THE EFFECTS OF INCREASING DIETARY LYSINE IN THE PHASE III STARTER DIET ON GROWTH PERFORMANCE OF SEGREGATED EARLY-WEANED PIGS[1]

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Summary

One hundred forty-four high-health, high-lean growth barrows were used to determine the dietary lysine requirement to maximize growth performance from 40 to 75 lb. The experiment was designed as a randomized complete block, with blocks established on initial weight. Prior to the start of the study, pigs were fed a common Phase II diet (1.4% lysine) for 14 d. After the 14 d acclimation period, pigs were allotted to each of six dietary treatments, ranging from .75 to 1.25% digestible lysine (.91 to 1.49% total dietary lysine). Pigs were housed in pens of four, with six replicate pens per treatment. Pig weights and feed disappearance were measured on d 7, 14, and 21 of the experiment to calculate average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G). Average daily gain increased with increasing dietary lysine from 40 to 75 lb, with a maximum observed at approximately 1.25 to 1.37% total lysine. Average daily feed intake from 40 to 75 lb was not influenced by dietary lysine. Increasing dietary lysine resulted in improved F/G, with pigs fed between 1.25 and 1.37% lysine having the best F/G. Based on the feed intake observed in this study, high-lean growth barrows that have been segregated early-weaned to improve health status require at least 16 to 17 g/d of lysine from 40 to 75 lb to maximize ADG and F/G. These requirements for the Phase III starter diet are substantially higher than previously recommended.

(Key Words: Pigs, Growth, Genotype, Lysine.)

Introduction

Previous research at Kansas State University has indicated that high-lean growth pigs have a greater dietary lysine requirement compared with medium-lean growth pigs. Furthermore, gilts of a high-lean growth potential require approximately 1.15% dietary lysine (approximately 18 g/d) from 80 to 120 lb. This requirement presents some unique diet formulation problems, because many current lysine recommendations are 1.10 to 1.15% for pigs from 25 to 50 lb. If requirements for 90 to 120 lb gilts are approximately 1.15%, perhaps the intense selection for lean tissue deposition also has increased the lysine requirement of the lighter pig. In addition, research from Iowa State University has demonstrated that the dietary lysine requirement is higher in pigs that have been segregated early-weaned to enhance health status. Therefore, the objective of this experiment was to determine the dietary lysine requirement of high-health, high-lean growth pigs from 40 to 75 lb.

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Procedures

A total of 144 (45 d old barrows) pigs was used to determine the appropriate dietary lysine requirement of pigs weighing from 40 to 75 lb. Pigs were early weaned at 7 days of age and fed high nutrient dense diets from weaning to 25 lb. After pigs reached 25 lb, they were fed a common diet (1.4% lysine, 2.5% spray-dried blood meal, and 10% dried whey) for 10 days. At this time, pigs were weighed and blocked by weight and allotted to each of six dietary treatments. Pigs were allowed another 4-day adjustment period (where they remained on the common diet) to permit social acclimation. Four pigs per pen and six pens per treatment were used.

Dietary treatments were fed for a 21-d period starting when the pigs were approximately 45 d of age and weighed 40 +/- .6 lb. Digestible lysine levels were .75, .85, .95, 1.05, 1.15, and 1.25%, with corresponding total lysine levels of .90, 1.02, 1.14, 1.25, 1.37, and 1.49% (Table 1). All diets were formulated on a digestible amino acid basis, with all amino acids other than lysine formulated to meet or exceed suggested requirements. L-lysine HCl was fixed at .15% of the diet and soybean meal was adjusted to increase dietary lysine concentrations.

Pigs were housed in an environmentally regulated nursery in which the initial temperature (80°F) was reduced by 3°F each week. Pens (4 ft × 4 ft) contained a four-hole self-feeder and one nipple waterer to allow ad libitum consumption of feed and water. Pigs and feeders were weighed on d 7, 14 and 21 of the experiment to calculated ADG, ADFI, and F/G.

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

Results

From d 0 to 7 of the experiment, ADG and F/G were improved (linear, $P < .01$) with increasing digestible lysine (Table 2). Pigs fed the highest level of digestible lysine had 20% higher ADG and 20% better F/G ratio than pigs fed the lowest level of digestible lysine (which is close to the current NRC, 1988 estimates). Increasing digestible lysine improved ADG and F/G (quadratic, $P < .01$) from d 0 to 14 and for the overall trial (d 0 to 21). However, ADFI was not influenced ($P > .10$) by dietary lysine at any point during the experiment.

Discussion

The results of this experiment indicate that the dietary lysine requirement to optimize growth performance for the high-health, high-lean growth barrow is greater than current National Research Council estimates for conventionally reared pigs. Although ADG and F/G improved linearly over the first 7 d of the experiment, overall (d 0 to 21) ADG and F/G appeared to plateau for barrows fed 1.05% digestible lysine (1.25% total lysine). Our original objective was to evaluate lysine requirements for 25- to 50-lb pigs. However, because initial starting weights were heavier than anticipated, data for the first 7 d of the experiment represent the weight period from 40 to 50 lb, which is closest to the weight period for the Phase III diet. Data for the first 7 d show that performance was maximized for pigs fed at least 1.25% digestible lysine (1.49% total lysine), suggesting that current lysine recommendations for the Phase III diet need to be increased to ensure that high-health, segregated early-weaned pigs get at least 16 g/d of lysine. These data represent a 2.75 g/d (11%) increase above NRC estimates. During the next 14 d of the experiment (pig weight period of 50 to 75 lb), performance was influenced quadratically as digestible lysine increased, with pigs fed 1.05% digestible lysine (1.25% total lysine) appearing to have the best ADG and F/G. Based on a

practical phase-feeding program, this lysine level corresponds with earlier research at Kansas State University using high-lean growth gilts from 80 to 120 lb. This research demonstrated that .94% digestible lysine (1.15% total lysine) is needed to optimize protein deposition. Also, as seen in earlier work with high-lean growth gilts, ADFI was not influenced by dietary lysine. However, barrows in this experiment consumed approximately 3.0 lb of feed/d from 40 to 75 lb. This ADFI is lower than current NRC estimates, indicating that much of the higher lysine requirement is a function of feed intake. The higher requirement also is needed for the greater demand for protein synthesis in high-health, high-lean pigs.

In summary, the lysine requirements for pigs of high-lean growth genetics that have been segregated early-weaned to improve health status exceed current recommendations. The results suggest that high-health, high-lean growth barrows require at least 16 to 17 g/d (1.25% to 1.35% total lysine) of lysine to optimize growth performance when fed from 40 to 75 lb.

Table 1. Diet Composition

	Digestible lysine, %					
Ingredient, %	.75	.85	.95	1.05	1.15	1.25
Corn	72.30	68.35	64.38	60.41	56.44	52.47
Soybean meal, (48.5% CP)	19.48	23.49	27.50	31.52	35.53	39.54
Soybean oil	3.00	3.00	3.00	3.00	3.00	3.00
Monocalcium phosphate (21% P)	2.24	2.17	2.10	2.03	1.96	1.89
Antibiotic[a]	1.00	1.00	1.00	1.00	1.00	1.00
Limestone	.96	.948	.93	.92	.90	.89
Salt	.35	.35	.35	.35	.35	.35
Vitamin premix	.25	.25	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15	.15	.15
L-Lysine HCl	.15	.15	.15	.15	.15	.15
Copper sulphate	.075	.075	.075	.08	.103	.12
L-threonine	.036	.048	.070	.075	.075	.075
L-tryptophan	.004	.014	.026	.038	.05	.061
DL-methionine	.003	.002	.017	.031	.045	.059
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis, %						
Crude protein	15.74	17.35	18.97	20.58	22.19	23.80
Total lysine	.91	1.02	1.14	1.25	1.37	1.49
Ca	.90	.90	.90	.90	.90	.90
P	.80	.80	.80	.80	.80	.80

[a]Provided 50 g/ton carbodox.

Table 2. Performance of Pigs Fed Increasing Levels of Dietary Lysine from 40 to 75 lb[a]

	Digestible lysine, %[b]						
Item	.75	.85	.95	1.05	1.15	1.25	CV
d 0 to 7							
ADG, lb[c]	1.32	1.37	1.52	1.58	1.61	1.65	8.7
ADFI, lb	2.29	2.26	2.33	2.28	2.33	2.33	7.4
F/G[c]	1.76	1.66	1.54	1.45	1.47	1.41	8.8
d 0 to 14							
ADG, lb[cd]	1.48	1.53	1.62	1.73	1.76	1.71	4.6
ADFI, lb	2.67	2.71	2.66	2.71	2.71	2.73	4.7
F/G[cd]	1.81	1.77	1.64	1.57	1.54	1.59	3.7
d 0 to 21							
ADG, lb[cd]	1.52	1.61	1.64	1.71	1.73	1.69	4.4
ADFI, lb	2.87	3.02	2.91	2.96	2.95	3.04	5.3
F/G[cd]	1.89	1.88	1.77	1.73	1.70	1.79	3.7

[a]One hundred forty four pigs were used (initially 40.1 lb and 44 d of age), 4 pigs/pen and 6 replications/treatment.
[b]Corresponding total lysine levels are: .90, 1.02, 1.14, 1.25, 1.37, and 1.49%.
[c]Linear effect of dietary lysine ($P < .01$).
[d]Quadratic effect of dietary lysine ($P < .01$).

The KSU Segregated Early-Weaning Facility