INFLUENCE OF DIETARY LYSINE ON GROWTH PERFORMANCE OF HIGH-LEAN GROWTH GILTS FED FROM 160 TO 300 LB[1]

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Summary

One-hundred eight high-lean growth gilts (159.6 lb) were used to determine the dietary lysine requirement to optimize growth performance from 160 to 300 lb. The experiment was designed as a randomized complete block, with initial weight serving as the blocking factor. Six dietary treatments were used, ranging from .44 to .94% digestible lysine (.59 to 1.16% total lysine). Pigs were housed in pens of three, with six replicate pens/treatment. Pig weights and feed disappearance were collected weekly to calculate average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G). Average daily gain increased from 160 to 230 lb, from 230 to 300 lb, and from 160 to 300 lb. Average daily feed intake was not influenced by dietary treatment. The gilts consumed 6.47, 6.65, and 6.56 lb/day from 160 to 230, from 230 to 300, and from 160 to 300 lb, respectively. Thus, F/G improved linearly from 160 to 230 lb and quadratically from 230 to 300 and from 160 to 300 lb as a function of increased ADG. Lysine intake was increased linearly for all three weight periods as digestible lysine increased in the diet. The data from this experiment suggest that high-lean growth gilts requires at least 26 g/d of lysine from 160 to 230 and from 230 to 300 lb. Thus, matching nutrition with genetics is essential to optimize both rate and efficiency of gain.

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

Introduction

The National Research Council (1988) reported extensive research on dietary lysine estimates for growing-finishing swine. However, the extent of experiments pertaining to dietary lysine requirements based on protein accretion rate or carcass leanness potential is limited. Previous research conducted at Kansas State University indicated that high-lean growth gilts exhibit a greater response to dietary lysine than barrows. Therefore, gilts had a greater lean deposition rate and improved lean efficiency, even though barrows had a greater average daily gain. Similar research conducted by the NCR-42 committee on swine nutrition indicated that gilts had a greater response to increased crude protein and lysine compared to barrows in terms of rate and efficiency of lean deposition. Thus, nutritional programs based upon genetics and gender are a necessity to maximize both rate and efficiency of lean deposition. Therefore, the objective of this experiment was to determine the dietary lysine requirement to optimize growth performance and protein accretion rate for high-lean growth gilts fed from 160 to 300 lb.

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Procedures

Animals. One hundred eight high-lean growth gilts (initially 159.6 lb) were used to determine the lysine requirement to optimize growth performance with six dietary treatments. The gilts were delivered to the Kansas State University Swine Research Center and were fed a corn-soybean meal diet containing 1.15% total dietary lysine until they reached an average weight of 160 lb. Three pigs were housed per pen (4 ft × 15 ft pens with solid flooring) in an open-fronted building with six replicate pens per treatment. The trial was conducted from May 19 to July 28, 1993, and when temperatures exceeded 80°F, drip coolers were activated to wet the pigs for 3 out of every 15 min. Each pen contained a single-hole feeder and a nipple waterer to accommodate *ad libitum* access to feed and water. Pig weights and feed disappearance were collected weekly to determine ADG, ADFI, feed efficiency (F/G), and lysine intake. When the mean weight for pigs in a pen reached 230 and 300 lb, one pig per pen was randomly selected and slaughtered.

Diet Formulation. Dietary treatments ranged from .44 to .94% digestible lysine, with total calculated dietary lysine ranging from .52 to 1.11% (Table 1). Corn-soybean meal diets were balanced to digestible lysine levels. Other amino acid levels were set using an ideal amino acid ratio to assure that lysine was the first limiting amino acid. Calculated amino acid digestibility coefficients were used for the feed ingredients. The corn-soybean meal ratio was altered to increase the dietary lysine content. L-Lysine-HCl was maintained at .05% of the complete diet, so that lysine bioavailability was not influenced by high inclusion of synthetic lysine. All diets contained 3% soybean oil. All other nutrients either met or exceeded NRC (1988) estimates for the 110 to 240 kg pig.

Results

From 160 to 230 lb, ADG was greater (linear, $P<.01$) as digestible lysine increased from .44 to .94%. However, ADFI was not influenced by dietary treatment. The gilts in this experiment consumed approximately 6.47 lb/day from 160 to 230 lb. Thus, the improvement (linear, $P<.05$) in F/G was a function of increased ADG. Lysine intake from 230 to 300 lb increased (linear, $P<.01$) as the percentage of dietary lysine increased. Average daily gain from 230 to 300 lb tended to be greater (quadratic, $P<.10$) for gilts fed increased dietary lysine. Average daily gain was maximal for gilts fed .74% digestible lysine. Average daily feed intake was not influenced from 230 to 300 lb, with all gilts consuming approximately 6.65 lb/day. Therefore, F/G tended (quadratic, $P<.10$) to improve as digestible lysine increased from .44 to .74% and then became poorer as digestible lysine increased to .94%. Lysine intake increased (linear, $P<.01$) as the percent digestible lysine increased in the diet. For the entire experiment (160 to 300 lb), ADG increased (linear, $P<.13$; quadratic, $P<.13$) as digestible lysine increased. Average daily feed intake was not influenced by dietary treatment, resulting in a tendency for improvement (quadratic, $P<.10$) in F/G as digestible lysine increased. Lysine intake for the entire experiment increased (linear, $P<.01$) as digestible lysine increased in the diet.

Discussion

The results of this experiment suggest that the high-lean growth gilt requires at least 26 g/d of lysine intake from 160 to 300 lb to optimize growth performance. These data represent a 23% increase in dietary lysine above National Research Council (1988) estimates. Unlike our research for high-lean growth gilts fed from 80 to 160 lb (p. 85), the gilts in this experiment had similar ADFI to NRC estimates (6.6 vs 6.9 lb). Thus, greater dietary lysine is necessary to support improvements in ADG and F/G.

When the gilts were fed .59% total lysine (.44% digestible lysine) from 160 to 230 lb, a 1.86 lb ADG was achieved. This is comparable to NRC estimates for both total lysine and ADG. Thus, the improvements in genetic potential are not realized if the dietary lysine requirement is not matched to genetic potential for lean tissue deposition. Similarly, F/G was improved by 7 to 10% when digestible lysine was increased from .44 to .74 or .94%, respectively. These data represent a 14% improvement above NRC estimated F/G for 160 to 230 lb pigs.

From 230 to 300 lb, ADG and F/G were improved by 13% for gilts fed .93% total lysine compared to gilts fed .59% total lysine. Again, these data suggest that genetic potential for lean deposition will not be realized if dietary lysine is not increased above NRC estimates. On the other hand, gilts fed excess dietary lysine (1.05 or 1.16% total lysine) had poorer ADG and F/G than gilts fed .93% total lysine. This poorer growth performance may reflect an increased energy expenditure to rid the body of excess amino acids not required for muscle deposition.

Thus, in summary, the results of this experiment suggest that the high-lean growth gilt requires at least 26 g/d lysine from 160 to 230 and from 230 to 300 lb. The data from this experiment suggest growth performance comparable to National Research Council estimates when the NRC recommendation for lysine (.60%) was fed. However, improvements in ADG and F/G resulted by increasing dietary lysine. Thus, matching nutrition with genetic potential will result in optimal growth performance.

Table 1. Diet Composition

	Digestible lysine, %					
Item, %	.44	.54	.64	.74	.84	.94
Corn	82.46	78.84	74.90	70.92	66.93	62.924
Soybean meal (48% CP)	10.88	14.89	18.90	22.91	26.93	30.94
Soy oil	3.00	3.00	3.00	3.00	3.00	3.00
L-lysine HCl	.05	.05	.05	.05	.05	.05
L-threonine	--	--	.008	.03	.052	.083
DL-methionine	--	--	.002	.036	.05	.119
Monocalcium phosphate (21% P)	1.66	1.58	1.51	1.44	1.37	1.30
Limestone	.96	.95	.93	.92	.90	.89
Salt	.35	.35	.35	.35	.35	.35
Trace mineral premix	.15	.15	.15	.15	.15	.15
Vitamin premix	.20	.20	.20	.20	.20	.20
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis, %						
Crude protein	12.47	14.08	15.68	17.32	18.95	20.60
Total lysine	.59	.70	.82	.93	1.05	1.16
Ca	.75	.75	.75	.75	.75	.75
P	.65	.65	.65	.65	.65	.65
Mcal/lb	1550	1550	1550	1550	1550	1550

Table 2. Effect of Increased Digestible Lysine on Growth Performance of High-Lean Growth Gilts Fed from 160 to 300 lb[a]

	Digestible Lysine, %						
Item	.44	.54	.64	.74	.84	.94	CV
ADG, lb							
160 to 230 lb[b]	1.86	1.93	1.95	1.97	2.03	2.05	7.17
230 to 300 lb[c]	1.88	1.77	1.82	2.15	2.02	1.70	14.19
160 to 300 lb[de]	1.86	1.85	1.89	2.02	2.01	1.88	7.05
ADFI, lb							
160 to 230 lb	6.54	6.24	6.45	6.43	6.67	6.49	7.74
230 to 300 lb	6.67	6.32	6.94	6.37	6.77	6.81	10.34
160 to 300 lb	6.59	6.27	6.63	6.46	6.72	6.64	7.48
F/G							
160 to 230 lb[f]	3.53	3.25	3.32	3.28	3.29	3.17	7.54
230 to 300 lb[c]	3.59	3.59	3.85	3.11	3.40	4.06	14.40
160 to 300 lb[c]	3.56	3.40	3.51	3.22	3.34	3.55	7.04
Lysine intake, g/d							
160 to 230 lb[b]	16.32	18.97	23.13	26.55	31.18	33.87	9.06
230 to 300 lb[b]	16.65	19.20	24.88	26.28	31.61	35.53	11.22
160 to 300 lb[b]	16.44	19.06	23.77	26.65	31.38	34.63	8.46

[a]A total of 108 pigs, three pigs/pen from 160 to 300 lb and two pigs/pen from 230 to 300 lb; six replicate pens/treatment.
[b]Linear effect of digestible lysine (P<.01).
[c]Quadratic effect of digestible lysine (P<.10).
[d]Linear effect of digestible lysine (P<.13).
[e]Quadratic effect of digestible lysine (P<.13).
[f]Linear effect of digestible lysine (P<.05).