ISOLEUCINE IN SEGREGATED EARLY WEANING AND TRANSITION DIETS

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Summary

Two studies were conducted to test the effect of isoleucine amount and source on nursery pig performance. In Exp. 1, a total of 194 pigs were used in a 10-d study in a research facility to test the effects of isoleucine rate in high or low lysine diets. Dietary treatments included either high or low lysine and high or low isoleucine in a 2 × 2 factorial arrangement. High-lysine diets were formulated to 1.56% TID lysine, and low-lysine diets were formulated to 1.30% TID lysine. High-isoleucine diets contained approximately 60% TID isoleucine:lysine, whereas low-isoleucine diets contained approximately 49% isoleucine:lysine. Overall (d 0 to 10), there were no significant lysine by isoleucine interactions (P<0.23). From d 0 to 5, pigs fed diets containing high lysine had higher (P<0.02) ADG and tended to have higher (P<0.09) ADFI, compared with performance of pigs fed diets containing low lysine. Also, pigs fed diets containing high isoleucine had a weak tendency for higher (P<0.17) ADG and ADFI, compared with performance of pigs fed diets containing low isoleucine, because pigs fed high isoleucine and low lysine gained and ate more than pigs fed low isoleucine and low lysine. Overall (d 0 to 10), pigs fed diets containing high lysine had higher (P<0.01) ADG and improved (P<0.01) F/G, compared with performance of pigs fed diets containing low lysine. There was a weak tendency to have improved (P<0.18) ADFI for pigs fed diets containing either high lysine or high isoluecine. In Exp. 2, a total of 1,540 pigs were used in a 21-d growth assay in a commercial facility to test the effects of increased dietary L-isoleucine from different isoleucine sources on nursery pig performance. Treatments included: control (standard SEW and transition diets) or the control with increased isoleucine from added L-isoleucine, soybean meal, wheat gluten, or poultry meal. During the SEW period (d 0 to 5), pigs fed diets containing added L-isoleucine had better (P<0.05) ADG than did pigs fed the control or diets containing added soybean meal. Also, pigs fed the diet containing wheat gluten had better (P<0.05) ADG than did pigs fed added soybean meal. Pigs fed diets containing added L-isoleucine had better (P<0.05) F/G than did pigs fed the control or diets containing added soybean meal. Also, pigs fed diets containing wheat gluten had better (P<0.05) F/G than did pigs fed added soybean meal. During the transition period (d 5 to 10), pigs fed diets containing poultry meal had lower (P<0.05) ADG than did pigs fed the control diet or added soybean meal. Also, pigs fed diets containing added soybean meal had better (P<0.05) F/G than did pigs fed diets with added L-isoleucine or poultry meal. From d 0 to 10, there were no differences in ADG or ADFI between treatments; nonetheless, F/G

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was better (P<0.05) for pigs fed added soybean meal than for pigs fed the control diet. Overall (d 0 to 21), there were no differences in ADG or ADFI between treatments, but F/G was better (P<0.05) for pigs fed diets with added soybean meal or wheat gluten than for pigs fed diets containing added L-isoleucine.

For the economic analysis, pigs fed the diets containing wheat gluten had higher (P<0.05) cost per pound of gain from d 0 to 5, d 5 to 10, and d 0 to 10 than did pigs fed all other diets. From d 0 to 5, margin over feed was higher (P<0.05) for the diets with added L-isoleucine or poultry meal, compared with the diet containing wheat gluten. From d 5 to 10, margin over feed was higher (P<0.05) for diets containing added soybean meal than for diets containing wheat gluten, added L-isoleucine, or poultry meal. From d 0 to 10, margin over feed was lowest (P<0.05) for the diet containing wheat gluten, compared with all other diets. These studies indicate that maintaining an adequate amount of isoleucine is critical in diets immediately after weaning, and the addition of L-isoleucine is an economical means of increasing isoleucine in the SEW diet to improve performance.

(Key Words: Isoleucine, Amino Acid, Nursery Pig.)

Introduction

The Kansas State University SEW and transition diets are currently formulated to a lower TID isoleucine:lysine ration than recommended by the NRC (1998). The NRC (1998) recommends a TID isoleucine:lysine ratio of 54%, whereas KSU diets currently contain a ratio of approximately 49 and 52% for the SEW and transition diets, respectively. This is mainly due to use of blood products in these diets, which are a poor source of isoleucine. Isoleucine in a synthetic form is available, but has been cost-prohibitive to use. But other protein sources are available, such as wheat gluten or poultry meal, which contain relatively high concentrations of isoleucine. Using additional soybean meal would help to contribute additional isoleucine, but due to anti-nutritional factors, increasing soybean meal in the SEW and transition diets may decrease performance. Therefore, the objective of these trials was to evaluate low and high concentrations of isoleucine in nursery diets, to evaluate several practical diet formulation alternatives to increase isoleucine, and to characterize the cost of these alternatives in a commercial nursery.

Procedures

Experiment 1. A total of 194 weaned pigs (BW of 13.2 lb) were blocked by weight in a 10-d growth study in a research facility to test the effects of isoleucine in high- or low-lysine diets. Pigs were randomly allotted to 1 of 4 dietary treatments of either high or low lysine and high or low isoleucine in a 2 × 2 factorial arrangement. Each pen contained 7 pigs/pen and 7 pens/treatment. Pigs were housed at the Kansas State University Swine Teaching and Research Center. All pens (4 × 5 ft) contained one stainless steel self-feeder and one nipple waterer to allow *ad libitum* access to feed and water. Procedures used in these experiments were approved by the Kansas State University Animal Care and Use Committee.

Experimental diets (Table 1) were based on corn-soybean meal. Treatment diets included: 1) high lysine, low isoleucine; 2) high lysine, high isoleucine; 3) low lysine, low isoleucine; and 4) low lysine, high isoleucine. High-lysine diets were formulated to 1.56% TID lysine, whereas low-lysine diets were formulated to 1.30% TID lysine. High-isoleucine diets contained approximately 60% TID isoleucine:lysine, whereas low-isoleucine diets contained approximately 49% isoleucine:lysine. High and low lysine concentrations were achieved by altering the amount of soybean meal in the diet. L-isoleucine was used to increase the TID isoleucine:lysine ratio within each lysine level. Pens and feeders were weighed on d 0, 5, and 10 to determine response criteria of ADG, ADFI, and F/G.

Data were analyzed as a randomized complete-block design, with pen as the experimental unit by using the PROC MIXED procedure of SAS. Least squares means were used to determine differences among treatments (P<0.05).

Experiment 2. A total of 1,540 pigs (BW of 12.3 lb) were used in a 21-d growth assay to determine the effect of increased dietary isoleucine from different sources on nursery pig performance. Pigs were randomly sorted into 1 of 70 pens (35 pens of barrows, 35 pens of gilts). All pigs were then weighed, and pens were allotted to 1 of 5 dietary treatments so that all pigs within block were the same average weight. One pen of barrows and one pen of gilts consumed feed from a single fenceline feeder; therefore, the experimental unit is the combined data from the 2 pens. Pigs were housed in a commercial research nursery in southern Minnesota.

Experimental diets (Table 2 and 3) were based on corn-soybean meal. Dietary treatments included: control (standard SEW and transition diets) or the control with increased isoleucine from added L-isoleucine, added soybean meal, wheat gluten, or poultry meal. All SEW diets were formulated to a 1.56% TID lysine, and transition diets were formulated to a 1.51% TID lysine. Treatments were fed in two phases: a SEW phase fed at 1 lb/pig and a transition phase fed until d 10 after weaning. All pigs were fed a common diet from d 10 to 21. Economic analysis of feed cost/lb of gain and margin over feed cost were determined by multiplying ADG by market price ($0.45/lb), then subtracting feed cost per pig. Calculations were made with ingredient pricing of: corn, $75/ton; soybean meal, $161/ton; L-isoleucine, $10.43/lb; poultry meal, $420/ton; wheat gluten, $2,700/ton; monocalcium phosphate, $376/ton; limestone, $82/ton; and $60/ton processing, pelleting, and delivery fee. The removal rate was calculated as the number of pigs left on trial during the period, divided by the number of pigs that started the trial. Pens and feeders were weighed at d 0, 5, 10, and 21 to determine the response criteria of ADG, ADFI, and F/G.

Data were analyzed as a complete-block design with initial weight as a covariate by using the PROC MIXED procedure of SAS. Pens (one barrow, one gilt) consuming feed from a single feeder were the experimental unit. Least squares means were used to determine differences between treatments (P<0.05).

Results and Discussion

Experiment 1. There were no significant lysine by isoleucine interactions (P>0.23) for the treatment period.

From d 0 to 5, pigs fed diets containing high lysine had higher (P<0.02) ADG and tended to have higher (P<0.09) ADFI than did pigs fed diets containing low lysine. Also, pigs fed diets containing high isoleucine had a weak tendency for higher (P<0.17) ADG and ADFI than those of pigs fed diets containing low isoleucine, because pigs fed high isoleucine and low lysine gained and ate more than pigs fed low isoleucine and low lysine.

From d 5 to 10, pigs fed diets containing high lysine had higher (P<0.04) ADG and tended to have better (P<0.06) F/G than did pigs fed diets containing low lysine.

Overall (d 0 to 10), pigs fed diets containing high lysine had higher (P<0.01) ADG and better (P<0.01) F/G than did pigs fed diets containing low lysine. There was a weak tendency to have improved (P<0.18) ADFI for pigs fed diets containing either high lysine or high isoluecine.

Experiment 2. During the SEW period (d 0 to 5), pigs fed diets containing added L-isoleucine had better (P<0.05) ADG than did pigs fed the control or diets containing added soybean meal. Also, pigs fed the diet containing wheat gluten had better (P<0.05) ADG than did pigs fed added soybean meal. Pigs fed diets containing added L-isoleucine had better (P<0.05) F/G than did to pigs fed the control or diets containing added soybean meal. Also, pigs fed diets containing wheat gluten had better (P<0.05) F/G than did pigs fed added soybean meal.

During the transition period (d 5 to 10), pigs fed diets containing poultry meal had lower (P<0.05) ADG than did pigs fed the control diet or added soybean meal. Also, pigs fed diets containing added soybean meal had better (P<0.05) F/G than did pigs fed diets with added L-isoleucine or poultry meal. From d 0 to 10, there were no differences in ADG or ADFI between treatments; nonetheless, F/G was improved (P<0.05) for pigs fed added soybean meal, compared with F/G of pigs fed the control diet.

Overall (d 0 to 21), there were no difference in ADG or ADFI between treatments, but F/G was better (P<0.05) for pigs fed diets with added soybean meal or wheat gluten than for pigs fed diets containing added L-isoleucine.

For the economic analysis, cost/lb gain and margin over feed were used to compare dietary treatments. Pigs fed the diets containing wheat gluten had higher (P<0.05) cost per pound of gain from d 0 to 5, d 5 to 10, and d 0 to 10 than did pigs fed all other diets. From d 0 to 5, margin over feed was higher (P<0.05) for the diets with added L-isoleucine or poultry meal than for the diet containing wheat gluten. From d 5 to 10, margin over feed was higher (P<0.05) for diets containing added soybean meal than for diets containing wheat gluten, added L-isoleucine, or poultry meal. From d 0 to 10, margin over feed was lowest (P<0.05) for the diet containing wheat gluten, compared with all other diets. Pigs fed the diet containing poultry meal had fewer (P<0.05) pigs remaining on test, compared with all treatments at both d 10 and 21. The primary reason for removal was unthrifty pigs or excess belly rubbing, of which 75% of those removed because of belly rubbing were fed the poultry meal dietary treatment.

When pigs were fed starter diets adequate in lysine in the first experiment, an isoleucine deficiency was not found. As the lysine content was reduced, performance decreased, demonstrating the importance of lysine for nursery diets. Although there were not interactions between lysine and isoleucine, increasing isoleucine in the diet marginally deficient in lysine increased weight gain by 0.5 lb for the first 5 days after weaning. The economic analysis demonstrates that isoleucine can be economically increased in the SEW diet or during the first 5 d after weaning by adding L-isoleucine.

Adding isoleucine to the diet after d 5 did not improve pig performance in either experiment, indicating that the amount of lysine fed may have been in excess of the pigs' requirement during this stage.

Because the SEW period, d 0 to 5, is critical for young pigs, the added isoleucine dietary treatment is beneficial during this period because it had the lowest cost/lb gain, and highest margin over feed, while having the highest ADG and best F/G. But these responses were not maintained during the transition phase, or from d 5 to 10 after weaning. The results of these trials warrant further research into the effects of isoleucine during the SEW period.

Table 1. Composition of Diets (Exp. 1; As-fed Basis)[a]

Item	Isoleucine:	High Lysine Low	High Lysine High	Low Lysine Low	Low Lysine High
Ingredient, %					
Corn		40.76	40.76	48.70	48.70
Soybean meal (46.5%)		11.80	11.80	4.04	4.04
Spray-dried plasma		6.70	6.70	6.70	6.70
Select menhaden fish meal		6.00	6.00	6.00	6.00
Spray-dried-blood cells		1.65	1.65	1.65	1.65
Spray-dried whey		25.00	25.00	25.00	25.00
Corn starch		0.18	-	0.15	-
Soybean oil		5.00	5.00	5.00	5.00
Monocalcium P (21% P)		0.30	0.30	0.30	0.30
Limestone		0.45	0.45	0.45	0.45
Salt		0.25	0.25	0.25	0.25
Zinc oxide		0.38	0.38	0.38	0.38
Vitamin premix		0.25	0.25	0.25	0.25
Trace mineral premix		0.15	0.15	0.15	0.15
L- lysine HCL		0.16	0.16	0.08	0.08
DL-methionine		0.15	0.15	0.13	0.13
L-threonine		0.08	0.08	0.04	0.04
L-isoleucine		-	0.18	-	0.15
Antibiotic[b]		0.70	0.70	0.70	0.70
Vitamin E, 20,000 IU		0.05	0.05	0.05	0.05
Total		100.00	100.00	100.00	100.00
Calculated Analysis					
Total lysine, %		1.70	1.70	1.42	1.42
True ileal digestible amino acids					
Lysine, %		1.56	1.56	1.30	1.30
Isoleucine:lysine ratio, %		49.1	60.2	49.0	60.4
Methionine:lysine ratio, %		31.0	31.0	32.0	32.0
Met & cys:lysine ratio, %		56.0	56.0	60.0	60.0
Threonine:lysine ratio, %		64.0	64.0	66.0	66.0
Tryptophan:lysine ratio, %		17.0	17.0	17.0	17.0
ME, kcal/lb		1,609	1,606	1,609	1,607
Lysine:ME ratio, g/Mcal		4.40	4.41	3.66	3.67
Calcium, %		0.79	0.79	0.77	0.77
Phosphorus, %		0.74	0.74	0.71	0.71
Available phosphorus, %		0.55	0.55	0.55	0.55
Avail P:calorie ratio, g/mcal		1.85	1.85	1.82	1.82

[a]Diets fed in meal form from d 0 to 10.
[b]Provided 140 g/ton neomycin sulfate and 140 g oxytetracycline HCI per ton of concentrate feed.

Table 2. Composition of SEW Diets (Exp. 2. As-fed Basis)[a]

Item	Control	L-isoleucine	Soybean Meal	Wheat Gluten	Poultry Meal
Ingredient, %					
Corn	34.86	34.75	31.40	31.40	31.20
Soybean meal (46.5 %)	12.50	12.50	17.60	12.50	12.50
Poultry meal	-	-	-	-	6.00
Spray-dried wheat gluten	-	-	-	5.00	-
Spray-dried porcine plasma	6.70	6.70	6.70	6.70	6.70
Select menhaden fishmeal	5.80	5.80	5.80	5.80	5.80
Spray-dried blood cells	1.65	1.65	-	-	-
Spray-dried whey	25.00	25.00	25.00	25.00	-
DairyLac 80	6.00	6.00	6.00	6.00	6.00
Choice white grease	5.00	5.00	5.00	5.00	5.00
Monocalcium P (21% P)	0.30	0.30	0.25	0.30	-
Limestone	0.31	0.31	0.36	0.45	-
Salt	0.25	0.25	0.25	0.25	0.25
Zinc oxide	0.38	0.38	0.38	0.38	0.38
MS vitamin premix	0.04	0.04	0.04	0.04	0.04
Trace mineral premix	0.11	0.11	0.11	0.11	0.11
L-lysine HCl	0.15	0.15	0.15	0.25	0.13
DL-methionine	0.15	0.15	0.15	0.04	0.14
L-threonine	0.08	0.08	0.06	0.04	0.03
L-isoleucine	-	0.10	-	-	-
Antibiotic[b]	0.43	0.43	0.43	0.43	0.43
Kemgest®	0.20	0.20	0.20	0.20	0.20
Selenium 0.06%	0.04	0.04	0.04	0.04	0.04
Choline chloride	0.04	0.04	0.04	0.04	0.04
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Total lysine, %	1.70	1.70	1.71	1.70	1.73
True ileal digestible amino acids[b]					
Lysine, %	1.56	1.56	1.56	1.56	1.56
Isoleucine:lysine ratio, %	49	54	57	54	55
Methionine:lysine ratio, %	30	30	31	28	32
Met & cys:lysine ratio, %	55	55	57	62	58
Threonine:lysine ratio, %	64	64	64	64	63
Tryptophan:lysine ratio, %	18	18	18	18	17
ME, kcal/lb	1,601	1,600	1,604	1,580	1,599
Calcium, %	0.76	0.76	0.78	0.82	0.85
Phosphorus, %	0.76	0.76	0.77	0.76	0.83
Available phosphorus, %	0.58	0.58	0.58	0.58	0.64
TID Lysine:calorie ratio, g/,cal	4.13	4.43	4.42	4.48	4.43

[a]SEW diet fed at 1 lb/pig.
[b]Provided 100 g of carbodox and 600 g of tetracycline per ton of complete feed.

Table 3. Composition of Transition Diets (Exp. 2. As-fed Basis)[a]

Item	Control	L-isoleucine	Soybean Meal	Wheat Gluten	Poultry Meal
Ingredient, %					
Corn	37.44	37.35	34.80	35.00	35.25
Soybean meal (46.5 %)	22.22	22.22	26.10	22.22	22.22
Poultry meal	-	-	-	-	4.25
Spray-dried wheat gluten	-	-	-	3.75	-
Spray-dried porcine plasma	2.50	2.50	2.50	2.50	2.50
Select menhaden fishmeal	5.50	5.50	5.50	5.50	5.50
Spray-dried blood cells	1.25	1.25	-	-	-
Spray-dried whey	12.50	12.50	12.50	12.50	-
DairyLac 80	11.25	11.25	11.25	11.25	11.25
Choice white grease	4.00	4.00	4.00	4.00	4.00
Monocalcium P (21% P)	0.70	0.70	0.70	0.70	0.25
Limestone	0.51	0.51	0.51	0.51	0.20
Salt	0.30	0.30	0.30	0.30	0.30
Zinc oxide	0.39	0.39	0.39	0.39	0.39
MS vitamin premix	0.04	0.04	0.04	0.04	0.04
Trace mineral premix	0.11	0.11	0.11	0.11	0.11
L-lysine HCl	0.26	0.26	0.26	0.34	0.25
DL-methionine	0.18	0.20	0.20	0.07	0.18
L-threonine	0.15	0.16	0.15	0.13	0.13
L-isoleucine	-	0.08	-	-	-
Antibiotic[b]	0.43	0.43	0.43	0.43	0.43
Kemgest®	0.20	0.20	0.20	0.20	0.20
Selenium 0.06%	0.04	0.04	0.04	0.04	0.04
Choline chloride	0.04	0.04	0.04	0.04	0.04
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Total lysine, %	1.65	1.65	1.65	1.65	1.67
True ileal digestible amino acids[b]					
Lysine, %	1.51	1.51	1.51	1.51	1.51
Isoleucine:lysine ratio, %	52	57	58	56	57
Methionine:lysine ratio, %	34	35	36	29	35
Met & cys:lysine ratio, %	56	57	58	58	58
Threonine:lysine ratio, %	63	64	64	63	63
Tryptophan:lysine ratio, %	17	17	17	17	17
ME, kcal/lb	1,572	1,571	1,574	1,557	1,575
Calcium, %	0.85	0.85	0.86	0.86	0.84
Phosphorus, %	0.78	0.78	0.80	0.78	0.78
Available phosphorus, %	0.55	0.55	0.55	0.55	0.55
TID Lysine:calorie ratio, g/,cal	4.37	4.37	4.36	4.41	4.36

[a]Diet fed after SEW until 10 d after weaning.
[b]Provided 100 g of carbodox and 600 g of tetracycline per ton of complete feed.

Table 4. Effects of High and Low Lysine and Isoleucine Levels on Nursery Pig Performance (Exp. 1)[a]

	Lysine × Isoleucine					Probability, P <			
	High Lysine[b]		Low Lysine[c]						
Item; Isoleucine	Low[d]	High[e]	Low	High	SED	Lysine × Isoleucine	Lysine	Isoleucine	SED
d 0 to 5									
ADG, lb	0.79	0.80	0.63	0.75	0.062	0.24	0.02	0.16	0.044
ADFI, lb	0.58	0.58	0.49	0.57	0.039	0.23	0.09	0.17	0.028
F/G	0.75	0.74	0.80	0.77	0.06	0.80	0.33	0.64	0.042
d 5 to 10									
ADG, lb	1.06	1.08	0.95	0.95	0.082	0.90	0.04	0.85	0.058
ADFI, lb	1.11	1.16	1.09	1.12	0.049	0.75	0.33	0.26	0.034
F/G	1.05	1.09	1.17	1.19	0.074	0.81	0.06	0.59	0.052
d 0 to 10									
ADG, lb	0.93	0.94	0.79	0.85	0.046	0.48	0.01	0.26	0.033
ADFI, lb	0.84	0.87	0.79	0.84	0.041	0.69	0.16	0.18	0.023
F/G	0.91	0.92	1.00	1.01	0.021	0.33	0.01	0.96	0.015

[a]A total of 194 pigs, initially 13.18 lb, were used in this study, with 7 replications per treatment.
[b]High-lysine diets formulated to 1.56% TID lysine.
[c]Low-lysine diets formulated to 1.30% TID lysine.
[d]High-isoleucine diets contained 0.60% isoleucine:lysine ratio.
[e]Low-isoleucine diets contained 0.49% isoleucine:lysine ratio.

Table 5. The Effect of Alternative Diet Formulation to Increase Isoleucine Concentration in SEW and Transition Diets (Exp. 2)[a]

Item:	Control	L-isoleucine	Poultry Meal	Soybean Meal	Wheat Gluten	SE
d 0 to 5						
ADG, lb	0.33[ef]	0.36[d]	0.35[def]	0.32[f]	0.36[de]	0.011
ADFI, lb	0.30	0.30	0.30	0.30	0.30	0.003
F/G	0.91[de]	0.83[f]	0.86[def]	0.92[d]	0.86[ef]	0.023
Cost/lb gain, $[b]	0.29[e]	0.27[e]	0.27[e]	0.29[e]	0.32[d]	0.008
Margin over feed, $[c]	0.27[de]	0.33[d]	0.31[d]	0.27[de]	0.24[e]	0.026
d 5 to 10						
ADG, lb	0.44[d]	0.40[de]	0.39[e]	0.44[d]	0.43[de]	0.017
ADFI, lb	0.43	0.42	0.40	0.40	0.43	0.015
F/G	0.98[de]	1.05[d]	1.02[d]	0.91[e]	0.99[de]	0.025
Cost/lb gain, $	0.22[fg]	0.25[e]	0.23[ef]	0.21[g]	0.27[d]	0.006
Margin over feed, $	0.50[de]	0.41[f]	0.43[ef]	0.54[d]	0.40[f]	0.027
d 0 to 10						
ADG, lb	0.39	0.38	0.37	0.38	0.40	0.001
ADFI, lb	0.37	0.36	0.35	0.35	0.37	0.008
F/G	0.95[d]	0.94[de]	0.95[de]	0.91[e]	0.92[de]	0.012
Cost/lb gain, $	0.25[ef]	0.26[e]	0.25[ef]	0.25[f]	0.29[d]	0.003
Margin over feed, $	0.77[d]	0.74[d]	0.74[d]	0.80[d]	0.63[e]	0.028
d 0 to 21						
ADG, lb	0.59	0.57	0.58	0.59	0.60	0.011
ADFI, lb	0.73	0.72	0.71	0.71	0.72	0.011
F/G	1.23[de]	1.25[d]	1.23[de]	1.20[e]	1.21[e]	0.011
Weight, lb						
d 0	12.3	12.3	12.3	12.3	12.3	0.000
d 5	14.0[ef]	14.2[d]	14.1[def]	13.9[f]	14.1[de]	0.056
d 10	16.2	16.2	16.2	16.2	16.3	0.104
d 21	24.8	24.5	24.9	25.0	25.0	0.182
Survival, %						
d 10	99.7%[d]	99.1%[d]	97.5%[e]	99.3%[d]	99.5%[d]	0.005
d 21	99.0%[d]	97.9%[d]	94.6%[e]	98.0%[d]	98.5%[d]	0.009

[a]A total of 1,540 gilts, initially 12.3 lb, were used in this study, with 7 replications per treatment. Pigs were budgeted 1 lb SEW diet and then fed the transition diet until d 10. Pigs were then fed a common Phase 2 diet until d 21.
[b]Ingredient pricing used in this analysis included: corn, $75/ton; soybean meal, $161/ton; L-isoleucine, $10.43/lb; poultry meal, $420/ton; wheat gluten, $2,700/ton; monocalcium phosphate, $376/ton; limestone, $82/ton; and $60/ton processing, pelleting, and delivery fee.
[c]Based on market price of $0.45/lb. Calculated as gain × $0.45/lb, minus feed cost per pig.
[defg]Means in the same row with different superscripts differ ($P<0.05$).