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Abstract

A 35-day growth trial was conducted to determine the threonine: lysine ratio necessary to optimize growth performance of the segregated early-weaned (SEW) pig. Twelve experimental diets included two levels of lysine (1.15% and 1.5% digestible lysine) and six digestible threonine:lysine ratios (50, 55, 60, 65, 70, and 75%) in a 2 x 6 factorial arrangement. Growth performance was improved by feeding 1.5% digestible lysine, rather than 1. 15% digestible lysine. However, growth performance was not improved by increasing dietary threonine. These data indicate that the threonine requirement is no more than 50% of digestible lysine.; Swine Day, Manhattan, KS, November 16, 1995

Keywords

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DETERMINING THE OPTIMAL THREONINE: LYSINE RATIO IN STARTER DIETS FOR THE SEGREGATED EARLY-WEANED PIG

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Summary

A 35-day growth trial was conducted to determine the threonine:lysine ratio necessary to optimize growth performance of the segregated early-weaned (SEW) pig. Twelve experimental diets included two levels of lysine (1.15% and 1.5% digestible lysine) and six digestible threonine:lysine ratios (50, 55, 60, 65, 70, and 75%) in a 2 × 6 factorial arrangement. Growth performance was improved by feeding 1.5% digestible lysine, rather than 1.15% digestible lysine. However, growth performance was not improved by increasing dietary threonine. These data indicate that the threonine requirement is no more than 50% of digestible lysine.

(Key Words: Early-Weaned Pigs, Amino Acids, Threonine.)

Introduction

The development of high nutrient dense diets for early-weaned pigs has facilitated the implementation of segregated early weaning (SEW) as a common management practice. Segregated early weaning involves weaning pigs at 10 to 16 days of age and moving them to a site separate from the sow herd. This allows producers to break disease cycles in the operation, which substantially improves overall herd health and pig performance. Our current limitation in the nutrition of the early-weaned pig is the lack of a thorough understanding of appropriate dietary amino acid levels. Research at Iowa State University has shown that high health pigs require a higher dietary lysine level than pigs of low health status. Additional research from Kansas State University indicates that high-lean growth SEW pigs, weaned at 12 to 14 days of age, require 1.65% to 1.8% dietary lysine to maximize growth rate.

The appropriate level of the other amino acids necessary to optimize growth performance has been an area of considerable debate. The ideal amino acid ratio developed by the University of Illinois indicates that methionine and threonine are deficient in typical diets formulated to meet the lysine requirement of the SEW pig, unless they are added as synthetic amino acids. Therefore, the objective of this experiment was to determine the appropriate threonine:lysine ratio necessary to optimize growth performance in the SEW pig.

Procedures

Three hundred and sixty high-lean growth pigs (PIC, 326 × C15) were weaned at 14 ± 2 d of age and delivered to the segregated early weaning (SEW) facilities at Kansas State University. The pigs were blocked by weight (initially 10.0 ± 1.0 lb) and allotted to one of 12 experimental diets, with a total of five pigs/pen and six pens/treatment. The twelve experimental diets consisted of two levels of lysine (1.15% and 1.5% digestible lysine) and six digestible threonine:lysine ratios (50, 55, 60, 65, 70, and 75%) in a 2 × 6 factorial arrangement (Table 1). The 1.15% digestible lysine diets (1.32% total lysine) were corn-soybean meal based and

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contained 20% dried whey, 15.6% lactose, 6.5% spray-dried plasma protein, and 4% select menhaden fish meal. The levels of digestible threonine in the six low lysine diets were .575, .633, .690, .748, .805, and .863%. The levels of dried whey, soybean meal, spray-dried plasma protein, and select menhaden fish meal were increased and 1% spray-dried blood meal added to achieve the 1.5% digestible lysine diets (1.72% total lysine). The levels of digestible threonine in the six high lysine diets were .750, .825, .900, .975, 1.050, and 1.125%.

Synthetic isoleucine, methionine, cystine, valine, and trypthophan (L-isoleucine, DL-methionine, L-cystine, L-valine, and L-tryptophan) were included in the basal diets to ensure that they contained all the essential amino acids suggested by the Illinois ideal amino acid ratio adjusted for an apparent digestible basis. Synthetic threonine (L-threonine) was added to the basal diets at the expense of corn starch to provide the six levels of threonine. The experimental diets were pelleted and fed from d 0 to 21 postweaning.

During phase II (d 21 to 35 postweaning), a common diet was fed. This diet was corn-soybean meal-based; contained 10% dried whey and 2.5% spray-dried blood meal; and was formulated to 1.35% lysine, 0.37% methionine, 0.9% Ca, and 0.8% P.

Pigs were housed in the Kansas State University SEW nurseries in 4 × 4 ft pens for the duration of the trial. Pens were equipped with one self-feeder and a nipple waterer to provide ad libitum access to feed and water.

The pigs were weighed and feed disappearance was determined on d 7, 14, 21, 28, and 35 postweaning. Average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) were the response criteria.

Data were analyzed as a randomized complete block design, with pen as the experimental unit. Pigs were blocked on the basis of initial weight. Analysis of variance was performed using the GLM procedure of SAS. Linear, quadratic, and cubic polynomials were evaluated for dietary threonine levels.

Results and Discussion

No dietary threonine by lysine interactions were observed during the trial (Table 2). Increasing the threonine:lysine ratio above 50% did not affect growth performance during any period of the trial. However, pigs that were fed the diets containing 1.5% digestible lysine had improved ADG and F/G ($P < .0001$) when compared to pigs fed the diets containing 1.15% digestible lysine. No differences in ADFI were observed until d 14 to 21, when pigs fed the 1.5% digestible lysine diets had lower ADFI ($P < .04$) than those fed diets containing 1.15% digestible lysine.

No differences occurred in ADG or F/G during phase II (d 21 to 35 postweaning), when all pigs were fed a common diet. However, from d 28 to 35, pigs fed 1.5% digestible lysine from d 0 to 21 had greater ADFI ($P < .002$) than those fed 1.15% digestible lysine during the same period.

For the entire trial period (d 0 to 35 postweaning), no differences in growth performance existed among pigs fed the various levels of threonine. However, pigs that were fed 1.5% digestible lysine from d 0 to 21 had improved ADG ($P < .0001$) and F/G ($P < .0001$) compared to those that were fed 1.15% digestible lysine during the same period.

Although the results of this study did not produce any conclusive evidence of an ideal threonine:lysine ratio, they indicate that most practical diets currently fed to the early-weaned pig may not be deficient in dietary threonine. The addition of synthetic threonine may not be justified, unless the level of digestible threonine:lysine is lower than 50%.

The results obtained during this trial with regard to lysine level, however, are consistent with those obtained in previous trials conducted at Kansas State University. The

high-lean growth SEW pigs fed 1.72% total dietary lysine (1.5% digestible lysine) gained more weight and had better F/G than those fed 1.32% total dietary lysine (1.15% digestible lysine).

Conclusions

Increasing the level of dietary threonine above 50% digestible threonine:lysine did not improve the growth performance of the high-lean growth, high-health status pig.

Table 1. Composition of Experimental Diets

	Digestible lysine, %	
Item, %	1.15%	1.50%
Corn	42.10	33.42
Dried whey	20.00	25.00
Lactose	15.60	12.00
Spray-dried plasma protein	6.50	7.50
Soy oil	6.00	6.00
Select menhaden fish meal	4.00	6.00
Soybean meal (46.5% CP)	0.52	4.27
Spray-dried blood meal	-	1.00
Monocalcium phosphate	1.51	0.97
Antibiotic	1.00	1.00
Limestone	0.57	0.40
L-lysine·HCl	0.48	0.49
Zinc oxide	0.38	0.38
Corn starch	0.29	0.38
Vitamin premix	0.25	0.25
L-isoleucine	0.21	0.27
DL-methionine	0.17	0.22
Trace mineral premix	0.15	0.15
L-cystine	0.10	0.15
L-valine	0.07	0.05
L-tryptophan	0.05	0.05
Salt	0.05	0.05
Total	100.00	100.00

[a]Diets were formulated to contain all essential amino acids (except threonine) at the University of Illinois ideal amino acid ratio adjusted for an apparent digestible basis. Diets also were formulated to contain .9% Ca and .8% P.

[b]Provided 50 g/ton carbadox.

[c]L-threonine replaced corn starch in the 1.15% and 1.50% digestible lysine basal diets to provide .575, .633, .690, .748, .805, and .863% digestible threonine and .750, .825, .900, .975, 1.050, and 1.125% digestible threonine, respectively. This provided 12 experimental diets in a 2 × 6 factorial arrangement, with two levels of lysine and six levels of digestible threonine:lysine (50, 55, 60, 65, 70, and 75%).

Table 2. Influence of Increasing the Level of Digestible Threonine:Lysine on Pig Performance[a]

	% Digestible threonine:lysine												
	1.15% Digestible lysine						1.50% Digestible lysine						
Item	50	55	60	65	70	75	50	55	60	65	70	75	CV
d 0 to 7													
ADG, lb[b]	0.36	0.29	0.32	0.29	0.29	0.31	0.42	0.37	0.44	0.43	0.43	0.39	19.7
ADFI, lb	0.41	0.42	0.39	0.38	0.37	0.39	0.40	0.38	0.44	0.40	0.38	0.38	14.4
F/G[b]	1.15	1.45	1.23	1.30	1.27	1.28	0.96	1.01	0.98	0.93	0.90	0.95	13.7
d 0 to 21													
ADG, lb[b]	0.61	0.60	0.62	0.58	0.61	0.58	0.71	0.71	0.75	0.72	0.76	0.72	9.7
ADFI, lb	0.81	0.81	0.83	0.81	0.80	0.78	0.77	0.78	0.82	0.77	0.78	0.79	9.0
F/G[b]	1.33	1.35	1.33	1.39	1.30	1.33	1.09	1.10	1.10	1.08	1.02	1.10	4.7
d 21 to 35													
ADG, lb	1.18	1.21	1.29	1.20	1.23	1.28	1.20	1.23	1.20	1.27	1.25	1.24	7.3
ADFI, lb	1.83	1.78	1.81	1.77	1.75	1.84	1.75	1.83	1.82	1.86	1.89	1.85	5.8
F/G	1.54	1.47	1.41	1.47	1.43	1.45	1.45	1.49	1.52	1.45	1.52	1.49	5.9
d 0 to 35													
ADG, lb[b]	0.83	0.84	0.89	0.83	0.86	0.86	0.91	0.92	0.93	0.94	0.95	0.93	6.2
ADFI, lb	1.21	1.20	1.22	1.19	1.18	1.21	1.16	1.20	1.22	1.21	1.22	1.21	5.8
F/G[b]	1.45	1.41	1.37	1.43	1.37	1.39	1.28	1.30	1.32	1.28	1.28	1.32	3.6

[a]Three hundred and sixty weanling pigs were used (initially 10.0 lb and 14 d of age), 5 pigs/pen, 6 pens/treatment.
[b]Effect of lysine ($P < .0001$).