Effect of Dietary Peptidoglycan on Growth Performance of Chronic Antigen Exposed Pigs

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ASL-1479

Summary and Implications

The effect of an orally active immune modulator on growth and feed utilization in chronic antigen-challenged pigs was evaluated. In each of 16 litters, four pigs were allotted from each litter to one of four dietary concentrations (0, 22, 44, or 66 ppm) of peptidoglycan derived from *Bifidobacterium thermophilum*. The pigs were derived from a single herd, weaned at 10 to 16 days of age, placed in nonsanitized nursery, and orally exposed to excreta of older pigs in the base herd at 4-day intervals from 9 to 76 lb body weight. Pigs were individually penned and allowed to consume feed and water ad libitum. Daily gains and feed/gain ratios of pigs were not altered by dietary peptidoglycan concentrations. Based on these data, dietary additions of peptidoglycan did not enhance the growth performance of chronic antigen-exposed pigs.

Introduction

Antigen exposure in pigs and the immune system response that follows result in economic losses in the pig industry. The immune system functions to eliminate antigens from the pig. The immune system will remain chronically active if the antigen is not completely eliminated or if the animal is continually reinfected. The immune response involves the release of cytokines, a class of pro-inflammatory compounds. Cytokines act on the animal's physiological capacity for growth by reducing feed intake and reducing anabolic hormone secretion, which results in slower accretion rates of proteinaceous body tissues and less efficient utilization of feed for growth. Enhancing the effectiveness of the immune system to rapidly eliminate antigens should enable pigs to grow faster and use feed more efficiently.

Preliminary evidence suggests that peptidoglycan from *Bifidobacterium thermophilum* may be an efficacious immune modulator in animals. Ingestion of peptidoglycan by pigs during the first five days post-farrowing enhances antibody production by immune cells in the small intestinal wall (1,2). Peptidoglycan ingestion also increases the cytotoxic activity of natural killer cells following *E. Coli* challenge and T cells in mice (3,4).

The purpose of this study was to determine the impact of peptidoglycan feeding on body growth and efficiency of feed utilization in chronic antigen exposed pigs.

Materials and Methods

Pigs from a single genetic strain and site of origin were used. The herd of origin commonly possesses serological titers for mycoplasma hyopneumonia (MP), actinobacillus pleuropneumoniae (APP), porcine reproductive and respiratory syndrome (PRRS), swine influenza virus (SIV), and transmissible gastroenteritis (TGE). Pigs were weaned at 12 days of age (range of 10 to 16 days of age) and placed in an unsanitized nursery facility located at the site of origin of the pigs. Pigs were individually penned in 1.5 x 4 ft pens on tri-bar flooring. Ambient room temperature was maintained at 88ºF at weaning and then lowered by 1.5ºF every 4 days until 74ºF was achieved. Pigs were allowed to consume a basal diet (Table 1) and water ad libitum from weaning to 76 lb body weight. Pigs were exposed to excreta from older pigs at four-day intervals throughout the duration of the study. No antimicrobial agents (subtherapeutic or therapeutic) were administered to the pigs during the study.

Table 1. Composition of basal diet.

Ingredient	%
Corn	24.7
Soybean meal, dehulled	46.2
Whey, dried	20.0
Skim milk, dried	5.0
D, L-Methionine	.25
Dicalcium phosphate	2.5
Limestone	.31
Salt	.25
Choline chloride	.17
Vit & TM Mix[a]	.48
Corn starch	.15

[a]Contributed the following per lb of diet: biotin, .05 mg; folacin, .81 mg; niacin, 40.9 mg; pantothenic acid, 27.3 mg; riboflavin, 9.5 mg; pyridoxine, 1.4 mg; vitamin B_{12}, .048 mg; vitamin A, 6000 IU; vitamin E, 44 IU; vitamin D, 601 IU; vitamin K, 1.4 mg; Fe, 80 mg; Zn, 68.2 mg; Mn, 27.2 mg; Cu, 8.0 mg; I, .09 mg; Se, .11 mg.

Sixteen sets of four littermate pigs were used. Pigs were allotted within litter to one of four dietary concentrations (0, 22, 44, or 66 ppm) of peptidoglycan (derived from *bifidobacterium thermophilum*).

Pig weights and feed consumption were determined every four days. One pig in each litter was bled at the initiation and termination of the study for determination of the pig's serological titers for prevalent antigens (MP, APP,

PRRS, SIV, and TGE). Pigs also were bled at 16-day intervals for quantification of the acute phase protein alpha-1-glycoprotein as an indicator of the level of antigen exposure the pigs' experienced during each stage of the study.

The data were analyzed as a randomized complete block design using the General Linear Model of SAS (1997). The pig was considered the experimental unit. Least square means are reported.

Results and Discussion

As desired in the study, the experimental pigs experienced a chronic antigen exposure during the study. Daily gains and feed/gain ratios of pigs in the current study were compatible with those of chronic antigen exposed pigs evaluated in previous studies conducted at our station.

Dietary peptidoglycan concentrations of 22 to 66 ppm did not alter the daily feed intake, daily weight gain, or feed/gain ratios of pigs fed from weaning (9 lb) to 76 lb body weight (Table 2).

Pigs weaned at 10 to 16 days of age initially possess some passive immunity via the antibodies they initially obtain from their dams' colostrum. Furthermore, the animals' ability to mount an immune response to an antigen is not immediate but requires recognition and processing of the antigen and subsequent synthesis of the immune components. Thus, the responses of the pigs to dietary peptidoglycan feeding at three different stages of growth (9 to 27, 27 to 44, and 44 to 76 lb) were evaluated. In each stage of growth, daily gain and feed ratios were not altered by dietary peptidoglycan additions (Table 3).

Based on these data, orally administered peptidoglycan (22 to 66 ppm in diet) is not an efficacious growth promotant in chronic antigen-exposed pigs.

Table 2. Growth and feed utilization in antigen-exposed pigs. I. Responses over the duration of the study.[a]

	Dietary peptidoglycan, ppm			
Criteria	0	22	44	66
No. of pens	16	14	15	16
Pig weight, lb				
Initial	9.3	9.3	9.1	9.4
Final	77.2	76.0	75.4	76.0
Growth and feed utilization[b]				
Daily gain, lb	1.02	1.03	1.02	1.02
Daily feed, lb	1.92	1.87	1.86	1.85
Feed/gain	1.89	1.82	1.83	1.83

[a]Pigs were individually penned and allowed to consume feed and water *ad libitum*.
[b]Least square means reported.

Table 3. Growth and feed utilization in antigen challenged pigs. II. Responses during three stages of growth.

	Pig	Dietary peptidoglycan, ppm			
Criteria	wt, lb	0	22	44	66
Daily gain, lb[a,b]	9-27	.53	.55	.55	.53
	27-44	1.63	1.67	1.67	1.67
	44-76	1.63	1.67	1.67	1.67
Feed/gain[a,b]	9-27	1.54	1.50	1.55	1.51
	27-44	1.72	1.65	1.66	1.67
	44-76	2.17	2.10	2.10	2.09

[a]Daily gains and feed/gain ratios of pigs fed from 9 to 27, 27 to 44, and 44 to 76 pounds. Raw means reported.
[b]Effect of pig weight, P<.01.

References

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