Dietary Niacin Needs of High Lean Pigs

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Summary and Implications

Pigs of a high lean strain reared via an SEW scheme were self-fed a basal diet supplemented with 0, 15, or 30 mg niacin/kg diet from 10 to 27 kg body weight. The basal diet contained 18 mg of total niacin and 9.4 mg of bioavailable niacin per kg diet. Dietary niacin supplementation did not alter pig growth, efficiency of feed utilization, or body nutrient (protein, fat) accretion. Based on these results, dietary niacin needs of high lean, high health pigs are not greater than current NRC (1998) estimated requirements.

Introduction

Traditionally, empirical experiments have been conducted to determine vitamin requirements based on the amount of each vitamin a pig requires to achieve maximum growth. Much of the research that these requirements are based upon, however, was conducted in the 1950s and 1960s. Since that time, pigs have become more efficient meat-producing animals with an ability to produce more proteinaceous tissue per kilogram of body weight gain.

Previous work at our station (1,2) indicated that higher dietary concentrations of one or more of a group of five B vitamins (niacin, pantothenic acid, riboflavin, B_{12}, and folic acid) were needed to optimize performance of a high-lean-growth strain of pigs compared with that needed by a moderate-lean-growth strain of pigs. These results indicate the dietary vitamin needs of pigs may vary among pigs differing in their capacity for proteinaceous tissue growth.

In subsequent work by Lutz and Stahly (3), the riboflavin needs for specific biological processes were determined to be about six times greater for a unit of body protein versus fat accretion. These data indicate that riboflavin needs of pigs are increased substantially as the animals capacity for proteinaceous tissue (i.e., muscle) accretion increases. Furthermore, the riboflavin needs of high lean pigs are substantial greater than current NRC (1998) estimated requirements.

The objective of this study was to determine if the dietary niacin needs of high lean pigs also were greater than current NRC (1998) estimated requirements.

Materials and Methods

Pigs (barrows) of a high lean strain were reared via an SEW scheme. The dietary treatments consisted of a basal diet supplemented with 0, 15, or 30 mg niacin/kg diet. The basal diet contained 18.6 mg total niacin and 9.4 mg bioavailable niacin per kg diet (Table 1). All other vitamins were supplemented at 600% of NRC (1998) estimated requirements for 5- to 10- kg pigs. The diets were formulated to minimize the presence of excess tryptophan that could be metabolically converted into niacin. Specifically, diets were formulated to contain ideal ratios of amino acids relative to digestible lysine. Digestible tryptophan concentrations were maintained at 18% of digestible lysine, which was maintained at 1.36, 1.26, and 1.16% for pigs fed from 10 to 15.5, 15.5 to 21, and 21 to 27 kg body weight, respectively.

Table 1. Basal diet composition,%.

	Body weight, kg		
Ingredient	10 - 15	15 - 21	21 - 27
Corn	63.17	63.17	63.17
Soybean meal	17.89	17.89	17.89
Casein	7.00	7.00	7.00
Choice white grease	5.00	5.00	5.00
Amino acid mix	.98	.62	.33
Starch	.00	.35	.65
Dicalcium phosphate	3.18	3.18	3.18
Limestone	.48	.48	.48
Salt	.40	.40	.40
Choline chloride	.23	.23	.23
Trace mineral-vitamin[a]	.31	.31	.31
Niacin carrier(starch)	.20	.20	.20
Potassium sulfate	.36	.36	.36
Sodium bicarbonate	.31	.31	.31
Antimicrobial agent[b]	.50	.50	.50

[a] Contributed the following per kg of diet: biotin, .30 mg; riboflavin, 21 mg; pantothenic acid, 60 mg; folic acid, 1.8 mg; pyridoxine, 9 mg; thiamin, 6 mg; vitamin B_{12}, .105 mg; vitamin E, 96 IU; vitamin A, 13,200 IU; vitamin D_3, 1320 IU; vitamin K, 3 mg; vitamin C, 100 mg; Fe, 280 mg; Zn, 240 mg; Mn, 96 mg ; Cu, 28 mg; I, .32 mg; Se, .30 mg.

[b] Contributed the following per kg of diet: chlortetracycline, 110 mg; sulfathiazole, 110 mg; penicillin, 50 mg.

Pigs were weaned at 8 to 12 days of age and placed in an isolated nursery unit at Iowa State University. Pigs were treated with Ceftiofur (4.4 mg/kg body weight) on days 0, 1, and 2 after arrival and ivermectin on day 0. Pigs were penned individually on slotted floors in a thermoneutral climate. Pigs were allowed to consume feed and water ad libitum.

Pigs were fed the basal diet from day 4 postweaning to 10 ± 1.5 kg body weight to minimize body stores. At 10 kg body weight, three littermate barrows in each of 10 litters were randomly allotted to one of the three dietary concentrations of niacin.

Experimental diets were analyzed for niacin concentration at the termination of the experiment by a commercial laboratory (Covance Laboratories Inc., Madison, WI) with a turbidimetric method according to AOAC (1) procedures (Table 2).

Table 2. Analyzed niacin content of diets.

	Added niacin, mg/kg		
Criteria	0	15	30
Dietary niacin, mg/kg			
Total	18.2	36.4	47.4
Bioavailable[a]	9.4	27.6	38.6
Dietary niacin, % NRC (1998) for 10- to -20 kg pigs			
Bioavailable	75	220	309

[a]Bioavailable niacin concentration was calculated as analyzed niacin values in individual ingredients corrected for a niacin bioavailability of 30% in corn and 100% in soybean meal (6).

Pig weights, feed consumption, and feed wastage were measured at 4-day intervals until the pigs reached 27 ± 1.5 kg body weight. Body composition of pigs at 10 kg (initiation) and 27 kg (completion) was determined via deuterium oxide dilution techniques. To quantify the level of immune system activation, serum concentrations of the acute phase protein alpha-1 acylglycoprotein (AGP) were determined in five replications of pigs fed the basal diet. Serological titers for four common swine pathogens, *Actinobacillus pleuronpneumoniae* (APP), *Mycoplasma hyopneumonia* (MP), porcine reproductive and respiratory syndrome (PRRS), and swine influenza virus (SIV), also were determined.

Data were analyzed as a completely randomized block design by analysis of variance techniques with the GLM procedure of SAS. The pig was considered the experimental unit. Orthogonal comparisons were made to test for linear and quadratic diet effects. Least square means are reported.

Results and Discussion

The pigs exhibited moderate to low serum concentrations of AGP at the initiation and completion of the study (Table 3), indicating the animals experienced a moderate to low level of antigen exposure. The pigs' serological titers indicated the pigs were not exposed to APP, PRRS, but had received passive antibodies from their dams for MP and SIV.

Table 3. Serological titers for prevalent antigens and serum AGP levels.

	Body weight, kg	
Criteria	10	27
Antibody titers[a]		
APP	-	-
MP	+	+
PRRS	-	-
SIV	+	+
AGP[b], µg/ml	811	477

[a]*Actinobacillus pleuropneumoniae* (APP), *Mycoplasma hyopneumonia* (MP), porcine reproductive and respiratory syndrome (PRRS), and swine influenza virus (SIV).
[b]Alpha-1 acylglycoprotein.

The high lean pigs in the current study consumed less feed (954 vs. 1,140 g/day), grew substantially faster (681 vs. 590 g/day), and required significantly less feed (1.40 vs. 1.92) per unit of body weight gain than pigs that the current NRC (1998) estimated nutrient requirements are based.

However, niacin supplementation in the current study did not alter daily body weight gain, feed intake, or efficiency of feed utilization. Niacin supplementation also did not alter body protein or fat accretion rates (Table 4). Based on these data, the dietary niacin needs of high lean, SEW reared pigs are not greater than current NRC (1998) estimated requirements.

Table 4. Growth, feed utilization, and body nutrient accretion.

Item	Added niacin, mg/kg 0	15	30	Prob[a]
Pig weight, kg				
Initial	10.1	10.1	10.3	NS
Final	27.6	26.9	28.0	NS
Growth and feed utilization, g/day				
Feed	973	931	958	NS
Gain	694	661	688	NS
Gain/feed	716	711	719	NS
Body nutrient accretion, g/day				
Protein	119	114	119	NS
Fat	84	76	79	NS

[a]NS indicates non-significant differences between dietary niacin concentrations.

References

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