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Abstract

An experiment was conducted to determine if baby pigs develop intestinal hypersensitivity to dietary soy protein. Challenging nursery pigs with soybean meal following oral infusion of soybean meal from day 7 to day 14 of age resulted in villus atrophy and lower average daily gain by 28 days of age. At 56 days of age, there were no differences in weight gains between pigs fed soy protein and pigs fed milk protein. Pigs exposed to soybean meal before weaning had increased anti-soybean protein immnoglobulin titers at 4 wk (7.2 vs 4.0) and at 8 wk (7.6 vs 4.2). Thus, challenging baby pigs with soybean meal followed by feeding soybean meal resulted in an immune response as indicated by transient hypersensitivity at 4 wk and increased anti-soy protein titers. Also, growth was temporarily decreased at 4 weeks, but increased at 8 weeks.; Swine Day, Manhattan, KS, November 17, 1988

Keywords

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TRANSIENT HYPERSENSITIVITY TO SOYBEAN MEAL IN THE EARLY-WEANED PIG

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Summary

An experiment was conducted to determine if baby pigs develop intestinal hypersensitivity to dietary soy protein. Challenging nursery pigs with soybean meal following oral infusion of soybean meal from day 7 to day 14 of age resulted in villus atrophy and lower average daily gain by 28 days of age. At 56 days of age, there were no differences in weight gains between pigs fed soy protein and pigs fed milk protein. Pigs exposed to soybean meal before weaning had increased anti-soybean protein immnoglobulin titers at 4 wk (7.2 vs 4.0) and at 8 wk (7.6 vs 4.2). Thus, challenging baby pigs with soybean meal followed by feeding soybean meal resulted in an immune response as indicated by transient hypersensitivity at 4 wk and increased anti-soy protein titers. Also, growth was temporarily decreased at 4 weeks, but increased at 8 weeks.

(Key words: Early Weaned Pigs, Soybean Protein, Villus, Crypt, Hypersensitivity).

Introduction

As swine production intensifies, producers are weaning litters at earlier ages to increase sow productivity. Research has focused on minimizing the severity of the postweaning lag in performance. Soy protein has been proposed as the antigen responsible for a hypersensitivity response. This response may have a cascading effect within the morphology of the small intestine, affecting pig performance in the first few weeks following weaning.

Villus atrophy and malabsorption may be produced experimentally by a hypersensitivity response in the intestine of the pig. The pig would be susceptible to such responses at weaning because it is suddenly introduced to large amounts of antigenic food. The purpose of this study was to investigate the possibility that changes in villus height and crypt depth are the result of a transient hypersensitive response to dietary protein sources in the starter diet.

Procedures

Thirty-two, Yorkshire-Duroc crossbred, young pigs with an average birth weight of 2.84 lb were utilized in a series of trials. Pigs were transferred between two litters, and a total of four litters of pigs were used. Half of the pigs were infused orally with 5 g soybean meal (48% crude protein) by stomach tubing from day 7 to day 14, and another half were infused orally with a commercial milk replacer (milk protein 30% crude protein). From day 21 (weaning) to day 28, pigs were fed either the control (milk protein diet) or a 20% protein corn soybean meal diet (Table 1). Half of the pigs from each treatment were sacrificed at 28 days of age and half at 56 days of age. Samples of the small intestine were taken,and villus height and crypt depth measured. One day prior to the day of sacrifice, blood samples were

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taken through the jugular vein with vacuum puncture tubes, and anti-soy protein titers were measured with serum from both groups of pigs. The pigs were weighed at the age of 1, 21, 28, 42, and 56 days, and feed intakes were recorded.

A sow diet containing corn gluten meal (14% crude protein) were fed from day 109 of pregnancy through the lactation in order to avoid intake of any soy proteins.

Skin thickness tests were conducted on the day before sacrificing with the injection of either saline, soy protein, or milk protein.

Results

At 4 and 8 wk of age, pigs did not show any response to soybean meal with skin thickness test (Table 2). However, at 4 wk of age, pigs challenged with soybean meal followed by feeding soybean meal had shorter ($P<.01$) villus height (Fig. 1) than pigs challenged with milk protein followed by feeding milk protein. The soybean meal treatment had no effect on crypt depth (Fig. 2). At 8 wk of age, the soybean meal treatment had no effect on villus height or crypt depth. One week after weaning, average daily gain was depressed ($P<.01$) for pigs receiving soy protein (Fig. 3), but was greatly improved ($P<.01$) by 5 wk after weaning.

Pigs challenged with soybean meal at day 7 to day 14 had higher anti-soy protein immunoglobulin titers ($P<.01$) than pigs challenged with milk protein at both 4 and 8 wk of age (Fig. 4).

Discussion

In these experiments, pigs treated with soy protein had shorter villus height compared to pigs receiving milk protein at 4 wk of age, but there were no differences at 8 weeks of age between the two treatments. One explanation may be that soybean meal can be absorbed intact,which stimulates complementary releasing factors to the reaction site-villi and damages the villi. Another explanation is that increased anti-soy protein antibodies may attack both bacteria and villus surface, therby reducing villus height.

Low preweaning feed-intake, which commonly occurs with weaning at 3 wk or less, results in the immune system being primed to the feed antigen. This leads to a transient gut damage, which, in turn, reduces absorption surface, lowers absorption rate, and decreases growth rate. However, by 8 wk of age, growth rate had compensated and showed a response similar to that of pigs fed milk proteins. Whether this is because of induced tolerance or increased immune system response to soybean meal is not clear. The data presented in this report suggest that transient hypersensitivity may be of particular significance to the early-weaned pig and is influenced by the amount of creep feed eaten before weaning.

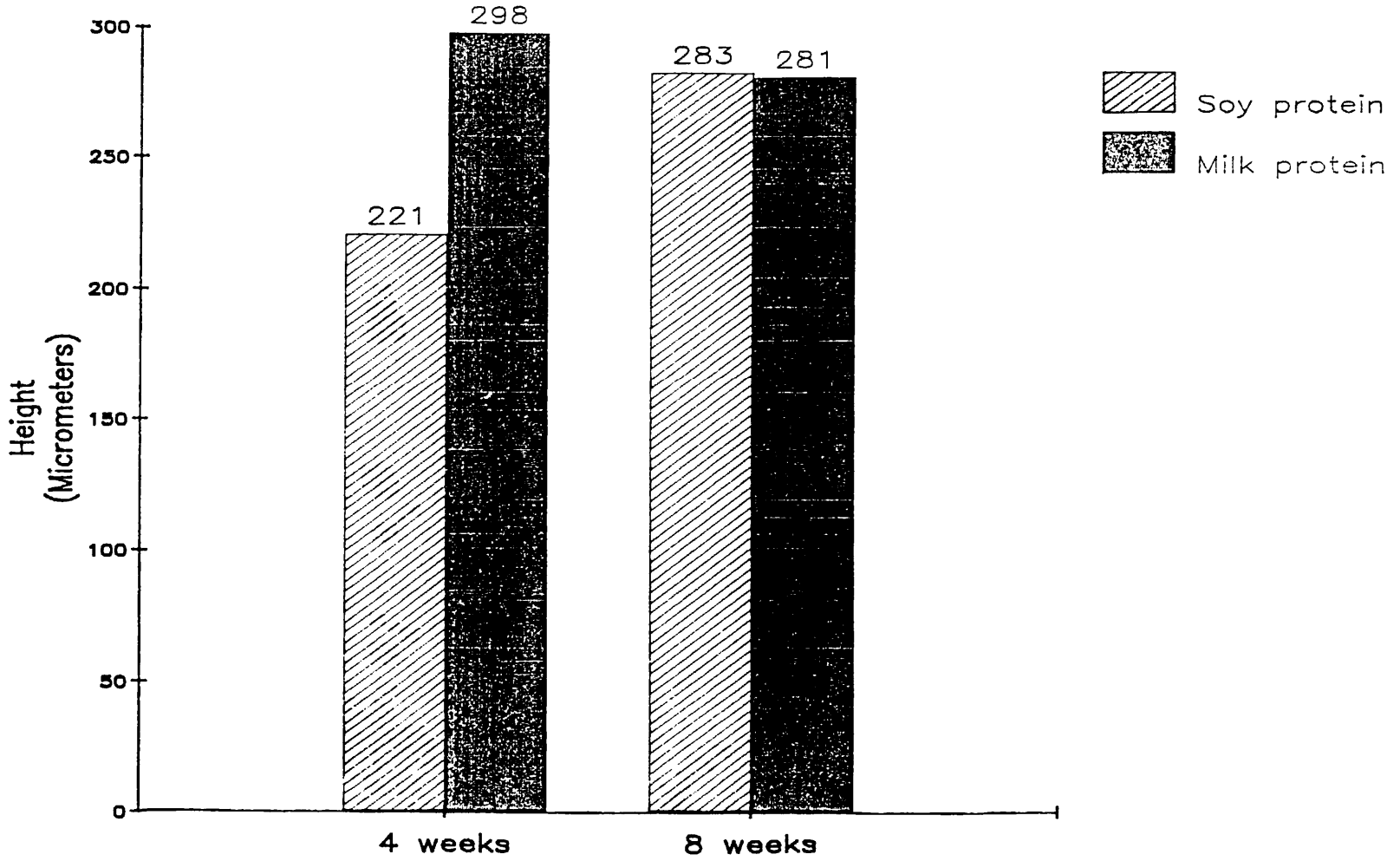
Table 1. Composition of Experimental Diets (%)

Item	Soybean	Milk
Corn	12.6	20.0
Oat groat	11.4	19.0
Swine TM premix	.1	.1
Vitamin premix	.1	.1
SBM (48% C.P.)	36.9	.0
Soy oil	2.0	2.0
Calcium carbonate	.4	.1
Dicalcium (21% P)	2.2	.3
Salt	.3	.0
Copper Sulfat	.1	.1
Selenium	.2	.2
L-lysine	.1	.1
Choice white grease	3.6	3.0
Lactose	30.0	.0
Dried skim milk	.0	35.0
Dried whey	.0	20.0
Total	100.0	100.0

Table 2. The Effect of Soybean and Milk Protein on Skin Thickness

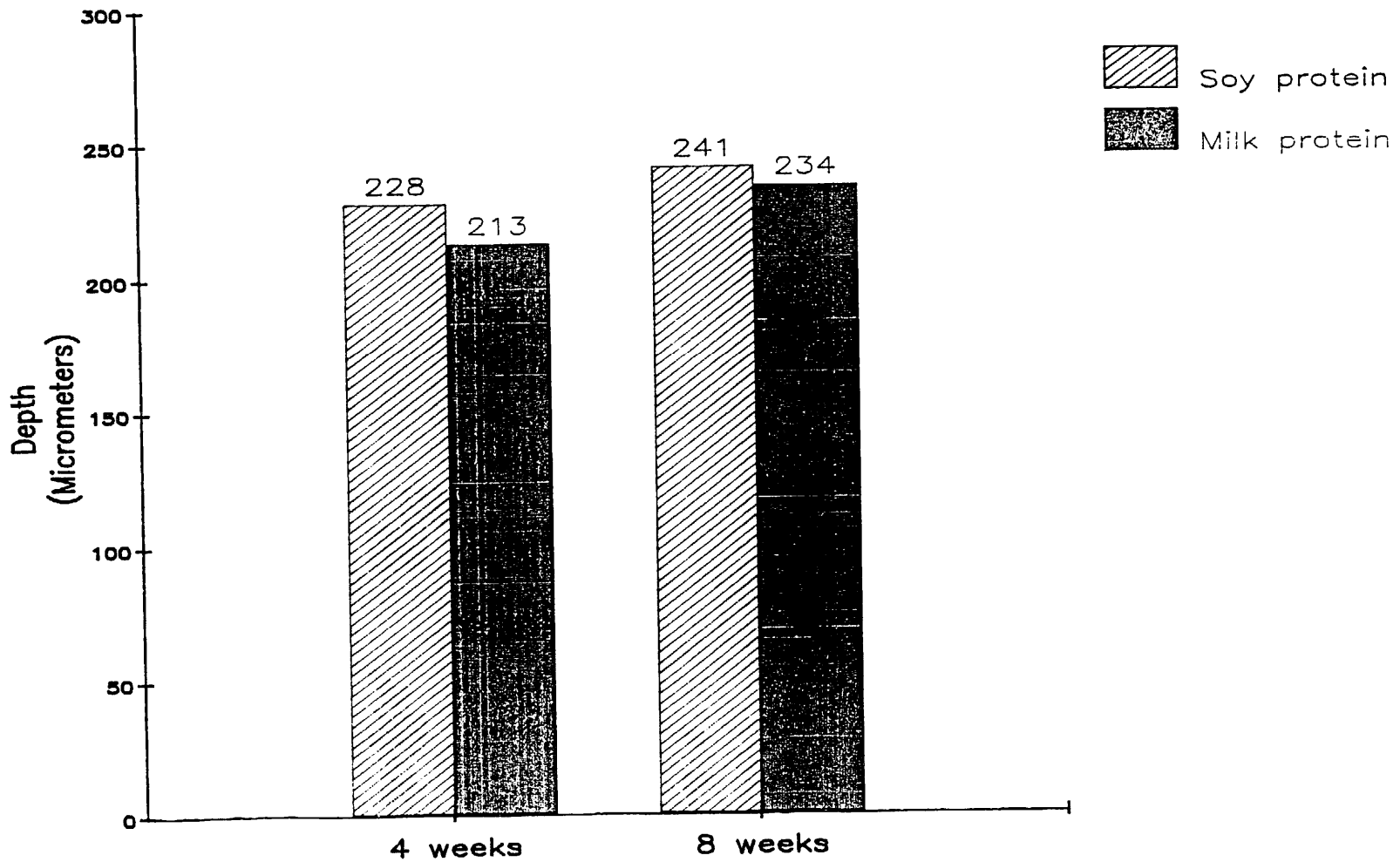
Item	Skin thickness (mm)	
	Soybean	Milk
Soy protein	.185	.230
Milk protein	.165	.470

(Fig. 1) Hypersensitivity to soy protein (Villus Height)

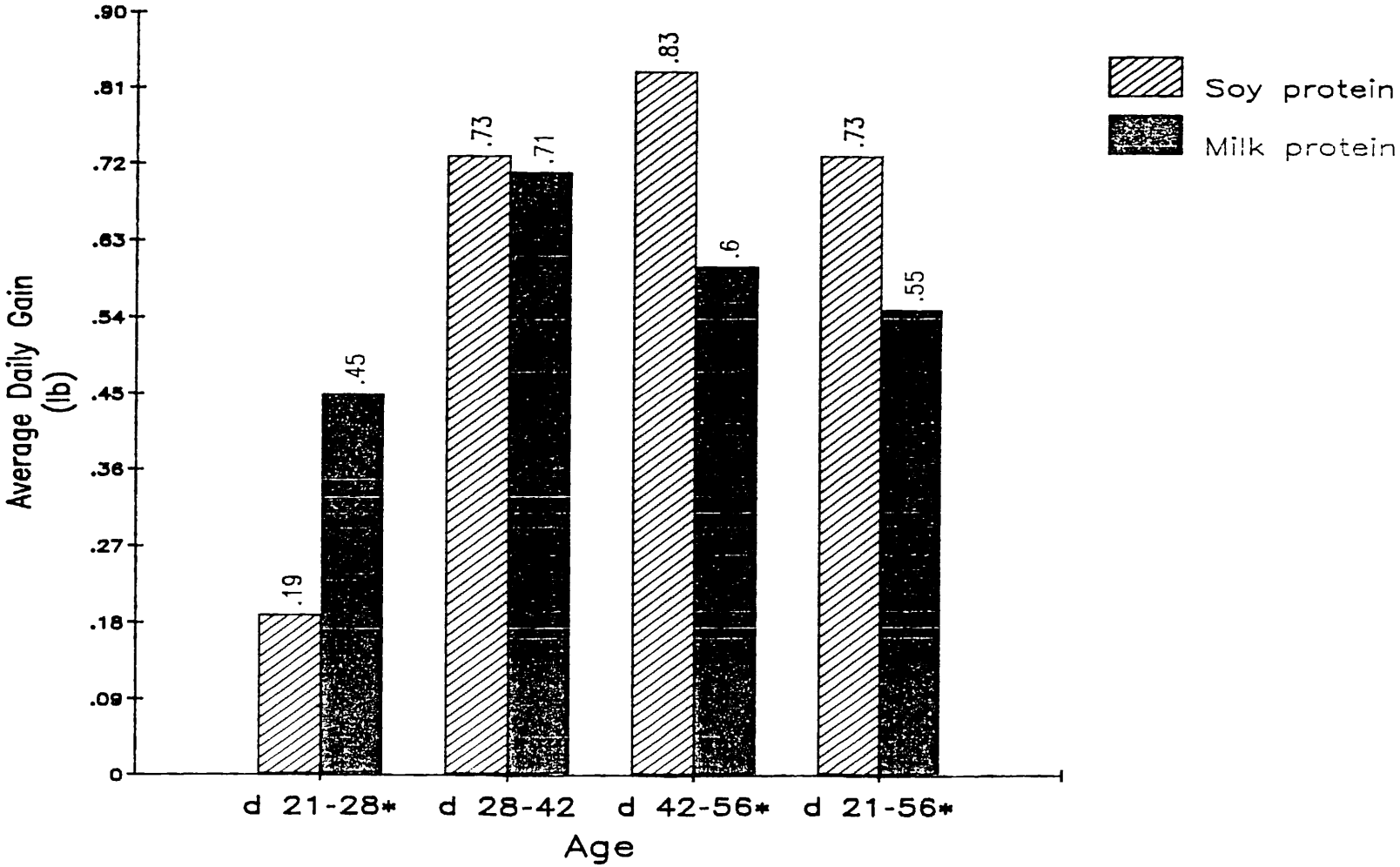


*Pigs challenged with soy protein had shorter (P<.01) villus.

(Fig. 2) Hypersensitivity to soy protein (Crypt Depth)

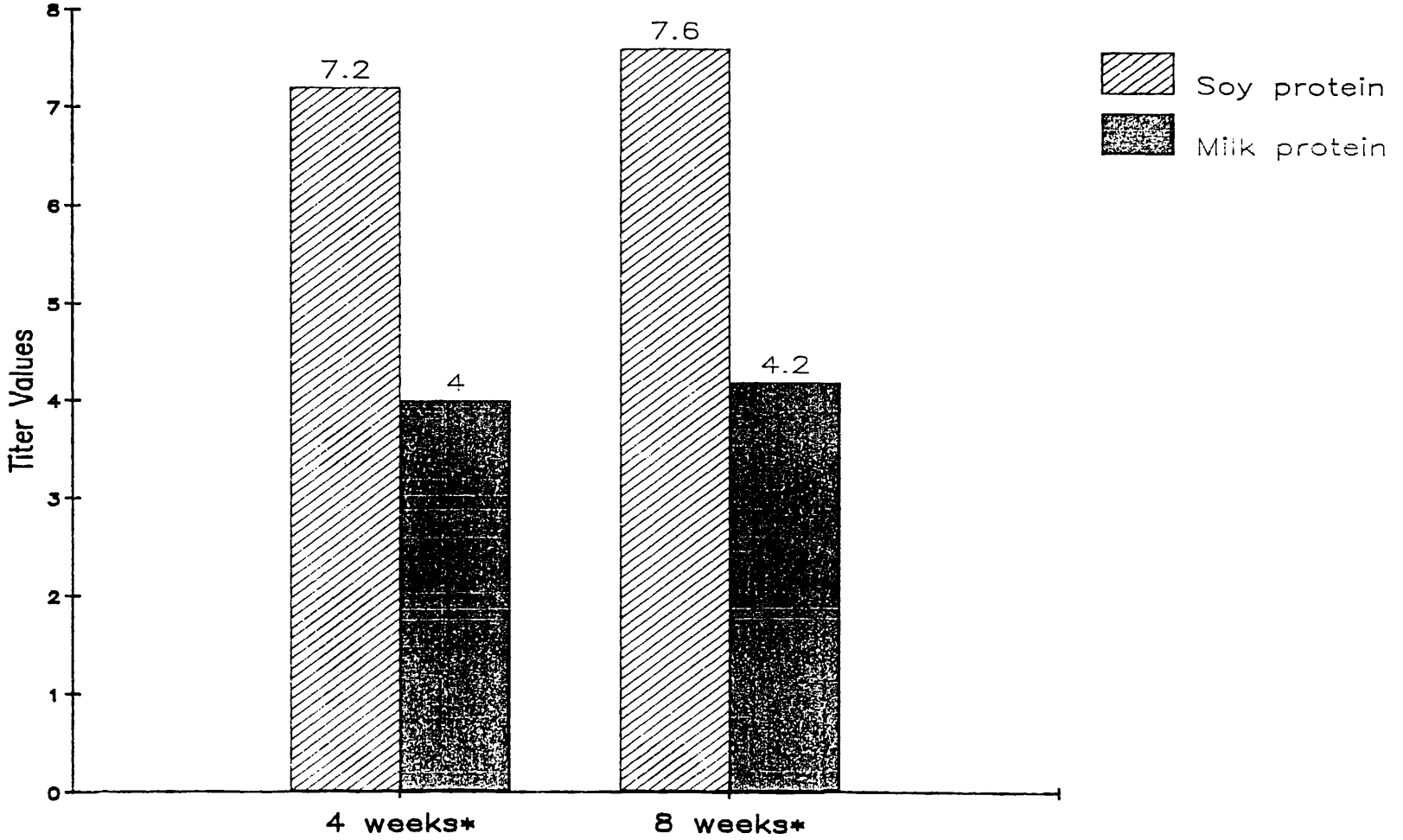


(Fig. 3) Hypersensitivity to soy protein (Average Daily Gain)



* Difference at (P<.01).

(Fig. 4)Anti-soy protein immunoglobulin titers (on log 2 base)



*pigs challenged with soy protein had higher (P<.01) anti-soy titers.