THE EFFECT OF DIETARY THREONINE ON GROWING PIG GROWTH PERFORMANCE

K. G. Friesen, J. L. Nelssen, R. D. Goodband, B. T. Richert, J. L. Laurin, and T. L. Weeden

Summary

Sixty pigs (initially 68.57 lb BW) were used in a 28-d growth trial to determine the effect of increased dietary threonine on growth performance for the grower pig. The basal diet was formulated with corn and peanut meal to contain 1.00% dietary lysine and .40% dietary threonine. Sucrose was replaced by synthetic threonine to give dietary threonine levels of .50, .60, .70, and .80%. Two pigs were housed per pen for a total of six pens per treatment (12 pigs per treatment). Pig weights and feeder weights were recorded weekly to determine ADG, ADFI, and feed efficiency. On d 14 and 28 of the experiment, serum samples were collected to determine serum urea N concentrations. From d 0 to 14, ADG increased quadratically and feed efficiency improved linearly and quadratically as dietary threonine increased. Average daily feed intake was not affected by dietary treatment. From d 14 to 28, ADG, ADFI, and feed efficiency were not affected by increased dietary threonine. Cumulative (d 0 to 28) ADG and ADFI were not significantly influenced by dietary treatment. However, ADG improve by 17% when dietary threonine was increased from .40 to .50%. Feed efficiency improved linearly and quadratically when dietary threonine was increased and was optimized between .50 and .60% dietary threonine (approximately 10 to 12 g/d) from d 0 to 28. Serum urea N was decreased as dietary threonine increased. Pigs fed .60% dietary threonine had the lowest serum urea N concentrations compared to the other treatments. These data suggest that the grower pig requires dietary threonine at approximately .50 to .60% (10 to 11 g/d) to optimize growth performance.

Introduction

A great deal of attention has been focused on determining the lysine requirement for all weight ranges of pigs. This research is essential because lysine is normally the first limiting amino acid for protein synthesis in pigs. However, once the lysine requirement is established, the effects of excess or deficient amounts of the remaining essential amino acids must be considered. Research from both the Universities of Georgia and Kentucky has suggested that increased dietary threonine above NRC (1988) recommendations in high lysine nursery and grower pig diets results in improved growth performance. Thus, the objective of this experiment was to determine the effect increasing dietary threonine has on growth performance and serum urea N in growing pigs.

Procedures

Sixty pigs (initially 68.57 lb) were allotted to one of five dietary treatments based upon initial BW. Pigs were fed a sorghum-peanut meal (1.00% dietary lysine) diet containing either .40, .50, .60, .70, or .80% dietary threonine (Table 1) throughout the entire 28-d trial. Peanut meal was used as the primary protein source, because it is deficient in threonine. The sorghum and peanut meal concentrations remained constant in each experimental diet. Sucrose was replaced by synthetic threonine on a 1 to 1 basis to increase the dietary threonine above that of the basal diet. Each pen housed two pigs, with each dietary treatment having six pens. Pigs were housed in 4 ft × 4 ft total slated pens containing a single hole feeder and a nipple waterer to provide *ad libitum* access to feed and water. Pig and feeder weights were recorded weekly to determine average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) ratio. On d 14 and 28, serum samples were collected to determine serum urea nitrogen (N) concentrations.

Table 1. Basal Diet Composition[a]

Ingredient	Percentage
Grain sorghum	76.08
Peanut meal	15.32
Soy oil	3.00
Monocalcium phosphate (21% P)	1.67
Limestone	1.02
Vitamin premix	.25
Trace mineral premix	.15
Selenium premix	.05
Salt	.25
Sucrose[b]	.40
L-lysine HCL	.72
L-tryptophan	.02
DL-methionine	.07
Antibiotic[c]	1.00
Total	100.00

[a]Basal diets were formulated to 1.00% lysine, .40% threonine, .75% Ca, and .65% P.
[b]L-threonine replaced sucrose on a lb/lb basis to achieve the .50, .60, .70, and .80% dietary threonine experimental diets.
[c]Provided 50 g/ton carbodox.

Results and Discussion

Average daily gain increased quadratically (P<.05) and F/G improved (P<.05) both linearly and quadratically as dietary threonine increased from d 0 to 14. A plateau in ADG was detected at approximately .60% dietary threonine, whereas feed efficiency reached a plateau at approximately .50 to .60% dietary threonine. Average daily feed intake was not influenced by increased dietary threonine; thus, threonine intake increased as threonine concentration increased. The NRC (1988) requirements suggest that the threonine requirement for the 45 to 110 lb pig is approximately .48% (9.1 g/d). The threonine requirement was nearly met when .50% (8.96 g/d) dietary threonine was fed. However, a 3% improvement in ADG was detected when dietary threonine was increased to .60% (10.83 g/d). Feed efficiency was also improved by 3% when dietary threonine was increased from .50 to .60%, suggesting improved amino acid utilization.

From d 14 to 28, no treatment effects were detected for ADG, ADFI, and F/G when dietary threonine was increased. However, ADG was improved by 16% and F/G was improved by 10% when dietary threonine was increased from .40 to .50%. This represents an increase in threonine intake from 8.18 to 11.00 g/d. The data from this period (d 14 to 28) suggest that in the later stages of the grower phase dietary threonine intake is greater than typical recommendations. As feed intake increased with maturity, the threonine intake required to maximize growth performance was achieved at a lower dietary threonine concentration than in the early (d 0 to 14) grower phase.

Although cumulative (d 0 to 28) ADG and ADFI were not influenced by increased dietary threonine, F/G improved (P<.01) linearly and quadratically as dietary lysine increased. A 17% increase in ADG was detected when dietary threonine was increased from .40 to .50% (7.60 vs 9.98 g/d, respectively), and F/G was improved 15% by the same increase. A 3% improvement in feed efficiency was detected when dietary threonine was increased form .50 to .60%.

Serum urea N (d 14) decreased (P<.01) linearly and quadratically as dietary threonine increased from .40 to .80%. A similar response was detected on d 28; serum urea N decreased linearly (P<.01) and quadratically (P<.05) as dietary threonine increased. In both instances, serum urea N was minimized at .60% dietary lysine. These data suggest that amino acid utilization is optimized for growing pigs when approximately .60% threonine is included in a 1.00% lysine diet.

Currently, NRC (1988) recommendations suggest that threonine be included at .48% (9.1 g/d) in 45 to 110 lb pigs. The results from this experiment suggest that ADG and F/G are optimized between .50 and .60%. Thus, dietary threonine requirements for grower pigs may be greater than current NRC recommendations during the early grower phase. The quadratic response to increased dietary threonine indicates maximal feed efficiency at approximately .60% dietary threonine. This observation is further supported by the minimal serum urea N concentrations in pigs fed .60% dietary threonine. Diets containing .60% threonine correspond to a threonine intake of approximately 10.83 g/d. As the pig matures, the magnitude of response to dietary threonine is not as great. Feed efficiency is improved by 15% when dietary threonine is increased from .40 to .50%, but by only 3% when it is increased from .50 to .60%. Thus, threonine intake at approximately 11 g/d (.60% dietary threonine from d 0 to 14 and .50% dietary threonine from d 14 to 28) is required to optimize growth performance during the growing phase.

The typical corn-soybean meal diet is not deficient in threonine. However, the results of our experiment and research from the Universities of Kentucky and Georgia suggest that dietary threonine may need to be increased in growing pig diets. Further research is necessary to quantitate the amount of dietary threonine required relative to lysine to optimize growth performance.

Table 2. The Effect of Increased Dietary Threonine on Growth Performance and Serum Urea Nitrogen in 60 lb Growing Pigs[a]

	Dietary threonine, %					
Item	.40	.50	.60	.70	.80	CV
ADG, lb						
d 0 to 14[e]	1.29	1.60	1.65	1.66	1.51	15.31
d 14 to 28	1.58	1.89	1.91	1.49	1.93	40.13
d 0 to 28	1.44	1.74	1.78	1.57	1.72	21.33
ADFI, lb						
d 0 to 14	3.87	3.95	3.98	3.86	3.81	11.40
d 14 to 28	4.51	4.85	4.72	4.90	4.71	9.34
d 0 to 28	4.19	4.40	4.35	4.35	4.26	9.51
F/G						
d 0 to 14[cd]	3.00	2.47	2.41	2.33	2.52	9.58
d 14 to 28	2.85	2.57	2.00	3.29	2.44	37.40
d 0 to 28[bd]	2.91	2.53	2.00	2.77	2.48	5.28
Threonine intake, g/d						
d 0 to 14	7.02	8.96	10.83	12.26	13.83	--
d 14 to 28	8.18	11.00	12.85	15.56	17.09	--
d 0 to 28	7.60	9.98	11.84	13.81	15.46	--
Serum urea N, mg/dl						
d 14[bd]	21.07	11.94	11.70	13.21	11.56	18.39
d 28[be]	18.43	13.03	12.84	13.62	12.39	20.58

[a]Means calculated from 60 pigs (initially 68.57 lb BW); two pigs/pen and six pens/treatment.
[bc]Linear effect of dietary threonine ($P<.01$) and ($P<.05$), respectively.
[de]Quadratic effect of dietary threonine ($P<.01$) and ($P<.05$), respectively.