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DIETARY METHIONINE REQUIREMENT FOR OPTIMAL GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS IN FINISHING GILTS [1]

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Summary

In Exp. 1, increasing dietary methionine from .12 to .22% (.10 to .20% apparent digestible methionine) in diets containing excess cystine had no effect on ADG, ADFI, 10th rib fat depth, and longissimus muscle area in finishing gilts from 130 to 190 lb. However, increasing dietary methionine tended to linearly improve feed efficiency. In Exp. 2, increasing dietary methionine from .11 to .17% (.10 to .15% apparent digestible methionine) in diets containing excess cystine resulted in linear improvements in ADG, ADFI, and F/G in finishing gilts from 160 to 230 lb. Quadratic improvements were observed for F/G. No effect was seen on 10th rib fat depth. These data suggest that finishing gilts fed .58% total lysine (.50% apparent digestible lysine) require approximately .14% (3.3 g/d) total methionine or .125 %, (2.9 g/d) apparent digestible methionine.

(Key Words: Growth, Methionine, Finishing Pigs.)

Introduction

Amino acid requirements of high-lean growth potential pigs has received considerable attention recently because of their increased protein accretion potential. With an increased dietary lysine requirement for the high-lean growth gilt, the potential exists for adjusting other amino acid requirements. High health status, coupled with better nutritional and environmental management in the early finishing period, also can affect the nutritional needs of market pigs.

Methionine generally is considered to be the third or fourth limiting amino acid in typical corn- or milo-soybean meal diets. University of Illinois recommendations indicate that the finishing pig's methionine requirement should be 30% of lysine, with a total sulfur amino acid requirement at 65% of lysine. However, research reported in the previous article (p. 133) indicates that the total sulfur amino acid requirement of the finishing pig is no greater that 50% of lysine. With this lower estimate, the methionine requirement of finishing pigs may be different than previously estimated. Therefore, the objective of these experiments was to determine the methionine requirement of finishing gilts fed diets containing adequate cystine.

Procedures

Experiment 1. Eighty gilts (PIC 326 × C-22; initially 136 lb) were used in a 24-d growth trial to determine the effects of increasing dietary methionine on growth performance and carcass traits. All gilts were fed a corn-soybean meal grower diet from 50 to 130 lb that was formulated to exceed all current nutrient recommendations. The gilts then were allotted randomly by initial weight to one of five dietary treatments in a randomized complete block design. Experimental diets consisted of: .116%, .141%, .166%, .191%, and .216% total methionine (0.1%, 0.125%, 0.15%, 0.175%, and 0.2% apparent digestible methionine). Cystine was main-

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tained at levels exceeding the amount of methionine in each diet. To ensure that methionine was the only limiting amino acid, all others were maintained at or above ratios relative to lysine as suggested by the University of Illinois (Table 1). Extruded cornstarch was the major ingredient, and methionine was substituted for equal amounts of cornstarch to make the dietary treatments. Soybean meal (17.86%), soybean oil (5%), glutamate (1%), and choline chloride 60% (0.15%) were identical among treatments, and calcium and phosphorus were 0.65% and 0.55%, respectively (Table 2).

Table 1. Basal Diet Amino Acid Composition (Exp. 1)

Item, %	Total	App. Dig.	Analyzed Total
Lysine	.60	.50	.53
Threonine	.42	.35	.37
Methionine[a]	.12	.10	.12
Cystine	.18	.15	.18
Methionine + Cystine	.30	.25	.30
Tryptophan	.14	.11	.13
Valine	.41	.36	.38
Isoleucine	.39	.33	.35

[a]Analyzed total methionine values for each treatment were: .12%, .15%, .18%, .21%, and .20%.

Pigs were housed two per pen (5 ft × 5 ft with slatted flooring). They were allowed ad libitum access to both feed and water from a single-hole dry bulk feeder and one nipple waterer per pen. They were enclosed in an environmentally controlled building with a constant temperature of 70°F, and manure was removed daily via mechanical pit scrapers. Pigs and feeders were weighed on d 0 and 24 to calculate ADG, ADFI, and F/G. Each pig was scanned ultrasonically both on day 0 and at day 24 by a certified technician to estimate 10th rib fat depth and longissimus muscle area.

Table 2. Basal Diet Composition (Exp. 1)

Ingredient	Percent
Extruded corn starch	72.58
Soybean meal, 46.5% CP	17.86
Soybean oil	5.00
Monocalcium phosphate	2.07
Limestone	.58
Salt	.35
Trace mineral premix	.15
Vitamin premix	.25
Choline chloride	.15
L-lysine HCl	.054
L-threonine	.082
L-tryptophan	.028
L-cysteine	.050
DL-methionine[b]	--
L-glutamate	1.00
Medication[c]	.125
Total	100.00

[a]Diets were formulated to contain .65% Ca and .55% P.

[b]DL-methionine and excess cystine were added at .025% and .0375% increments, respectively, to provide treatments of: .116%, .141%, .166%, .191%, and .216% total (.10%, .125%, .15%, .175%, and .20% app. dig) methionine.

[c]Provided 100 g/ton of tylosin.

Experiment 2. A total of 105 gilts (PIC 326 × C-22; initial weight 159 lb) was used in a 34-d growth trial to determine the effects of increasing dietary methionine on growth performance and carcass characteristics. All gilts were fed a corn-soybean meal grower diet from 50 to 160 lb that was formulated to exceed all current nutrient recommendations. Gilts were blocked by weight and randomly assigned by initial weight to one of three dietary treatments in a randomized complete block design. Experimental diets consisted of .11, .14, and .17% total methionine (.10, .125, and .15% apparent digestible methionine). Experimental treatments were created by substituting increasing levels of L-methionine for equal parts of cornstarch. Cystine was maintained at 130% of the highest methionine treatment to ensure that methionine was the only limiting sulfur amino acid. All others were maintained at or above ratios relative to lysine as suggested by the University of Illinois (Table 3). Soybean meal (3%), sucrose (10%), soybean oil (5%), glutamate (1%), and choline chloride 60% (.14%) were identical among treatments, and calcium and phosphorus were .65% and .55%, respectively. Grain sorghum, cornstarch, and L-methionine levels varied as dietary methionine levels increased (Table 4).

Table 3. Basal Diet Amino Acid Composition[a] (Exp. 2)

Item, %	Total	Apparent Digestible
Lysine	.56	.50
Threonine	.40	.33
Methionine	.11	.10
Cystine	.22	.20
Methionine + Cystine	.33	.30
Tryptophan	.12	.10
Valine	.51	.45
Isoleucine	.34	.30

[a]Experimental treatments were made by substituting .025% and .050% L-methionine for equal amounts of cornstarch. Total cystine was maintained at .22% in each treatment.

Table 4. Basal Diet Composition[a] (Exp. 2)

Ingredient	Percent
Grain sorghum	48.31
Cornstarch	26.53
Sucrose	10.00
Soybean meal, 46.5% CP	3.00
Soybean oil	5.00
Blood meal	2.00
Monocalcium phosphate	1.86
Limestone	.73
Salt	.35
Choline chloride	.14
Vitamin premix	.25
Trace mineral premix	.15
L-methionine	--
L-cysteine	.118
L-threonine	.139
L-lysine HCl	.229
L-tryptophan	.029
L-glutamate	1.00
Medication[b]	.125

[a]Each diet was formulated to contain .65% Ca and .55% P.
[b]Provided 100 g/ton tylosin.

Pigs were housed in a modified open-front building with natural and mechanical ventilation. Drip coolers were activated when ambient temperatures exceeded 80°F. Each pen measured 6 × 16 ft with 50% solid and 50% slatted flooring. Each pen contained a two-hole dry feeder and a single nipple waterer allowing ad libitum access to feed and water. Pig and feeder weights were recorded on d 0, 19, and 34 to calculate ADG, ADFI, and F/G. On d 34 three pigs were selected randomly from each pen and was scanned ultrasonically at the last lumbar position to determine 10th rib fat depth.

All data were analyzed as a randomized complete block design with pen as the experimental unit, using general linear model procedures. Orthogonal contrasts were used to determine linear and quadratic effects of dietary methionine level on pig performance.

Results and Discussion

Experiment 1. From 130 to 190 lb, increasing methionine levels above .12% (.10% apparent digestible methionine) had no effect ($P > .05$) upon any of the growth performance and carcass characteristics measured, but F/G tended to improve with increasing methionine levels (linear, $P < .07$; Table 5). No linear or quadratic effects ($P > .05$) were noted for ADG, ADFI, 10th rib fat depth, and longissimus muscle area (LMA) as a result of increasing dietary methionine.

Experiment 2. From 160 to 225 lb, increasing dietary methionine from .11 to .17% (.10 to .15% apparent digestible methionine) linearly improved ADG, ADFI, and F/G (linear, $P < .001$, .01, .003, respectively; Table 6). A tendency for a quadratic effect was observed for ADG ($P < .12$). No effect was observed for 10th rib fat depth ($P < .68$). Feed efficiency also was improved quadratically ($P<.02$) with increasing total methionine up to .14% (.125% apparent digestible methionine).

The results of these experiments are consistent with results presented in the previous article (p. 133) indicating that the total dietary requirement of total sulfur amino acids for finishing gilts is .285% (.25% apparent digestible; approximately 50% of lysine). Approximately half of the total sulfur amino acid requirement is met by methionine, which suggests that the requirement should be approximately .13% total methionine (.125% apparent digestible). Additionally, in the 1994 KSU Swine Day Report of Progress, researchers indicated that the methionine requirement was less than .25% apparent digestible methionine (25% of lysine). However, those diets were formulated with a high level of lysine and an attempt was made to maintain a constant lysine:methionine ratio between treatments, resulting in over-supplementation of dietary methionine. In our current trial, more focus was placed on dietary methionine levels with secondary emphasis on a constant lysine: methionine ratio. This experiment also indicates that recommendations based upon the ideal amino acid pattern suggested by the University of Illinois tend to overestimate the methionine requirement of finishing pigs. Our results indicate that the methionine requirement in diets containing adequate cystine for finishing pigs is .14 % or 3.3 g/d total methionine (.125 % or 2.9 g/d apparent digestible methionine).

Table 5. Effects of Dietary Methionine on Early Finishing Pig Performance[a] (Exp. 1)

	Apparent Digestible Methionine, %						Probability ($P<$)	
Item,	.10	.125	.15	.175	.20	CV	Linear	Quadratic
Overall								
ADG, lb	2.29	2.36	2.37	2.27	2.51	8.90	.16	.45
ADFI, lb	7.50	7.38	7.50	7.00	7.40	11.59	.56	.72
F/G	3.29	3.14	3.17	3.09	2.98	10.03	.07	.91
PUN, mg/dl	5.56	6.21	4.79	5.63	5.76	23.5	.90	.49
10th rib BF	.75	.77	.73	.72	.76	13.05	.86	.58
LMA, in^2	4.93	5.17	4.67	4.97	4.54	10.68	.11	.42

[a]Eighty gilts (PIC 326 × C-22; initial weight 136 lb) were used in a randomized complete block design with two gilts/pen and eight replications per treatment.

Table 6. Influence of Dietary Methionine on Finishing Pig Growth Performance[a] (Exp. 2)

	Apparent Digestible Methionine, %				Probability ($P<$)	
Item,	.10	.125	.15	CV	Linear	Quadratic
d 0 to 34						
ADG, lb	1.69	1.93	1.98	5.02	.001	.12
ADFI, lb	4.93	5.31	5.47	5.07	.01	.48
F/G	2.93	2.76	2.77	2.04	.003	.02
10th rib fat depth, in	.84	.88	.80	10.68	.68	.30
Lysine, g/d	12.53	13.50	13.92	5.07	.01	.48
Methionine, g/d	2.53	3.33	4.05	4.71	.0001	.68

[a]A total of 105 gilts (PIC 326 × C-22; initial weight 159 lb) was arranged in a randomized complete block with seven pigs/pen and five replications per treatment.