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Determining the optimal isoleucine:lysine ratio for the 25 to 50 lb pig

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DETERMINING THE OPTIMAL ISOLEUCINE:LYSINE RATIO FOR THE 25 TO 50 LB PIG[1]

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Summary

A 21-day growth trial was conducted to determine the isoleucine:lysine ratio necessary to optimize growth performance of the 25 to 50 lb nursery pig reared in a segregated early-weaning (SEW) system. Ten experimental diets, including two levels of lysine (.75% and 1.10% digestible lysine) and five apparent digestible isoleucine:lysine ratios (45, 50, 55, 60, and 65%), were used in a 2 × 5 factorial arrangement. Growth performance was improved by feeding 1.10% rather than .75% digestible lysine. Also, results indicated that the apparent digestible isoleucine requirement for the SEW-reared, 25 to 50 lb pig is approximately 50% of digestible lysine.

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

Introduction

In a previous experiment, the optimal isoleucine:lysine ratio for the SEW pig weighing 12 to 18 lb was found to be approximately 60% of lysine on an apparent digestible basis. However, the amount of isoleucine necessary to maximize the pig's growth will change continually as the pig grows. Because amino acids and protein are some of the most expensive nutrients in a typical animal diet, determining the animal's requirements also is important, so that these important nutrients are not under- or overfed. Therefore, the objective of this experiment was to determine the isoleucine:lysine ratio necessary to optimize growth performance of the SEW-reared pig weighing 25 to 50 lb.

Procedures

Two hundred and seventy high-lean growth pigs were blocked by weight (initially 25.14 ± 1.85 lb and 33 ± 2 d of age) and allotted to one of 10 experimental diets, with a total of four or five pigs/pen (depending upon the block) and six pens/treatment. The 10 experimental diets consisted of two levels of lysine (.75% and 1.10% apparent digestible lysine) and five apparent digestible isoleucine:lysine ratios (45, 50, 55, 60, and 65%) in a 2 × 5 factorial arrangement (Table 1). The pigs had been used in a previous trial to determine the optimal isoleucine: lysine ratio for the 12 to 18 lb pig and then were placed on a common phase II diet for 7 days prior to being reallotted for this study.

The .75% and 1.10% digestible lysine basal diets were corn-soybean meal based. Crystalline threonine, methionine, cystine, valine, and tryptophan (L-threonine, 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 isoleucine (L-isoleucine) was added to the basal diets at the expense of corn starch to provide the five levels of isoleucine. The levels of digestible isoleucine in the .75% digestible lysine diets

[1]The authors extend appreciation to Keesecker Agribusiness of Washington, KS for providing the pigs used in this research. We also thank Heartland Lysine for donation of synthetic amino acids.

were .338, .375, .413, .450, and .488%. The levels of digestible isoleucine in the 1.10% digestible lysine diets were .495, .550, .605, .660, and .715%. The experimental diets were fed in a meal form for 21 d.

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, and 21 of the experiment. Average daily gain (ADG), ADFI, and F/G were the response criteria.

The 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 isoleucine levels.

Results and Discussion

From d 0 to 7, pigs fed the diets containing 1.10% apparent digestible lysine had improved ($P<.05$) ADG, ADFI, and F/G (Table 2). Average daily gain and ADFI also were improved (linear, $P<.02$; quadratic, $P<.01$; cubic, $P<.06$) as the digestible isoleucine:lysine ratio increased up to 55%, with no significant improvement thereafter. Similarly, F/G was improved (linear, $P<.04$; quadratic, $P<.09$) by increasing the isoleucine:lysine ratio in the diet to 55%.

During the d 7 to 14 period, pigs fed diets containing 1.10% digestible lysine had improved ($P<.05$) ADG and F/G compared with those fed .75% digestible lysine. The level of isoleucine in the diet had no effect on ADG or F/G. However, there was a lysine × isoleucine interaction ($P<.02$) for ADFI. This resulted from the greatly reduced feed intake observed among pigs fed the .75% digestible lysine diet formulated to the 45% digestible isoleucine:lysine ratio.

As observed during the first 2 weeks, ADG and F/G were improved ($P<.05$) from d 14 to 21 when pigs were fed the diets containing 1.10% digestible lysine. Also, ADG and ADFI were improved (linear, $P<.01$; and linear, $P<.01$; quadratic, $P<.01$; cubic, $P<.06$; respectively) by increasing the isoleucine:lysine ratio.

Overall, from d 0 to 21, ADG and F/G were improved by feeding 1.10% rather than .75% apparent digestible lysine. Average daily gain also was improved (linear, $P<.01$; quadratic, $P<.09$; cubic, $P<.03$) by increasing the digestible isoleucine:lysine ratio to 50%. There was a lysine × isoleucine interaction ($P<.09$) for ADFI. This occurred as a result of the low feed intake observed among pigs fed the .75% digestible lysine diets that were formulated to the 45% isoleucine:lysine ratio.

In conclusion, these data indicate that the SEW-reared, 25 to 50 lb pig requires an apparent digestible isoleucine:lysine ratio of at least 50% to optimize growth performance.

Table 1. Composition of the Basal Diets[a]

	Digestible Lysine, %	
Ingredient, %	.75%	1.10%
Corn	84.25	73.54
Soybean meal (46.5% CP)	4.96	15.44
Soy oil	3.00	3.00
Spray-dried blood meal	2.00	2.00
Monocalcium phosphate	2.03	1.85
Antibiotic[b]	1.00	1.00
Limestone	1.00	1.02
L-lysine HCl	0.44	0.57
Copper sulfate	0.08	0.08
Corn starch[c]	0.25	0.25
Vitamin premix	0.25	0.25
L-threonine	0.10	0.18
DL-methionine	0.05	0.12
Trace mineral premix	0.15	0.15
L-cystine	0.03	0.09
L-valine	-	0.06
L-tryptophan	0.06	0.08
Salt	0.35	0.35
TOTAL	100.00	100.00

[a]Diets were formulated to contain all essential amino acids (except isoleucine) 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-isoleucine replaced corn starch in the .75% and 1.10% digestible lysine basal diets to provide .338, .375, .413, .450, and .488% digestible isoleucine and .495, .550, .605, .660, and .715% digestible isoleucine, respectively. This provided 10 experimental diets in a 2 × 5 factorial arrangement, with two levels of lysine and five levels of digestible isoleucine:lysine (45, 50, 55, 60, and 65%).

Table 2. Influence of Increasing the Digestible Isoleucine:Lysine Ratio (45-65%) on Pig Performance[a]

	.75% Digestible Lysine					1.10% Digestible Lysine					
Item	45	50	55	60	65	45	50	55	60	65	CV
d 0 to 7											
ADG, lb[bc]	.54	.81	.84	.83	.86	1.06	1.16	1.22	1.20	1.22	10.4
ADFI, lb[c]	1.40	1.85	1.75	1.84	1.91	1.73	1.90	1.94	1.86	1.93	8.7
F/G[bd]	2.63	2.27	2.08	2.22	2.22	1.64	1.64	1.59	1.54	1.59	10.4
d 7 to 14											
ADG, lb[b]	.74	.97	.81	.94	.98	1.20	1.27	1.24	1.20	1.30	19.6
ADFI, lb[f]	1.58	2.25	2.12	2.18	2.22	2.04	2.19	2.27	2.17	2.23	8.9
F/G[b]	2.17	2.33	2.70	2.33	2.22	1.69	1.72	1.82	1.79	1.72	19.0
d 14 to 21											
ADG, lb[bg]	.92	1.12	1.09	1.13	1.13	1.34	1.39	1.37	1.41	1.45	10.3
ADFI, lb[c]	1.87	2.43	2.36	2.38	2.45	2.27	2.47	2.56	2.35	2.42	11.1
F/G[b]	1.96	2.17	2.13	2.08	2.17	1.69	1.79	1.85	1.67	1.67	11.4
d 0 to 21											
ADG, lb[bh]	.73	.97	.91	.97	.99	1.20	1.27	1.28	1.27	1.32	8.4
ADFI, lb[e]	1.62	2.18	2.07	2.13	2.19	2.02	2.19	2.26	2.12	2.19	7.3
F/G[b]	2.22	2.27	2.27	2.22	2.22	1.67	1.72	1.75	1.67	1.67	6.8

[a]Two hundred and seventy pigs were used (initially 25.1 lb and 33 d of age), four or five pigs/pen (depending upon the block), six pens/treatment.
[b]Lysine effect ($P<.05$).
[c]Isoleucine effect (linear, $P<.01$; quadratic, $P<.01$; cubic, $P<.06$).
[d]Isoleucine effect (linear, $P<.04$; quadratic, $P<.09$).
[ef]Lysine × Isoleucine interaction ($P<.09$ and $P<.02$, respectively).
[g]Isoleucine effect (linear, $P<.01$).
[h]Isoleucine effect (linear, $P<.01$; quadratic, $P<.09$; cubic, $P<.03$).