INFLUENCE OF DIETARY TRYPTOPHAN LEVELS ON THE GROWTH PERFORMANCE OF SEGREGATED EARLY-WEANED PIGS (10 TO 20 LB)

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Summary

A total of 360 pigs (averaging 13 d of age and 9.4 lb) was used to determine the effects of increasing dietary tryptophan:lysine ratio on the growth performance of segregated early-weaned (SEW) pigs. Two apparent digestible lysine levels (1.15 and 1.50%) and six apparent digestible tryptophan:lysine ratios (12.5, 15, 17.5, 20, 22.5 and 25%) were fed from d 0 to 16 after weaning. Lysine × tryptophan interactions were observed for ADG and F/G. Increasing the tryptophan:lysine ratio in the low lysine diets improved ADG and F/G in a quadratic manner. Increasing the tryptophan level had no effect in the high lysine diets. Results of this trial indicate that optimal apparent digestible tryptophan:lysine ratio is approximately 15%.

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

Introduction

The use of new technologies, like segregated early weaning (SEW), has helped increase producer profitability. Recent KSU Swine Day Reports of Progress have provided requirement estimates for lysine, methionine, threonine, and isoleucine based upon the growth performance of 10 to 20 lb SEW pigs. However, research evaluating the tryptophan requirement of SEW pigs has not been conducted. Ideal amino acid ratios for nursery weight pigs developed by various researchers have indicated that tryptophan may be limiting in typical SEW diets. Therefore, the objective of this experiment was to determine the apparent digestible tryptophan:lysine ratio that maximizes growth performance of the SEW pig.

Procedures

Three hundred and sixty high lean growth pigs (Newsham Hybrids) were weaned at 13 ± 2 d of age and delivered to the KSU SEW facilities. The pigs were blocked by weight (initially 9.4 lb ± 3 lb) and allotted to one of 12 experimental diets, with five pigs per pen and six replications (pens) per treatment. Treatments were arranged in a 2 × 6 factorial with two levels of dietary lysine (1.15% and 1.50% apparent digestible lysine) and six apparent digestible tryptophan:lysine ratios (12.5, 15, 17.5, 20, 22.5, and 25%). All diets were corn-soybean meal-based with 10% dried whey, 15% lactose, 6% soybean oil, 6% spray-dried animal plasma, and 3% select menhaden fishmeal (Table 1). In addition, DL-methionine, L-isoleucine, L-valine, L-threonine, and L-cysteine were added to maintain a similar ideal pattern for all amino acids except tryptophan. L-tryptophan replaced cornstarch to form the experimental diets. The six 1.15% apparent digestible lysine diets were formulated to contain .144, .173, .201, .230, .259, and .288% apparent digestible tryptophan. Soybean meal was increased to achieve the 1.50% apparent digestible lysine diets, with formulated apparent digestible tryptophan levels of .188, .225, .263, .30, 338, and .375%. The diets were pelleted and fed from d 0 to 16 postweaning. All pigs were housed in the KSU SEW nursery in 4 × 4 ft pens, each with a self-feeder and one nipple waterer to provide ad libitum access to feed and water.

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The pigs were weighed and feed disappearance was measured on d 0, 7, and 16 to determine ADG, ADFI, and F/G.

Data were analyzed in a randomized complete block design in a 2 × 6 factorial arrangement. Pigs were blocked by initial weight, with pen as the experimental unit. Analysis of variance was determined using general linear model procedures, and linear and quadratic polynomial contrasts were used to determine the effects of increasing dietary tryptophan levels.

Results and Discussion

Increasing the lysine level from 1.15 to 1.5% apparent digestible lysine improved ($P<.01$) ADG from d 0 to 7 and F/G for all periods in the study. ADFI was lower ($P<.01$) for pigs fed the higher lysine diet from d 7 to 16 and 0 to 16.

Lysine × tryptophan interactions ($P<.05$) were observed for F/G from d 0 to 7 and d 0 to 16 and for ADG from d 7 to 16 and d 0 to 16. Increasing the tryptophan:lysine ratio had no influence on performance of pigs fed the diets containing 1.5% apparent digestible lysine. The lowest level of tryptophan at this lysine level (12.5% of lysine; .188% tryptophan) must have exceeded the pigs' requirement. However, increasing the apparent digestible tryptophan:lysine ratio improved ADG (quadratic, $P<.10$) from d 7 to 16 and 0 to 16. The greatest response occurred as the apparent digestible tryptophan:lysine ratio was increased from 12.5 to 15%, with a smaller increase as the ratio increased to 17.5%. Quadratic responses also were found for F/G from d 0 to 7 ($P<.10$), 7 to 15 ($P<.10$), and 0 to 16 ($P<.05$). Increasing the apparent digestible tryptophan:lysine ratio from 12.5 to 15% improved F/G, but no further improvement occurred at the higher ratios.

The improvement in growth performance indicates that tryptophan was limiting performance when supplied at levels below 15% of apparent digestible lysine in the low lysine diets. The F/G response observed from d 7 to 16 indicates that 1.15% apparent digestible lysine is not sufficient to maximize growth performance in the SEW pig.

Based on the results of this experiment, the optimal apparent digestible tryptophan:lysine ratio for the 10 lb SEW pig is approximately 15%. This ratio is similar to the apparent digestible tryptophan:lysine ratio suggested by the University of Illinois for 10 to 45 lb pigs.

Table 1. Basal Diet Composition[a]

	Apparent Digestible Lysine, %	
Ingredient, %	1.15	1.50
Corn	46.39	36.69
Soybean meal (46.5% CP)	7.83	17.38
Dried whey	10.00	10.00
Lactose	15.00	15.00
Soybean oil	6.00	6.00
Spray-dried plasma protein	6.00	6.00
Select menhaden fishmeal	3.00	3.00
Monocalcium phosphate	1.76	1.60
Limestone	.77	.79
Salt	.10	.1
Medication[b]	1.00	1.00
Vitamin premix	.25	.25
Trace mineral premix	.15	.15
Zinc oxide	.38	.38
L-Lysine HCl	.43	.58
DL-Methionine	.16	.224
L-Isoleucine	.18	.25
L-Valine	.074	.18
L-Threonine	.15	.25
L-Cystine	.10	.16
Cornstarch[c]	.288	.375

[a]All diets were formulated to contain .9% Ca and .8% P.

[b]Provided 50 g/ton carbadox.

[c]L-tryptophan replaced cornstarch in the 1.15 and 1.50% digestible lysine basal diets to provide .14375, .1725, .20125, .230, .25875, and .2875% apparent digestible tryptophan and .1875, .225, .2625, .30, .3375, and .375% apparent digestible tryptophan, respectively. This provided apparent digestible tryptophan:lysine ratios of 12.5, 15, 17.5, 20, 22.5, and 25% at both lysine levels.

Table 2. Influence of Increasing Tryptophan:Lysine Ratios on Growth Performance of 10 to 20 lb SEW Pigs[a]

	1.15% Apparent Digestible Lysine						1.50% Apparent Digestible Lysine							Probability (P<)		
Item	12.5	15	17.5	20	22.5	25	12.5	15	17.5	20	22.5	25	CV	Lys	Trp	Lys × Trp
d 0 to 7																
ADG, lb	.24	.27	.30	.31	.31	.30	.35	.32	.31	.34	.30	.35	18.9	.01	.72	.21
ADFI, lb	.32	.32	.37	.34	.33	.35	.33	.32	.33	.34	.32	.34	14.6	.50	.61	.81
F/G[c]	1.32	1.19	1.24	1.10	1.05	1.17	.97	1.00	1.09	1.02	1.09	.97	11.9	.01	.24	.02
d 7 to 16																
ADG, lb[c]	.50	.60	.63	.62	.63	.61	.63	.60	.66	.55	.55	.63	14.4	.85	.31	.05
ADFI, lb	.75	.81	.87	.83	.87	.85	.74	.72	.76	.69	.70	.75	14.1	.01	.69	.60
F/G[c]	1.50	1.36	1.38	1.37	1.38	1.39	1.16	1.22	1.15	1.31	1.27	1.19	10.2	.01	.70	.15
d 0 to 16																
ADG, lb[c]	.39	.45	.49	.48	.49	.48	.51	.48	.50	.45	.45	.51	13.0	.17	.42	.03
ADFI, lb	.56	.60	.65	.61	.63	.63	.56	.55	.57	.54	.53	.57	13.1	.01	.64	.72
F/G[b]	1.45	1.31	1.34	1.28	1.28	1.32	1.10	1.15	1.13	1.20	1.21	1.12	7.7	.01	.80	.01

[a]Three hundred sixty pigs (Newsham Hybrids; initially 14 d of age and 9.4 lb) were used with 5 pigs per pen and 6 replications per treatment.
[bc]Quadratic effect of tryptophan at 1.15% apparent digestible lysine (P< .05, .10, respectively).