EVALUATION OF THE TOTAL SULFUR AMINO ACID REQUIREMENT OF FINISHING PIGS[1]

J. A. Loughmiller, R. D. Goodband, M. D. Tokach, J. L. Nelssen, J. W. Smith II, and J. R. Bergstrom

Summary

Sixty four gilts (initially 120 lb) were used to evaluate the effects of increasing total sulfur amino acid (TSAA):lysine ratios on growth performance and carcass characteristics. Diets included two levels of lysine (.55% and .70% total lysine) and three TSAA:lysine ratios (60, 65, and 70% of lysine) arranged in a 2 × 3 factorial. A tendency for a lysine × TSAA interaction was observed for ADG and ADFI. Increasing TSAA:lysine ratio decreased ADG and ADFI in pigs fed .55% lysine; however, ADG and ADFI were increased in pigs fed .70% lysine and 65% TSAA:lysine. Pigs fed .70% lysine had improved ADG, F/G and 10th rib fat depth compared to those fed .55% lysine. However, no effects were observed with increasing TSAA:lysine ratios. These results suggest that the TSAA requirement of finishing pigs is not greater than 60% of total lysine.

(Key Words: Finishing Pigs, Methionine, Amino Acids.)

Introduction

Methionine and cystine are used mainly for gut tissue maintenance and as substrates in several biological functions. Thus, the TSAA requirement increases only moderately as the pig grows. Because of this moderately increasing need for TSAAs and the decreasing need for lysine, it is hypothesized that the TSAA:lysine ratio should increase with increasing age of the pig. However, little conclusive data exists to confirm this hypothesis. Therefore, the objective of this experiment was to evaluate the TSAA requirement of finishing pigs and determine if it changes relative to lysine.

Procedures

A total of 64 gilts (PIC 326 × C-15; initially 120 lb) was used in a 64 d growth assay. Gilts were blocked by initial weight in a randomized complete block design using a 2 × 3 factorial arrangement. Each treatment had two gilts per pen (5 ft × 5 ft) and six pens. Pigs were housed in an environmentally controlled building with totally slatted flooring. Pigs had access to a nipple waterer and a single-hole feeder providing ad libitum access to both water and feed. Pig weights and feed disappearance were measured every 21 d to determine ADG, ADFI, and F/G. Blood samples were taken via jugular venapuncture on d 21 and at trial conclusion to evaluate plasma urea nitrogen (PUN). Ultrasonic images of 10th rib fat depth and longissimus muscle area were taken by a certified technician at the conclusion of the trial to calculate final carcass composition.

All diets were grain sorghum-soybean meal based with added synthetic L-lysine HCl, L-threonine, and DL-methionine (Table 1). The high lysine diets were formulated to contain .70% total (.56% apparent digestible) lysine with methionine at 30% of total lysine and TSAA at 60, 65, or 70% of total lysine. Low lysine diets were formulated to contain .55% total (.44% apparent digestible) lysine and TSAA:lysine ratios identical to those of

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the high lysine treatments. All diets were formulated to make lysine and/or cystine the first limiting amino acid with DL-methionine added in place of cornstarch to provide the TSAA:lysine ratios of 60, 65, and 70%. An 80% transulfation efficiency was calculated into diet formulation compensating for conversion of methionine to cystine. All other amino acid levels except cystine were based on ideal amino acid patterns from the University of Illinois (Table 2). All dietary treatments contained .60% Ca and .50% P, and all other nutrients either met or exceeded current recommendations for high-lean growth potential, finishing pigs.

Table 1. Basal Diet Composition[a]

	Total Dietary Lysine	
Ingredient, %	.70%	.55%
Grain sorghum	84.36	92.34
Soybean meal 46.5%	12.87	4.66
Monocalcium phosphate	.86	1.00
Limestone	1.01	.99
Salt	.35	.35
Vitamin premix	.15	.15
Trace mineral premix	.10	.10
L-lysine HCl	.15	.25
L-threonine	.02	.05
Cornstarch[b]	.08	.06
Medication	.05	.05
Total	100.00	100.00

[a]Each diet was formulated to contain .6% Ca and .5% P.

[b]DL-methionine replaced cornstarch at the following levels: .70% lysine (.04 and .08%); .55% lysine (.03 and .06%) to create the 65 and 70% TSAA:lysine ratios.

Data were analyzed as a randomized complete block design in a 2 × 3 factorial arrangement. General linear model procedures were used to conduct the analysis of variance. Linear and quadratic regression polynomials were used to detect the influence of increasing the TSAA:lysine ratio.

Results and Discussion

An improvement in performance was observed for all response criteria except ADFI and longissimus muscle area for pigs fed .70% lysine compared with those fed .55% lysine. A tendency for a lysine × TSAA interaction ($P<.10$) was observed for ADG and ADFI. Pigs fed the .70% lysine had increasing ADG and ADFI up to the 65% TSAA:lysine ratio, whereas pigs fed .55% lysine had decreasing ADG and ADFI as TSAA:lysine ratios increased. However, increasing the ratio above 60% of lysine had no ($P>.05$) effects upon any of the growth, blood, or carcass response criteria evaluated. Longissimus muscle area was not affected ($P>.05$) by either increasing lysine or TSAA:lysine ratios but did tend to be higher for gilts fed the high lysine diet. Tenth rib fat depth was decreased in pigs fed .70% lysine ($P<.03$), but increasing the TSAA ratio had no effect on backfat depth. Plasma urea nitrogen (PUN) concentrations were lower in pigs fed .55% lysine compared with those fed .70% lysine ($P<.01$), but did not differ between TSAA:lysine ratios. The increased PUN concentration for gilts fed the .70% lysine diets compared to gilts fed the .55% lysine diets was caused by feeding a higher level of dietary CP.

Table 2. Total and Apparent Digestible Amino Acid Composition of Basal Diets[a]

	.70% Lysine		.55% Lysine	
Item, %	Total	(dig.)	Total	(dig.)
Lysine	.70	.56	.55	.44
Threonine	.49	.35	.39	.28
Tryptophan	.17	.12	.12	.08
Methionine	.21	.19	.18	.15
Cystine	.22	.16	.15	.13
Methionine + Cystine	.43	.35	.33	.28
Isoleucine	.65	.56	.51	.44
Valine	.62	.48	.51	.40

[a]All amino acids were analyzed and met or exceeded formulated values.

The results of this experiment suggest that the TSAA:lysine ratio may have been overestimated in the past. No improvements ($P<.05$) in any response criteria were noted with increasing TSAA:lysine ratios. However, a numerical increase in ADG was ob-

served for pigs fed the 65% TSAA:lysine ratio compared to the 60% TSAA:lysine ratio at .70% lysine. The trend for an interaction of ADG and ADFI as the TSAA:lysine ratio increased above 60% indicates that TSAA levels above 60% relative to lysine can inhibit optimal growth when low lysine (.55%) diets are fed. The lack of improvement in feed efficiency provides further evidence that the optimal TSAA:lysine ratio was less than 60% in this trial. This experiment also indicates that gilts with a high-lean potential require dietary lysine levels greater than .55% total lysine (17 g/d total lysine) to maintain optimal lean gain. This result is consistent with previous research conducted to determine the lysine requirement of high-lean potential gilts.

In conclusion, no effect ($P<.05$) was seen for overall growth performance and carcass characteristics with increased levels of TSAA relative to lysine. A positive lysine effect ($P<.05$) was seen for ADG, F/G, longissimus muscle area, and 10th rib fat depth. Further research is needed to determine the TSAA requirement of high-lean growth pigs.

Table 3. Effects of Increasing Total Sulfur Amino Acids (TSAA, 60, 65, and 70%) Relative to Lysine on Growing-Finishing Pig Growth Performance[a]

							Probabilities ($P<$)			
	.70% Lysine			.55% Lysine				TSAA		
Item	60%	65%	70%	60%	65%	70%	CV	Linear	Quadratic	Lysine
Overall										
ADG, lb[b]	1.86	1.96	1.97	1.83	1.81	1.68	7.6	.65	.32	.002
ADFI, lb[b]	6.35	6.73	6.86	6.95	6.94	6.53	7.0	.81	.34	.34
F/G	3.42	3.44	3.49	3.78	3.90	3.90	5.7	.28	.79	.001
10th rib BF	.98	1.04	1.05	1.15	1.12	1.17	12.3	.47	.87	.03
LMA, in^2	5.96	5.77	5.84	5.76	5.44	5.51	11.1	.49	.47	.28
Lysine, g/d	20.2	21.4	21.8	17.4	17.3	16.3	6.9	.59	.35	.001
TSAA, g/d	6.1	7.3	8.7	5.0	6.0	6.5	7.3	.0001	.68	.001
PUN, mg/dl	9.2	9.3	9.3	5.6	5.4	6.0	17.1	.64	.76	.001

[a]A total of 64 pigs (two pigs/pen and six pens/treatment) with an initial average body weight of 120 lb and an average final body weight of 238 lb.
[b]Lysine × TSAA interaction ($P<.10$).