Dietary Thiamin Needs of High Lean Growth Pigs

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Summary and Implications

Ten sets of five littermate pigs with a high genetic capacity for lean tissue growth (350 to 370 g/day) and reared via a segregated-early-weaning scheme were used to determine the dietary thiamin needs of pigs exhibiting a high rate of lean tissue growth. Within each litter, pigs were randomly allotted to one of five dietary thiamin concentrations equivalent to 200, 330, 460, 590, and 720% of the current NRC (1988) estimated requirement for 11 to 22 pound pigs. Pigs were penned individually and given ad libitum access to experimental diets and water from 22 to 88 pounds body weight (BW). Pooled across diets, the pigs' body weight gains and feed:gain ratios averaged 1.70 pounds per day and 1.44 pounds, respectively, from 22 to 88 pounds body weight. Dietary thiamin concentration did not alter daily feed intake, rate of body weight gain, or feed:gain ratios. Based on these data, dietary thiamin in a corn-soy-based diet (2.2 ppm) is adequate for optimal rate and efficiency of gain in high lean growth pigs from 22 to 88 pounds body weight.

Introduction

Recent advances in pork production technologies have resulted in greater rates of lean tissue growth in pigs. These advancements include the use of genetic strains with higher capacities for lean tissue accretion and the use of rearing schemes (i.e., segregated-early-weaning, three-site production) which minimize antigen exposure and allow greater rates of lean tissue growth. Dietary nutrients, including vitamins, are needed for the synthesis of lean tissue. The vitamin thiamin is required for dietary carbohydrates, fats, and proteins to be metabolized in the pig and for the subsequent production of energy for use in tissue growth. Pigs exhibiting a high rate of lean tissue growth are considered to be in the phase of growth in which energy is the most limiting nutrient. Therefore, more vitamins may be needed in these animals to provide the energy needed to support this higher level of lean tissue growth.

Recent research at our station has demonstrated that pigs with a high health status and genetic capacity for lean tissue deposition rate need as much as five times current NRC (1988) recommendations for one or more of a group of five B vitamins (niacin, pantothenic acid, riboflavin, B12, and folacin) from 22 to 62 pounds body weight. Vitamins in that study were added to a basal diet containing bioavailable amounts equal to approximately 70% of current NRC (1988) values. Because thiamin is found at greater concentrations in normal feed ingredients (i.e., corn), it was not included in the original study.

The objective of this study was to determine the impact of dietary thiamin concentration on rate and efficiency of gain in high health status pigs with a high genetic capacity for lean tissue growth.

Materials and Methods

Ten sets of five littermate pigs with a high genetic capacity for lean tissue growth were weaned at 12±2 days of age via a segregated-early-weaning (SEW) scheme. Pigs were given ceftiofur (Naxcel) at 0, 1, and 2 days post-weaning (4.5 mg/lb bodyweight) and placed into a nursery physically isolated from other pigs. The SEW procedure was designed to minimize pigs' exposure to foreign antigens. Pigs were penned individually in 2 ft x 4 ft pens and given ad libitum access to a milk pellet diet from 12 until 19 days of age. Pigs were then given the basal diet (Table 1) until 22 pounds body weight. At 22 pounds body weight, pigs were transported to a grower unit and penned individually in 2.5 ft x 7.0 ft pens on a concrete slatted floor. Pigs were randomly allotted within litter to one of five dietary thiamin concentrations (0.9, 1.5, 2.1, 2.7, 3.3 mg/pound). These concentrations are equivalent to 200, 330, 460, 590, and 720% of current NRC (1988) estimated thiamin requirements for 11 to 22 pound pigs (Table 2).

Table 1. Diet composition of basal diet.

Ingredient	%
Corn	46.5
Soy concentrate	19.9
Casein	8.0
Lactose	15.0
Corn oil	3.0
Tryptosine	.50
L-Threonine	.27
DL-Methionine	.35
Starch	.50
Monodicalcium phosphate	3.45
Limestone	.58
Salt	.40
Choline Cl	.38
Trace mineral-vitamin premix[a]	.60
Thiamin carrier	.07
Antimicrobial agents[b]	.50

[a]Contributed the following per lb of diet: biotin, .14 mg; folacin, .81 mg; niacin, 40.9 mg; pantothenic acid, 27.3 mg; riboflavin, 9.5 mg; pyridoxine, 4.1 mg; vitamin B12, .052 mg; vitamin E, 48.0 IU; vitamin A, 5600 IU; vitamin D3, 601.4 IU; vitamin K, 1.4 mg; Fe, 79.6 mg; Zn, 103.0 mg; Mn, 27.2 mg; Cu, 8.0 mg; I, 1.1 mg; Se, .14 mg.
[b]Contributed the following per lb of diet: chlortetracycline, 50 mg; sulfathiazole, 50 mg; penicillin, 25 mg.

Table 2. Thiamin concentration in pelleted test diets.[a]

	Thiamin concentration, % of NRC				
Item	200	330	460	590	720
Calculated value mg/lb	0.9	1.5	2.1	2.7	3.3
Analyzed value mg/lb	1.0	1.6	2.2	2.7	3.2
% of NRC	220	350	480	590	710

[a]Thiamin analysis performed by Corning Hazelton, Madison, WI.

Pig weights and feed consumption were measured at four-day intervals until the pigs reached 88 pounds body weight. All test diets were pelleted through a 3/16" die.

Results and Discussion

The basal diet (no supplemental thiamin) was analyzed to contained 2.2 ppm thiamin, which is 220% of the current NRC (1988) values. Previous research at our station showed that genetically lean, high health status pigs require as much as 500% of current NRC (1988) values for one or more of a group of five B vitamins that are needed for proteinaceous tissue growth in pigs. These vitamins (niacin, pantothenic acid, riboflavin, B12, and folacin) are involved with energy and protein metabolism

In the current study, dietary thiamin concentrations did not affect daily feed intake, body weight gain, or feed:gain ratios (Table 3). The lack of response is likely related to the pigs apparent unique ability to store thiamin for as long as two months on a thiamin deficient diet (Heinemann et al., 1946). The high rates of lean tissue deposition in the genetically lean pigs may have increased the pigs' demand for energy and thiamin, but sufficient body stores may have existed to meet the pig's needs.

Table 3. Pig growth and feed utilization.

	Thiamin concentration, % of NRC				
Item	200	330	460	590	720
Pig weight, lb					
Initial	22.2	21.4	21.3	21.4	21.9
Final	86.8	89.1	86.9	87.6	89.2
Feed, lb/day	2.45	2.50	2.47	2.38	2.42
Gain, lb/day	1.73	1.70	1.68	1.63	1.71
Feed/gain	1.42	1.47	1.47	1.46	1.42

Based on these data, the concentrations of thiamin in a corn-soy based diet appear to be adequate for optimizing rate and efficiency of gain in high health status, genetically lean pigs.

Pig weights and feed intakes were recorded at four-day intervals over the entire study to determine if the pig's need for dietary thiamin differed at different stages of the pig's development. No diet by pig weight interaction was detected. The pigs responses at different stages of development to dietary thiamin concentrations equivalent to 200 and 720% of the current NRC (1988) estimated requirement for thiamin are shown in Figure 1. Higher dietary concentrations of thiamin did not improve pig performance at any stage of growth monitored.

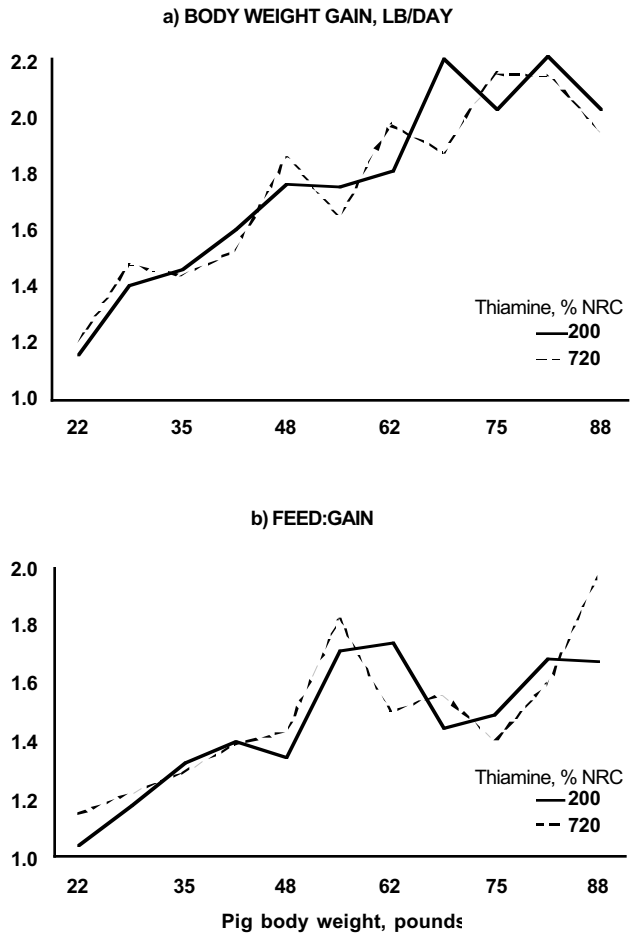

Figure 1. Effect of dietary thiamin concentration on (a) daily body weight gain and (b) feed:gain ratios of pigs during each 6.5 pound weight gain from 22 to 88 pounds body weight. The pigs' response to dietary thiamin concentration equivalent to 220 (basal) and 720% of current NRC (1988) estimates are shown.