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J A. Loughmiller

D A. Knabe

K Hongtrakul

See next page for additional authors

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J A. Loughmiller, D A. Knabe, K Hongtrakul, S Moser, C Civis, P R. O'Quinn, J W. Smith II, Jim L. Nelssen, Michael D. Tokach, and Robert D. Goodband

DETERMINING THE OPTIMAL TRYPTOPHAN:LYSINE RATIO FOR THE SEGREGATED EARLY-WEANED PIGS (25 TO 50 LB)

J. A. Loughmiller, J. L. Nelssen, M. D. Tokach, R. D. Goodband, D. A. Knabe[1], K. Hongtrakul, S. Moser, C. Civis, P. R. O'Quinn, and J. W. Smith II

Summary

A 21 d growth trial was conducted to evaluate the effects of increasing the apparent digestible tryptophan:lysine ratio on growth performance of the 25 to 50 lb pig raised in a high-health, segregated early-weaning (SEW) system. Ten diets were fed with two levels of lysine (.75% and 1.10% apparent digestible lysine) and five apparent digestible tryptophan levels (13, 16, 19, 22, or 25% of lysine). Feeding the high dietary lysine consistently improved ADG and F/G and reduced ADFI. Increasing the tryptophan: lysine ratio did not improve overall performance. Based upon our results, the dietary tryptophan level to maximize growth performance in the 25 to 50 lb pig is not greater than 13% of apparent digestible lysine.

(Key Words: Tryptophan, Lysine, SEW Pig.)

Introduction

Since 1981, several ideal amino acid patterns have been suggested. These patterns have different suggested tryptophan:lysine ratios, which leads to uncertainty by industry professionals concerning the appropriate ratio to use. A previous experiment (pg. 45) determined that the optimal apparent digestible tryptophan:lysine ratio for the 10 to 20 lb SEW pig is approximately 15%. However, amino acid requirements change as the pig grows. Previous research with 20 to 50 lb pigs at KSU has evaluated the optimal ratios for methionine, threonine, and isoleucine relative to lysine; however, the optimal tryptophan:lysine ratio has not been determined. The objective of this experiment was to determine the apparent digestible tryptophan:lysine ratio that would optimize the growth performance of the 25 to 50 lb pig raised in an SEW system.

Procedures

Two hundred and sixty high-lean growth pigs (Newsham Hybrids) were blocked by weight (initially 25.3 lb and 37 d of age) and allotted to one of 10 dietary treatments. We used four or five pigs per pen (equal number of pigs per pen by block) and six replicate pens per treatment. The experimental diets consisted of either .75% or 1.10% apparent digestible lysine, with five apparent digestible tryptophan:lysine ratios (13, 16, 19, 22, or 25%) in a 2 × 5 factorial arrangement (Table 1). The pigs used in this trial had been used previously in a trial to determine the optimal apparent digestible tryptophan:lysine ratio for the 10 to 20 lb SEW pig. All pigs were fed a common diet for 7 d prior to being realloted for this trial.

All diets were corn-soybean meal-based with added L-lysine HCl, DL-methionine, and L-threonine. In addition, the 1.10% apparent digestible lysine diets had added L-isoleucine, L-valine, and L-cysteine. The crystalline amino acids were added to maintain all amino acids, except tryptophan, relative to lysine based upon the University of Illinois ideal amino acid pattern. The pattern was formulated on an apparent digestible basis. L-tryptophan replaced cornstarch to provide the increasing apparent digestible tryptophan:lysine ratios. The formulated

[1]Department of Animal Science, Texas A&M University.

levels of apparent digestible tryptophan in the .75% apparent digestible lysine diets were: .098, .12, .143, .165, and .188%. The formulated levels of apparent digestible tryptophan in the 1.10% apparent digestible lysine diets were: .143, .176, .209, .242, and .275%. All diets in this experiment were fed in meal form for 21 d.

Pigs were housed in the KSU SEW nursery in 4 × 4 pens. They were allowed ad libitum access to feed and water through a four-hole dry feeder and one nipple waterer per pen. The pigs were weighed and feed disappearance was measured at 7-d intervals to determine ADG, ADFI, and F/G.

The data were analyzed as a randomized complete block design in a 2 × 5 factorial arrangement. Pigs were blocked by initial weight with pen as the experimental unit. Analysis of variance was performed using general linear model procedures, and linear and quadratic polynomial contrasts were used to determine the effects of increasing dietary tryptophan levels on pig performance.

Results and Discussion

Increasing the apparent digestible lysine level from .75 to 1.10% improved ($P < .01$) ADG and F/G for all 3 weeks of the trial. Feed intake also was reduced ($P < .05$) from d 7 to 14, 14 to 21, and 0 to 21. These data confirmed that the diets containing .75% apparent digestible lysine were below the pigs' requirement.

Increasing the tryptophan level had no influence on ADG or ADFI during any week of the study. No tryptophan × lysine interactions were observed; however, a tendency ($P < .10$) for an interaction was found for F/G from d 7 to 14. In practical terms, this interaction is of little importance because of the lack of consistent improvement in F/G as the tryptophan:lysine ratio increased at either level of lysine. A linear improvement in F/G from d 0 to 7 was found as the apparent digestible tryptophan:lysine ratio was increased from 13 to 25%. However, this response was lost during the following weeks, and pigs fed the lowest apparent digestible tryptophan:lysine ratio (13%) had similar or better F/G compared to pigs fed higher tryptophan levels.

The quadratic ($P < .05$) change in F/G measured from d 0 to 21 F/G was primarily a result of poorer F/G with increasing tryptophan:lysine ratios at .75% apparent digestible lysine.

The response to increasing apparent digestible lysine from .75% to 1.10% indicates that the apparent digestible lysine requirement of the high-health, SEW-reared, 25 to 50 lb pig is greater than .75%. This response is consistent with research reported in the 1994 KSU Swine Day Report of Progress. In that study, between 1.05 and 1.15% apparent digestible lysine was required to maximize growth performance of high health, SEW-reared pigs from 25 to 50 lb.

Based on the lack of consistent improvement in performance from tryptophan level, we conclude that the apparent digestible tryptophan requirement for 25 to 50 lb, high-health, SEW-reared pigs is not greater than 13% of apparent digestible lysine. This level is slightly lower than the 15% apparent digestible tryptophan:lysine ratio suggested by the University of Illinois.

Table 1. Basal Diet Composition[a]

	Apparent Digestible Lysine, %	
Ingredient, %	.75	1.10
Corn	79.20	68.45
Soybean meal (46.5% CP)	13.17	23.12
Soybean oil	2.50	2.90
Monocalcium phosphate	1.87	1.71
Limestone	.91	.93
Salt	.35	.35
Medication[b]	1.00	1.00
Vitamin premix	.25	.25
Trace mineral premix	.15	.15
Copper sulfate	.075	.075
L-Lysine HCl	.363	.51
DL-Methionine	.018	.09
L-Isoleucine	--	.054
L-Valine	--	.076
L-Threonine	.072	.165
L-Cystine	--	.047
Cornstarch[c]	.90	.132

[a]Diets were formulated to contain all essential amino acids in an ideal amino acid ratio, adjusted on an apparent digestible basis. Diets also were formulated to contain .9% Ca and .8% P.

[b]Provided 50 g/ton carbadox.

[c]L-tryptophan replaced cornstarch in the .75% and 1.10% digestible lysine basal diets to provide .0975, .12, .1425, .165, and .1875% apparent digestible tryptophan and .143, .176, .209, .242, and .275% apparent digestible tryptophan, respectively. This provided 10 experimental diets in a 2 × 5 factorial arrangement, with two levels of lysine and five apparent digestible tryptophan:lysine ratios (13, 16, 19, 22, and 25%).

Table 2. Influence of Increasing Tryptophan:Lysine Ratios on the Growth Performance of 25 to 50 lb SEW Pigs[a]

	.75% Apparent Digestible Lysine					1.10% Apparent Digestible Lysine						Probability (P<)		
Item	13	16	19	22	25	13	16	19	22	25	CV	Lys	Trp	Lys × Trp
d 0 to 7														
ADG, lb	.84	.85	.88	.92	.94	1.24	1.25	1.25	1.22	1.28	12.3	.01	.71	.87
ADFI, lb	1.76	1.99	1.89	1.82	1.85	1.83	1.91	1.88	1.80	1.89	9.4	.99	.23	.86
F/G[b]	2.24	2.37	2.17	2.01	1.98	1.49	1.53	1.50	1.48	1.49	14.1	.01	.22	.44
d 7 to 14														
ADG, lb	1.24	1.35	1.17	1.30	1.27	1.39	1.46	1.48	1.53	1.54	11.7	.01	.32	.54
ADFI, lb[d]	2.28	2.46	2.54	2.54	2.44	2.28	2.36	2.40	2.30	2.39	8.0	.04	.16	.58
F/G	1.86	1.83	2.21	1.97	1.93	1.65	1.63	1.63	1.53	1.55	10.7	.01	.10	.10
d 14 to 21														
ADG, lb	1.17	1.21	1.22	1.30	1.19	1.43	1.47	1.46	1.36	1.39	11.1	.01	.84	.41
ADFI, lb	2.35	2.62	2.53	2.51	2.52	2.29	2.31	2.47	2.28	2.38	9.4	.01	.35	.63
F/G	2.06	2.19	2.08	1.95	2.15	1.60	1.57	1.70	1.68	1.71	9.9	.01	.50	.24
d 0 to 21														
ADG, lb	1.08	1.14	1.08	1.17	1.13	1.35	1.39	1.39	1.37	1.40	6.6	.01	.39	.60
ADFI, lb	2.13	2.35	2.31	2.29	2.27	2.13	2.19	2.24	2.12	2.22	7.2	.04	.18	.66
F/G[c]	1.98	2.07	2.14	1.96	2.01	1.58	1.58	1.61	1.55	1.58	4.5	.01	.01	.22

[a]Two hundred and sixty pigs (Newsham Hybrids; initially 37 d of age and 25.3 lb) were used with 4 or 5 pigs per pen and 6 replications (pens) per treatment.
[b]Linear effect of tryptophan (P<.05).
[cd]Quadratic effect of tryptophan (P<.05; .10, respectively).