigs help to provide amino acid sources without the negative effects of anti-nutritional factors such as glycinin and β-conglycinin present in soybean meal.[3] A relatively recent alternative protein source to consider for nursery pigs is corn-derived protein ingredients. Through wet corn processing, the starch, sweeteners, and other texturized materials are removed from the kernel, leaving a product that is approximately 60 to 65% crude protein. In a recent experiment, pigs fed three different corn protein sources were observed to have decreased BW and ADG, and worsened feed efficiency through d 21 as the corn protein sources increased.[4] Advances in the manufacturing process have resulted in an alternative product that is based on modified corn protein mixed with a high energy liquid corn co-product, but this product has not been previously tested in pig diets. Therefore, the objective of this study was to investigate the effects of increasing levels of a modified corn protein product on nursery pig growth performance and fecal dry matter.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the Kansas State University Segregated Early Weaning Facility in Manhattan, KS. The facility has two identical barns that are completely enclosed, environmentally controlled, and mechanically ventilated. Each pen contained a 4-hole, dry self-feeder and a cup waterer to provide *ad libitum* access to feed and water. Pens (4 × 4 ft) had metal tri-bar floors and allowed approximately 2.7 ft^2/pig.

A total of 360 barrows (DNA 200 × 400; initially 13.4 ± 0.01 lb) were used in a 38-d study with 5 pigs per pen and 12 pens per treatment. Pigs were randomly assigned to pens and then pens were allotted to 1 of 6 dietary treatments. The modified protein source (Cargill Inc., Blair, NE) was added at 3, 6, 9, 12, and 15% of the diet in phase 1 and 1.5, 3, 4.5, 6, and 7.5% in phase 2, respectively (Tables 1 and 2). The nutrient loading values for minerals and amino acids (total and SID coefficients) were estimated by the supplier and the energy was calculated using equations based on its nutrient profile (EvaPig). Diets were balanced to provide similar SID AA and STTD P levels, but not balanced for energy. Diets were also formulated to maximize L-Lysine HCl

[3] Zhao, Y., G. X. Qin, Z. W. Sun, B. Zhang, and T. Wang. 2010. Effects of glycinin and β-conglycinin on enterocyte apoptosis, proliferation, and migration of piglets. Food Agr. Immunol. 21(3):209-218. doi:10.1080/09540101003596644.

[4] Roa, Z. X., J. C. Woodworth, M. D. Tokach, S. S. Dritz, J. M. DeRouchey, R. D. Goodband, H. I. Calderón, and K. Mertz. 2020. Effects of different corn protein sources and level on nursery pig growth performance and feed efficiency. Kansas Agriculture Experiment Station Research Reports. 6(10). doi:10.4148/2378-5977.7991.

while keeping the SID Lys:CP ratio constant between treatments. A control diet was also fed that had 6 and 3% inclusion of enzymatically treated soybean meal (HP300, Hamlet Protein, Findlay, OH) in phases 1 and 2, respectively. Phase 1 and 2 diets were formulated to contain 3,000 and 2,000 ppm of Zn from ZnO, respectively. A corn-soybean meal diet formulated to 1.35% SID Lys was provided as a common phase 3 diet and contained no specialty protein sources or zinc oxide. Treatment diets were fed from d 0 to 25 (d 0 to 10 and 10 to 25 for phase 1 and 2, respectively). A common phase 3 diet was fed from d 25 to 38. Treatment diets were fed in pellet (phase 1) and meal (phase 2) form with the common phase 3 diet fed in meal form. A single base diet was manufactured at Hubbard Feeds in Beloit, KS, with hand additions of enzymatically treated soybean meal, test protein source, amino acids, calcium carbonate, and monocalcium phosphate mixed at the O.H. Kruse Feed Technology Innovation Center at Kansas State University, Manhattan, KS. Mixing was completed with a 60 s dry mix time and 120 s wet mix time after addition of the liquid corn product. Percentage of pellet fines and pellet durability were measured with values not meaningfully different between treatments and ranging from 3.3 to 6.7 and 92.2 and 94.8, respectively. Pellet fines were measured by the weight of any pelleted material that passed through a #6 (3.35 mm) sieve. Pellet durability was measured by a pellet durability tester (NHP100 Holmen, Tekpro, Norfolk, UK). Pig weights and feed disappearances were measured on d 0, 10, 17, 25, 31, and 38 of the experiment to determine ADG, ADFI, and F/G.

Complete diet samples of each treatment were taken with a grain probe from every other bag (phase 1) and every 4th bag (phase 2) upon completion of manufacturing. Phase 3 diet samples were taken with a grain probe from four random bags per ton of feed delivered. All diet samples were stored at 68°F. One sub-sample of each diet was submitted to NP Analytical Laboratories (St. Louis, MO) for analysis (Tables 3 and 4).

On d 10 and 25 of the experiment, feces were collected from the same 3 pigs per pen and dried at 130°F for 48 h to determine fecal dry matter. Pigs that showed continued weight loss through d 10 or seemed unthrifty were removed for welfare concerns. Water soluble gentamicin (Gen-Gard; Agri Laboratories, LTD, St. Joseph, MO) was administered for 3 d at labeled dosage to control clinical colibacillosis beginning on d 11 and 15 for the two barns, respectively.

Statistical analysis

Data were analyzed as a completely randomized design with pen serving as the experimental unit. Treatment was included in the statistical model as a fixed effect and barn was incorporated in the model as a random effect. Data were analyzed using R Studio (Version 3.5.2, R Core Team, Vienna, Austria). Fecal dry matter was analyzed as repeated measures were analyzed. Pairwise comparisons were used to test for differences between all treatments, and contrasts were used to test for linear and quadratic responses between treatments including the corn protein source. Results were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

During the phase 1 period, there was no evidence ($P > 0.10$) for differences in ADG, ADFI, or F/G (Table 5). There was a tendency (linear, $P = 0.092$) for decreased d 10 BW as the level of the modified corn protein increased. On d 25, BW tended (quadratic, $P = 0.037$) to increase with increasing levels of the modified corn protein.

From d 10 to 25 (phase 2), there was no evidence ($P > 0.10$) for differences between the treatments with the modified corn protein and the ESBM. The ADG increased (quadratic, $P = 0.026$) up to 3.0% inclusion of modified corn protein in the diet. Pigs fed up to 6% modified corn protein had increased ADFI (quadratic, $P = 0.034$) but a reduction in ADFI was observed when feed with 7.5% of modified corn protein was fed. There was a tendency (linear, $P = 0.063$) for feed efficiency to worsen as modified corn protein source increased.

From d 0 to 25 (experimental feeding period), there was evidence (quadratic, $P = 0.030$) for ADG to increase up to the intermediate level (6.0 and 3.0% in phases 1 and 2, respectively). There was also evidence (quadratic, $P = 0.036$) for increased ADFI up to 12.0 and 6.0% inclusion of the modified corn protein in phases 1 and 2, respectively, with a reduction observed thereafter. Feed efficiency worsened (linear, $P = 0.006$) as the amount of modified corn protein in the diet increased.

From d 25 to 38 (common period), there was no evidence ($P > 0.10$) for differences in growth performance; however, d 38 BW was maximized (quadratic, $P = 0.041$) in the pigs fed 6.0 and 3.0% modified corn protein in phase 1 and phase 2, respectively. For the overall experiment, there was no observed evidence ($P > 0.10$) for differences between the treatments with the modified corn protein source and ESBM. However, ADG (quadratic, $P = 0.028$) and ADFI (quadratic, $P = 0.032$) increased then decreased, with the 6.0 and 3.0% inclusion level in phase 1 and phase 2 having the highest ADFI. There was also a tendency (linear, $P = 0.066$) for F/G to worsen as the inclusion level of modified corn protein increased.

Fecal DM on d 25 tended to increase (quadratic, $P = 0.051$) as the level of the modified corn protein was increased. Fecal dry matter was also greater ($P = 0.004$) on d 25 than on d 10.

These data suggest that this new modified corn protein product may be used in swine diets to elicit similar responses as diets containing enzymatically treated soybean meal when fed up to 12% in phase 1 and 6% in phase 2. The worsening of F/G as the level of modified corn protein product increased in the diet may be reflective of overestimating its calculated energy value used in diet formulation. Additionally, diets were not balanced for NE, and dietary NE decreased as modified corn protein product in the diet increased. Additional research should be conducted to better determine the energy content of the modified corn protein product.

Table 1. Phase 1 diet composition (as-fed basis)[1]

	ESBM, %[2]	Modified corn protein %[3]				
Ingredient, %	**6.0**	**3.0**	**6.0**	**9.0**	**12.0**	**15.0**
Corn	38.29	36.96	37.03	37.11	37.04	37.10
Soybean meal, 46.5% CP	23.52	27.90	24.85	21.80	18.91	15.86
ESBM	6.00	---	---	---	---	---
Modified corn protein	---	3.00	6.00	9.00	12.00	15.00
Spray-dried whey	12.50	12.50	12.50	12.50	12.50	12.50
Whey permeate	11.25	11.25	11.25	11.25	11.25	11.25
Corn oil	3.00	3.00	3.00	3.00	3.00	3.00
Spray-dried bovine plasma	2.00	2.00	2.00	2.00	2.00	2.00
Calcium carbonate	0.73	0.73	0.75	0.75	0.78	0.80
Monocalcium phosphate	0.75	0.68	0.60	0.55	0.48	0.43
Zinc oxide	0.39	0.39	0.39	0.39	0.39	0.39
Sodium chloride	0.33	0.33	0.33	0.33	0.33	0.33
Vitamin premix with phytase[4]	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-Lys-HCl	0.35	0.34	0.33	0.33	0.32	0.31
DL-Met	0.20	0.19	0.19	0.18	0.17	0.16
L-Thr	0.16	0.16	0.17	0.18	0.18	0.19
L-Trp	0.01	0.02	0.03	0.05	0.06	0.07
L-Val	0.11	0.13	0.13	0.13	0.13	0.13
L-Ile	0.03	0.05	0.06	0.07	0.08	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00

continued

Table 1. Phase 1 diet composition (as-fed basis)[1]

	ESBM, %[2]	Modified corn protein %[3]				
Ingredient, %	**6.0**	**3.0**	**6.0**	**9.0**	**12.0**	**15.0**
Calculated analysis						
SID amino acids, %						
Lys	1.40	1.40	1.40	1.40	1.40	1.40
Ile:Lys	60	61	60	60	60	61
Leu:Lys	114	119	125	131	138	144
Met:Lys	34	34	34	34	34	33
Met and Cys:Lys	56	57	57	57	57	57
Thr:Lys	63	63	63	63	63	63
Trp:Lys	19.7	19.6	19.7	19.6	19.6	19.6
Val:Lys	72	72	72	72	72	72
Total Lys, %	1.54	1.56	1.57	1.59	1.60	1.62
NE, kcal/lb	1,197	1,179	1,175	1,172	1,168	1,164
SID Lys:NE g/Mcal	5.31	5.39	5.40	5.42	5.44	5.46
CP, %	21.7	21.8	21.8	21.8	21.8	21.8
Ca, %	0.70	0.68	0.67	0.65	0.64	0.63
P, %	0.63	0.61	0.60	0.59	0.58	0.57
STTD P, %	0.54	0.54	0.53	0.54	0.53	0.54
Formulated analyzed Ca:P	1.11	1.12	1.12	1.10	1.11	1.11

[1] Phase 1 experimental diets were fed for 10 d.
[2] Enzymatically treated soybean meal, HP300, Hamlet protein, Findlay, OH.
[3] Cargill, Inc., Blair, NE.
[4] Ronozyme HiPhos 2700 (DSM Nutritional Products) provided a 0.13% release of STTD P with 1,250 FYT/kg inclusion in the diet.

Table 2. Phase 2 diet composition (as-fed basis)[1]

	ESBM, %[2]	Modified corn protein, %[3]				
Ingredient, %	**3.00**	**1.50**	**3.00**	**4.50**	**6.00**	**7.50**
Corn	55.55	54.95	54.91	55.05	54.96	54.90
Soybean meal, 46.5% CP	26.38	28.49	27.05	25.44	24.00	22.56
ESBM	3.00	---	---	---	---	---
Modified corn protein	---	1.50	3.00	4.50	6.00	7.50
Spray-dried whey	10.00	10.00	10.00	10.00	10.00	10.00
Corn oil	1.00	1.00	1.00	1.00	1.00	1.00
Calcium carbonate	0.88	0.88	0.88	0.88	0.90	0.93
Monocalcium phosphate	0.88	0.85	0.83	0.78	0.78	0.75
Zinc oxide	0.25	0.25	0.25	0.25	0.25	0.25
Sodium chloride	0.55	0.55	0.55	0.55	0.55	0.55
Vitamin premix with phytase	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-Lys-HCl	0.48	0.47	0.47	0.47	0.46	0.46
DL-Met	0.21	0.21	0.20	0.20	0.19	0.19
L-Thr	0.20	0.20	0.21	0.21	0.22	0.22
L-Trp	0.04	0.05	0.05	0.06	0.07	0.07
L-Val	0.16	0.16	0.16	0.17	0.17	0.17
L-Ile	0.05	0.06	0.06	0.07	0.07	0.08
Total	100.00	100.00	100.00	100.00	100.00	100.00

continued

Table 2. Phase 2 diet composition (as-fed basis)[1]

	ESBM, %[2]	Modified corn protein, %[3]				
Ingredient, %	**3.00**	**1.50**	**3.00**	**4.50**	**6.00**	**7.50**
Calculated analysis						
SID amino acids, %						
Lys	1.35	1.35	1.35	1.35	1.35	1.35
Ile:Lys	60	60	60	60	60	60
Leu:Lys	113	116	119	122	126	129
Met:Lys	36	36	36	36	35	36
Met and Cys:Lys	57	57	57	57	57	57
Thr:Lys	63	63	63	63	63	63
Trp:Lys	19.6	19.6	19.6	19.6	19.6	19.6
Val:Lys	72	71	72	72	72	72
Total Lys, %	1.48	1.49	1.50	1.51	1.51	1.52
NE, kcal/lb	1,133	1,124	1,122	1,120	1,118	1,115
SID Lys:NE g/Mcal	5.41	5.45	5.46	5.47	5.48	5.49
CP, %	20.9	20.9	20.9	20.9	20.9	20.9
Ca, %	0.74	0.73	0.72	0.71	0.71	0.71
P, %	0.61	0.61	0.60	0.59	0.60	0.59
STTD P, %	0.50	0.50	0.50	0.50	0.50	0.50
Formulated analyzed Ca:P	1.20	1.20	1.19	1.19	1.20	1.20

[1] Phase 2 experimental diets were fed from d 10 to 25.
[2] Enzymatically treated soybean meal, HP300, Hamlet protein, Findlay, OH.
[3] Cargill, Inc., Blair, NE.
[4] Ronozyme HiPhos 2700 (DSM Nutritional Products) provided a 0.13% release of STTD P with 1250 FYT/kg inclusion in the diet.

Table 3. Phase 1 and 2 diet analysis[1]

	ESBM, %[2]	Modified corn protein, %[3]				
d 0 to 10:	6.00	3.0	6.0	9.0	12.0	15.0
Item[4] d 10 to 25:	3.00	1.5	3.0	4.5	6.0	7.5
Phase 1						
Moisture	10.6	11.1	11.4	12.3	12.9	13.3
Starch	35.4	35.0	30.7	29.8	30.2	28.9
Gelatinized	11.9	12.0	11.3	10.3	9.19	7.99
Protein	21.9	22.6	23.4	23.7	23.7	24.6
Fat	3.15	3.29	3.50	3.27	3.61	3.67
Ash	6.59	6.04	6.43	6.76	6.83	6.74
Phytic acid[4]	0.754	0.767	0.759	0.708	0.704	0.652
Phase 2						
Moisture	11.1	11.7	12.0	12.4	12.6	12.9
Starch	44.9	45.0	43.7	42.9	43.1	43.1
Gelatinized	8.2	8.7	8.9	8.9	9.0	9.2
Protein	18.9	18.9	19.9	20.6	20.0	20.1
Fat	3.08	2.97	3.18	3.17	3.24	3.05
Ash	4.78	4.81	4.75	5.01	5.06	5.09
Phytic acid[4]	0.714	0.723	0.776	0.751	0.688	0.703

[1] Phase 1 and 2 experimental diets were fed for 10 and 15 d, respectively.
[2] Enzymatically treated soybean meal, HP300, Hamlet protein, Findlay, OH.
[3] Cargill, Inc., Blair, NE.
[4] Diet samples were submitted to NP Analytical laboratories, St. Louis, MO, for analysis.
[5] Ronozyme HiPhos 2700 (DSM Nutritional Products) provided a 0.13% release of STTD P with 1,250 FYT/kg inclusion in the diet.

Table 4. Phase 1 and 2 amino acid analysis[1]

	ESBM, %[2]	Modified corn protein, %[3]				
d 0 to 10:	6.00	3.0	6.0	9.0	12.0	15.0
Item[4] d 10 to 25:	3.00	1.5	3.0	4.5	6.0	7.5
Phase 1						
SID AA, %						
Lys	1.40 (1.32)	1.40 (1.36)	1.40 (1.43)	1.40 (1.46)	1.40 (1.58)	1.40 (1.57)
Ile	0.85 (0.79)	0.85 (0.86)	0.85 (0.89)	0.84 (0.89)	0.84 (0.97)	0.85 (0.95)
Leu	1.60 (1.49)	1.67 (1.69)	1.75 (1.82)	1.84 (1.94)	1.93 (2.16)	2.01 (2.31)
Met	0.48 (0.39)	0.47 (0.41)	0.47 (0.41)	0.47 (0.44)	0.47 (0.44)	0.47 (0.45)
Met + Cys	0.79 (0.82)	0.79 (0.84)	0.80 (0.85)	0.80 (0.90)	0.80 (0.89)	0.80 (0.93)
Thr	0.88 (0.92)	0.88 (0.99)	0.89 (0.98)	0.89 (0.99)	0.89 (1.02)	0.88 (1.05)
Trp	0.28 (0.24)	0.27 (0.26)	0.28 (0.24)	0.27 (0.24)	0.27 (0.24)	0.27 (0.26)
Val	1.01 (0.97)	1.00 (1.03)	1.01 (1.06)	1.00 (1.07)	1.00 (1.14)	1.00 (1.14)
His	0.50 (0.48)	0.49 (0.51)	0.48 (0.51)	0.47 (0.51)	0.47 (0.55)	0.46 (0.54)
Phase 2						
SID AA, %						
Lys	1.35 (1.28)	1.35 (1.19)	1.35 (1.34)	1.35 (1.37)	1.35 (1.31)	1.35 (1.32)
Ile	0.82 (0.77)	0.81 (0.74)	0.81 (0.77)	0.81 (0.77)	0.81 (0.75)	0.81 (0.77)
Leu	1.53 (1.44)	1.57 (1.46)	1.61 (1.61)	1.65 (1.59)	1.70 (1.63)	1.74 (1.72)
Met	0.48 (0.34)	0.48 (0.38)	0.48 (0.41)	0.48 (0.39)	0.48 (0.39)	0.48 (0.37)
Met + Cys	0.76 (0.77)	0.77 (0.83)	0.77 (0.86)	0.77 (0.85)	0.77 (0.85)	0.77 (0.84)
Thr	0.85 (0.84)	0.85 (0.79)	0.85 (0.87)	0.85 (0.86)	0.86 (0.85)	0.85 (0.85)
Trp	0.26 (0.19)	0.26 (0.21)	0.26 (0.22)	0.26 (0.22)	0.26 (0.20)	0.26 (0.21)
Val	0.97 (0.91)	0.97 (0.88)	0.97 (0.92)	0.97 (0.96)	0.97 (0.90)	0.97 (0.92)
His	0.47 (0.45)	0.47 (0.43)	0.47 (0.43)	0.46 (0.43)	0.46 (0.42)	0.46 (0.44)

[1] Phase 1 and 2 experimental diets were fed for 10 and 15 d, respectively.
[2] Enzymatically treated soybean meal, HP300, Hamlet protein, Findlay, OH.
[3] Cargill, Inc., Blair, NE.
[4] Diet samples were submitted to NP Analytical Laboratories, St. Louis, MO, for analysis. Formulated values are reported with analyzed values in parentheses.

Table 5. Effects of increasing a modified corn protein on nursery pig growth performance[1]

	ESBM[2]	Modified corn protein, %[3]							
d 0 to 10:	6.00	3.0	6.0	9.0	12.0	15.0		P =[4]	
Item d 10 to 25:	3.00	1.5	3.0	4.5	6.0	7.5	SEM	Linear	Quadratic
BW, lb									
d 0	13.4	13.4	13.5	13.5	13.5	13.4	0.12	0.532	0.113
d 10	16.1	16.2	16.5	16.1	16.2	15.8	0.21	0.092	0.278
d 25	29.1	29.2	30.3	29.4	29.9	28.4	0.65	0.210	0.037
d 38	43.4	43.4	45.3	44.0	44.7	43.2	0.81	0.569	0.043
Day 0 to 10 (Phase 1)									
ADG, lb	0.27	0.28	0.30	0.27	0.27	0.24	0.020	0.124	0.430
ADFI, lb	0.27	0.27	0.29	0.27	0.27	0.26	0.013	0.245	0.408
F/G	1.02	1.01	1.00	1.05	1.03	1.11	0.050	0.139	0.396
Day 10 to 25 (Phase 2)									
ADG, lb	0.87	0.85	0.92	0.88	0.91	0.84	0.036	0.723	0.026
ADFI, lb	1.18	1.14	1.22	1.21	1.26	1.17	0.035	0.338	0.034
F/G	1.36	1.34	1.33	1.38	1.38	1.40	0.040	0.063	0.902
Day 0 to 25 (Experimental period)									
ADG, lb	0.62	0.62	0.67	0.63	0.65	0.59	0.023	0.293	0.030
ADFI, lb	0.80	0.79	0.84	0.83	0.86	0.80	0.024	0.703	0.036
F/G	1.28	1.27	1.27	1.32	1.32	1.34	0.025	0.006	0.784
Day 25 to 38 (Common period)									
ADG, lb	1.11	1.10	1.16	1.12	1.14	1.13	0.023	0.444	0.299
ADFI, lb	1.75	1.75	1.84	1.80	1.81	1.79	0.042	0.631	0.232
F/G	1.59	1.60	1.59	1.61	1.59	1.58	0.026	0.734	0.742
Day 0 to 38 (Overall)									
ADG, lb	0.79	0.78	0.83	0.80	0.82	0.77	0.020	0.671	0.028
ADFI, lb	1.12	1.11	1.18	1.16	1.18	1.13	0.028	0.638	0.032
F/G	1.43	1.43	1.42	1.45	1.45	1.46	0.016	0.066	0.951
Fecal DM, %[5]									
d 10	19.5	23.1	21.8	21.0	23.3	21.8	1.13	0.715	0.488
d 25	23.7	23.0	24.0	24.2	24.4	21.7	1.13	0.493	0.051

[1] 360 weaned barrow pigs (DNA 200 × 400, initially 13.4 ± 0.12 lb) approximately 21 days of age were used in a 38-d experiment with 5 pigs per pen and 12 pens per treatment.
[2] Enzymatically treated soybean meal (HP300, Hamlet protein, Findlay, OH) was included at 6.0% in phase 1 and 3.0% in phase 2.
[3] Cargill, Inc., Blair, NE.
[4] Pairwise comparisons were used to test for differences among treatments. Contrasts were used to test for linear and quadratic differences between treatments with the modified corn protein.
[5] Feces from three piglets from each pen were pooled, weighed, and dried to measure fecal dry matter. Treatment × day, quadratic $P = 0.064$. day, $P = 0.004$.