AMINO ACID SUPPLEMENTATION OF WHEAT DIETS FOR GROWING-FINISHING SWINE

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Story in Brief

To determine the effect of replacing a portion of the soybean meal in wheat rations with lysine with or without added threonine on performance, 348 growing-finishing pigs were fed wheat-soybean meal diets. Substituting only lysine for soybean meal reduced daily gains and efficiency of feed use. Addition of threonine together with lysine improved daily gain in the growing period but not in the finishing period. Gains by pigs fed wheat plus lysine and threonine were equal to those fed the control wheat-soybean meal diet for slow growth line pigs but not for those from a rapid growth line. Following lysine, threonine limited feed intake and gain from wheat diets for growing pigs but not for finishing pigs.

Introduction

Portions of the soybean meal used to supplement diets of sorghum or corn grain for swine can be replaced by addition of limiting amino acids. Levels of the primary amino acids which may limit growth (lysine, sulfur amino acids, tryptophan and threonine) are higher in wheat than in corn or milo grains, but research information to determine the feasibility of replacing a portion of the soybean meal in wheat diets with semipurified amino acids is not available. All the limiting amino acids are available in sufficient quantities to supplement though cost is currently quite high. Amounts required to supplement wheat diets are considerably less than needed for corn or sorghum grain diets. This study was conducted to determine the effect of replacing half or all of the supplemental soybean meal in wheat diets with lysine or with lysine plus threonine on performance of growing-finishing swine.

Materials and Methods

This trial was conducted at the Livestock and Forage Resarch Laboratory at El Reno, Oklahoma. A total of 348 pigs in 22 indoor pens equipped with self-feeders and waterers were fed the test diets. Pigs came from groups genetically selected for slow growth or rapid growth and were randomly allotted within growth line to the three dietary treatments (table 1). All diets contained 0.75 percent lysine from wheat plus soybean meal or lysine during the growing phase (42-116 lb) and 0.62 percent lysine during the finishing (116-217 lb) phase. The three treatments consisted of: (1) a wheat-soybean meal diet; (2) wheat supplemented with lysine but formulated to supply only the required amount of threonine which was calculated to be the second limiting amino acid or (3) diet 2 plus threonine at 120% of the NRC (1979) requirement.

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TABLE 1. Composition of experimental rations.

Item	Grower Diets			Finisher Diets		
	1 wheat	2 wheat + lys	3 wheat + lys + thr	1 wheat	2 wheat + lys	3 wheat + lys + thr
	----------% Composition (as-fed)----------					
Wheat, hard red winter	81.00	89.00	88.92	86.80	96.53	96.45
Soybean meal (44%)	14.37	7.00	7.00	10.15	0.00	0.00
Dicalcium phosphate	1.46	1.60	1.60	1.25	1.38	1.38
Calcium carbonate	0.92	0.90	0.90	0.95	0.92	0.92
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Vit TM mix[a]	0.25	0.25	0.25	0.25	0.25	0.25
Lysine hydrochloride	0.00	0.25	0.25	0.00	0.32	0.32
Threonine	0.00	0.00	0.08	0.00	0.00	0.08
Tylan 10	0.50	0.50	0.50	0.10	0.10	0.10
Calculated analysis						
% Protein	16.64	13.94	13.93	15.06	12.06	12.06
% Lysine	0.75	0.75	0.75	0.62	0.62	0.62
% Met + cys	0.48	0.41	0.41	0.44	0.35	0.35
% Threonine	0.59	0.46	0.54	0.51	0.37	0.44
% Calcium	0.75	0.75	0.75	0.70	0.70	0.70
% Phosphorus	0.65	0.65	0.65	0.60	0.60	0.60

[a]Supplied 4,000,000 IU vitamin A, 3,000,000 IU vitamin D, 4 g riboflavin, 20 g pahtothenic acid, 30 g niacin, 800 g choline chloride, 15 mg vitamin B_{12}, 10,000 IU vitamin E, 2 g menadione, 200 mg iodine, 90 g iron, 20 g manganese, 10 g copper, 90 g zinc and 100 mg selenium per ton of feed.

These levels of amino acids (.32 and .40% of the diet) replaced 7.4% (over half) and 10.1% (all) of the soybean meal in the diet during the growing phase and the finishing phase, respectively.

Results and Discussion

A block (growth rate selection line) by treatment interaction for average daily gain and average daily feed intake was detected, so results are presented within line of selection (table 2). During the growing period, pigs fed the wheat-soybean meal diet (treatment 1) grew faster ($P<.01$) than pigs fed the wheat-lysine diet (treatment 2). Lysine substitution for soybean meal reduced growth rate by 22.0 and 12.9 % for the rapid growth and for the slow growth line, respectively. Addition of threonine (treatment 3) to the wheat-lysine diet (treatment 2) increased gain ($P<.01$) by 16.4 for pigs from the rapid growth line

and by 14.8% for pigs from the slow growth line. Compared to growth rates of pigs fed the wheat-soybean meal diet (treatment 1), growth rate with the wheat-lysine-threonine diet (treatment 3) remained low (P<.01) for pigs from the rapid growth line. In contrast, gains from treatments 1 and 3 were equal for pigs from the slow growth line. This differential response to supplemental amino acids between the rapid and slow growth lines caused a selection line by treatment interaction (P<.001) and indicates that amino acid requirements as a percentage of the diet change as potential growth rate changes.

TABLE 2. The effect of level of soybean meal and amino acids on gain and feed intake in two lines of growing-finishing swine fed wheat based diets.

	Rapid Growth Line Treatments			Slow Growth Line Treatments		
	1 wheat + soy	2 wheat + lys	3 wheat + lys + thr	1 wheat + soy	2 wheat + lys	3 wheat + lys + thr
Pigs per treatment, no	60	55	41	61	58	62
Pens per treatment, no	4	3	3	4	4	4
Growing period (42-116 lb)						
Avg daily gain, lb[ab]	1.64[c]	1.28[d]	1.49[e]	1.32[c]	1.15[d]	1.32[c]
Avg daily feed intake, lb	4.24[f]	3.82[g]	4.08[fg]	3.42[f]	3.41[f]	3.78[g]
Finishing period (116-217 lb)						
Avg daily gain, lb[ab]	2.17[c]	1.85[d]	1.85[d]	1.60[f]	1.51[g]	1.54[fg]
Avg daily feed intake, lb	6.64[c]	6.21[cd]	5.88[d]	5.00	5.06	5.07

[a] Growth rate line by treatment interaction (P<.0001).
[b] Growth rate line effect (P<.0001).
[cde] Means in the same row with a different superscript within line differ (P<.01).
[fg] Means in the same row with a different superscript within line differ (P<.1).

Feed intake during the growing period also responded differently to supplementation in the two growth rate lines. For pigs from the rapid growth line, feed intake was highest for pigs fed the wheat-soybean meal diet (treatment 1) and lower (P<.10) for pigs fed the wheat-lysine diet (treatment 2) with intake of the wheat-lysine-threonine diet (treatment 3) being intermediate. In contrast, feed intake of pigs from the slow growth line was equal for the wheat-soybean meal (treatment 1) and wheat-lysine (treatment 2) diet but tended to increase (P<.1) with added threonine (treatment 3). Most of the added gain can be explained by the additional feed consumed. These data suggest that threonine limited

feed intake and gain of pigs fed a wheat-lysine diet calculated to meet the threonine requirement. Possibly lysine supply for the rapid growth line limited response to added threonine. Effects of threonine on growth hormone release also could differ between pigs selected for slow versus rapid growth. Responses in feed intake but not in gain could indicate that threonine, not lysine, was the first limiting amino acid in wheat diets for pigs from the slow growth line.

TABLE 3. The effect of level of soybean meal and amino acids on feed efficiency and backfat in two lines of growing-finishing swine fed wheat based diets.

Item	Treatments 1 wheat	2 wheat + lys	3 wheat + lys + thr
Pigs per treatment, no	122	118	108
Pens per treatment, no	8	7	7
Growing period (42-116 lb)			
Feed per lb gain, lb	2.70^{ae}	3.01^{bf}	2.88^{abf}
Finishing period (116-217 lb)			
Feed per lb gain, lb	3.35^{ce}	3.61^{df}	3.40^{cde}
Growing-finishing period (42-217 lb)			
Backfat, in	1.14^{e}	1.12^{e}	1.11^{f}

^{ab}Means in the same row with different superscripts differ (P<.01).
^{cd}Means in the same row with different superscripts differ (P<.05).
^{ef}Means in the same row with different superscripts differ (P<.1).

During the finishing period (116-217 lb), pigs selected for rapid growth again gained more rapidly than those selected for slow growth (P<.0001). The wheat-soybean meal diet (treatment 1) produced more rapid gains than the wheat-lysine diet for pigs from the rapid (P<.01) and from the slow (P<.10) growth line. The addition of threonine failed to improve performance in pigs from either selection line. Differences in growth rate between pigs fed the wheat-soybean meal diet and those fed the wheat-lysine diet was much greater for pigs from in the rapid growth line than for pigs in the slow growth line which resulted in the selection line by treatment interaction (P<.001). Responses could suggest that some amino acid other than lysine or threonine was limiting growth rate or feed intake with these wheat diets and that threonine may be limiting for slowly but not rapidly growing pigs. Feed intake during the finishing period was lower (P<.01) for pigs from the rapid growth line with the wheat-lysine-threonine diet (treatment 3) than with the wheat-soybean meal diet (treatment 1). Since the addition of threonine

did not produce a growth rate or feed intake response, these data support the suggestion that threonine was not the amino acid limiting growth in finishing swine fed a wheat-lysine diet or that a combination of amino acids was limiting.

No interaction between growth rate line and diet was detected for feed efficiency so trial means are presented in table 3. Feed efficiency was poorer for the wheat-lysine than the wheat-soybean meal diet in both the growing ($P<.01$) and finishing ($P<.05$) periods. Feed efficiency was improved slightly by adding threonine to the wheat-lysine diet for both growing and finishing pigs. Feed efficiency tended to be poorer for pigs fed the wheat-lysine-threonine diet than for pigs fed the wheat-soybean meal diet during the growing period ($P<.10$) but not during the finishing period. Backfat tended to be lower for pigs fed amino acid supplemented diets. These data suggest that supplementing wheat diets with threonine and lysine to meet the NRC (1979) threonine requirement will restore feed efficiency during the finishing, but notduring the growing period. The observation that feed efficiency of finishing swine was improved by addition of both lysine and threonine is inconsistent with the observation that average daily gain was not improved in either line by adding threonine to the wheat-lysine diet.

Literature Cited

NRC. 1979. Nutrient Requirements of Swine. National Academy of Sciences. National Research Council, Washington, DC.