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Dietary energy density and growing-finishing pig performance and profitability (2003)

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DIETARY ENERGY DENSITY AND GROWING-FINISHING PIG PERFORMANCE AND PROFITABILITY

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Summary

A retrospective analysis of 25 studies (16 at university and 9 at field research facilities) was conducted to model the response in ADG and F/G to increasing dietary energy density and its effect on profitability. Average daily feed intake in the field studies was approximately 30% lower than in the university studies, and as pigs increase in weight in the university studies they transition to a non-energy dependent phase of growth at a lighter weight than those in the field studies. The percentage response in ADG per percent added fat in the university studies was greater for the first 2.5% added fat than for higher fat levels, indicating a diminishing return. However, the percentage response in ADG was similar for both the 2.5 and 5% added fat levels in the field studies, indicating a linear response to fat additions. As expected the F/G improvement was greater in the field compared to the university studies.

A five-year price series was used to determine the impact of fat additions to corn-soybean meal-based diets on profitability. For lighter weight pigs (70 to 120 lb), the net return to added fat is almost always positive, with feed cost per unit of gain being increased and deceased 50% of the time. However, the net return to added fat for heavier weight pigs (230 to 265 lb) fluctuates, with feed cost per unit of gain being increased in most scenarios. Using high energy diets for lighter weight pigs is cost effective and increases profit the majority of the time. The optimal energy density for late finishing pig diets is more dependent on the economic conditions.

(Key Words: Growing-Finishing Pigs, Energy Density, ADG)

Introduction

In many countries the energy density of growing-finishing pig's diets is set at the desired level, and diets are formulated by least cost formulation using the available energy sources to meet these energy levels. Contrarily in the United States, energy density of growing-finishing pig diets is generally allowed to float, with dietary energy density being dictated by the available energy sources and their cost competitiveness.

Several studies have been conducted to determine the influence of dietary energy density of growing-finishing pig diets on pig performance and carcass composition. Increasing energy density by adding fat to diets for growing-finishing pigs typically improves ADG and feed efficiency and reduces ADFI. Most of the early studies evaluating dietary added fat were conducted in university research facilities with low animal density and good en-

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vironments, which result in higher feed intakes and growth rates than those that occur in commercial swine production. The availability of data from field research barns has allowed the documentation of field versus university facility responses to dietary energy density. The lower feed intakes in a commercial environment make a favorable response to higher energy density diets more likely, and perhaps larger.

Modern pigs are genetically leaner and have lower feed intake, which makes it more likely these pigs will respond to increased energy intake with increased growth rate and less likely they will become fatter. The move to all-in all-out systems has increased the emphasis on ADG for throughput to improve site utilization. Also, the packer's penalty for selling below the optimal market weight has increased greatly. This is especially critical during the summer because of the seasonal reduction in ADG.

Although we have conducted numerous experiments to examine the energy density of finishing diets, a composite summary of trials has not been available. Thus, our objective was to do a retrospective analysis of 25 energy density experiments conducted by Kansas State University in the last 13 years to evaluate the response in pig performance to dietary energy density and its effect on profitability.

Procedures

Twenty five studies have been conducted to evaluate the effect of diet energy density on the performance of growing-finishing pigs. Sixteen of the studies were conducted in university facilities with a total of 2,144 pigs, while 9 were conducted in field research facilities with a total of 9,899 pigs. The studies conducted at both the university and field research facilities utilized barrows, gilts, and mixed sex groups. For the studies conducted at the university facilities, pigs were housed in groups of 2 to 6 pigs per pen, on totally slatted floors and given ad libitum access to feed and water. The field data were collected in 2 production systems with either PIC 327 or PIC 337 sired pigs. Under field conditions, pigs were housed in groups of 20 to 25 per pen on totally slatted floors and allowed ad libitum access to feed and water.

The data were analyzed for the percentage change in ADG and F/G per percentage added dietary fat using the Proc Mixed procedure of SAS. The model included pig body weight, feed intake as a percentage of body weight, location (field or university), dietary fat level and the location × dietary fat level interaction. After the retrospective analysis was completed, we used a 5-year price series from southern Minnesota to determine the economic impact of dietary fat additions during various stages of the grow-finish phase.

Results and Discussion

From the retrospective analysis of the 25 energy density studies, prediction equations to determine ADFI as a percentage of body weight and the response in ADG and F/G per percentage added fat in growing-finishing pig diets were determined (Table 1). From the studies conducted under field conditions, ADFI was up to 30% lower than in the university research studies (Figure 1). Also, feed intake plateaus at about 200 lb in the field studies while continuing to increase in the university studies. This indicates that in university studies, as pigs increase in weight, they transition to a non-energy dependent phase of growth at a lighter weight compared to those in the field. Therefore, the improvement in growth rate to increased dietary energy density from adding fat decreases with increasing body weight in the university data. However, in the data from field studies where feed intake does not increase rapidly with the increase in body weight, this decrease in response is at a slower rate.

In the field studies, the percentage increase in ADG per percentage added fat was relatively similar regardless of the dietary energy density or added fat level (Figure 2). However, in the university setting, the response was greater for the first 2.5% added fat than when adding 5% fat. For example, adding 2.5% fat to the diet of pigs weighing 115 lb results in a 2% improvement in ADG, while adding 5% fat only results in a 2.1% improvement in ADG. This suggests a quadratic response to adding fat to the diet with little benefit in ADG to adding more than 2.5% fat. The practical application of this is that for farms where pigs are achieving high levels of feed intake, the value of increasing ADG with dietary energy density is less and the transition away from the energy dependent phase of growth will occur at a lighter weight.

The improvement in F/G in the university studies per percentage added fat was similar for both the 2.5 and 5% added fat levels, with the improvement decreasing with increasing body weight (Figure 3). As a result of the lower feed intake and greater ADG response in the field studies, the improvement in F/G was greater than in the university studies.

To evaluate the economics of increasing energy density (added fat) of growing-finishing pig diets, a number of important questions need to be answered. First, is your production system short on days for your pigs to reach the ideal market weight? Second, what is the value of ADG in your production system? If added fat improves ADG, the value of the gain must be included in the economic analysis. If extra finishing space is available, this value may be zero, as pigs could be left in the barn additional days to reach the same end weight. However, if finishing space is short, the extra weight is at least worth market price or could be worth more than market price if the additional weight helps move pigs into the packer's optimal weight window, reducing weight discounts.

Increasing energy density of growing-finishing pig diets by adding fat will increase diet cost, but because of the importance of energy intake in driving average daily gain and market weight, high energy diets can often increase margin over feed cost and net profit, even though feed cost per lb of gain is often increased. Using the response described above, we have modeled the impact of increasing energy density on net return and feed cost using actual prices paid for corn, soybean meal, and fat by one Midwestern production system over the last 5 years. The net return to added fat is almost always positive in lighter weight pigs (70 to 120 lb, Figure 4). However, the net return to added fat fluctuates for heavier weight pigs (230 to 265 lb, Figure 5). Adding fat to diets of lighter weight pigs increased feed cost per unit of gain 50% of the time and decreased it about 50% of the time (Figure 6). However, in heavier weight pigs, adding fat increased feed cost per unit of gain in most scenarios. This would tend to indicate that using high energy diets for lighter weight pigs are cost effective and increase profit the majority of the time. However, the optimal energy density of late finishing pig diets will depend on the economic conditions at the time and the importance of ADG to the production system. If ADG is not important, feed cost per pound of gain will dictate the optimal dietary energy density. If ADG is important, the value of the ADG must be included making net return the more important criterion in determining the optimal dietary energy density.

Table 1. Prediction Equations to Determine ADFI, and the Response in ADG and F/G to Added Fat in Growing-finishing Pig Diets

Response (Y)	Location	Equation
ADFI % BW	Field	Y = -0.0109 × BW, lb + 4.948
	University	Y = -0.0098 × BW, lb + 5.374
% ADG change per % added fat	Field	Y = 1.097 – 0.0009 × BW, lb × ADFI% BW – 0.0173 × fat level, %
	University	Y= 1.586 – 0.0009 × BW, lb × ADFI% BW – 0.1429 × fat level, %
% F/G change per % added fat	Field	Y = -2.9217 + 0.0017 × BW, lb × ADFI% BW + 0.0967 × fat level, %
	University	Y = -1.8851 + 0.0017 × BW, lb × ADFI% BW + 0.0306 × fat level, %

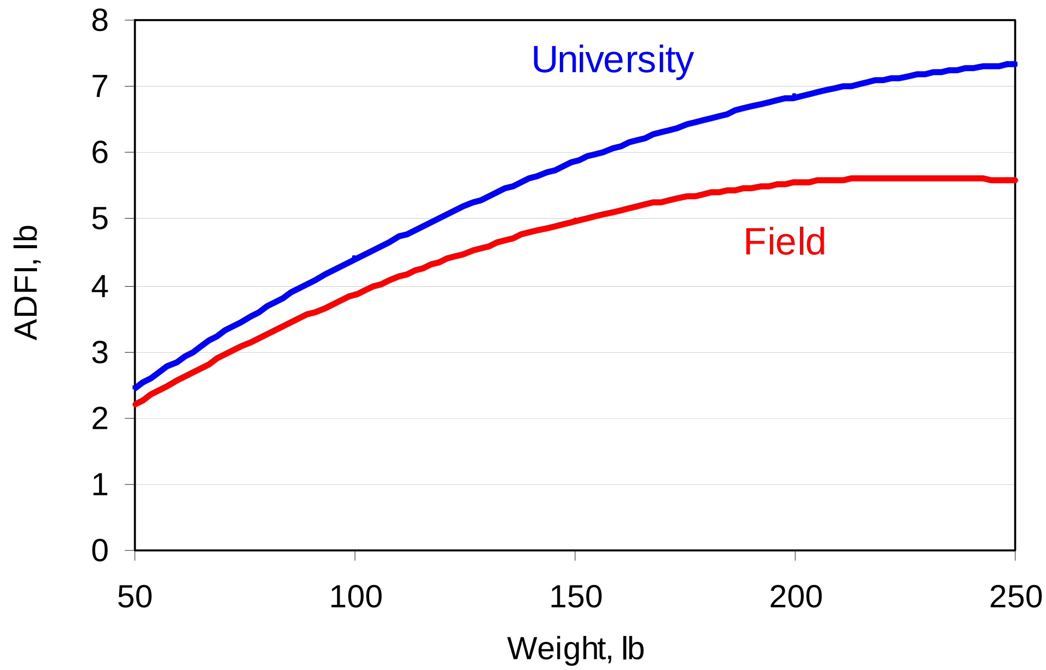

Figure 1. The Influence of Location on Average Daily Feed Intake.

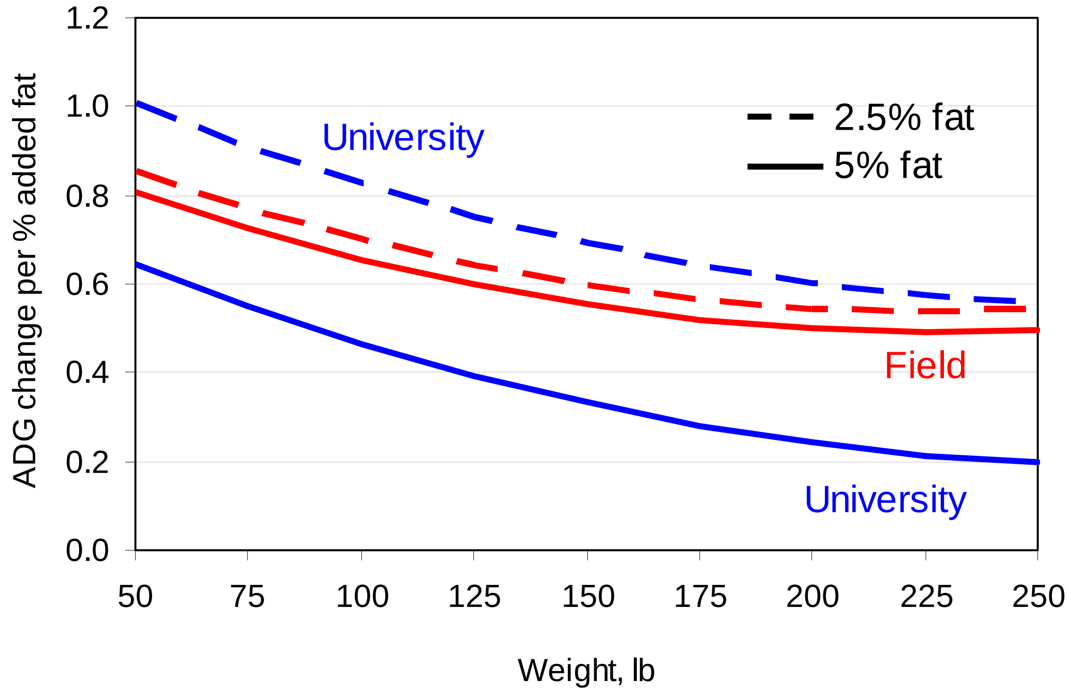

Figure 2. Impact of Study Location on ADG Response to Increased Energy Density by Adding Fat to a Corn Soybean Meal Diet.

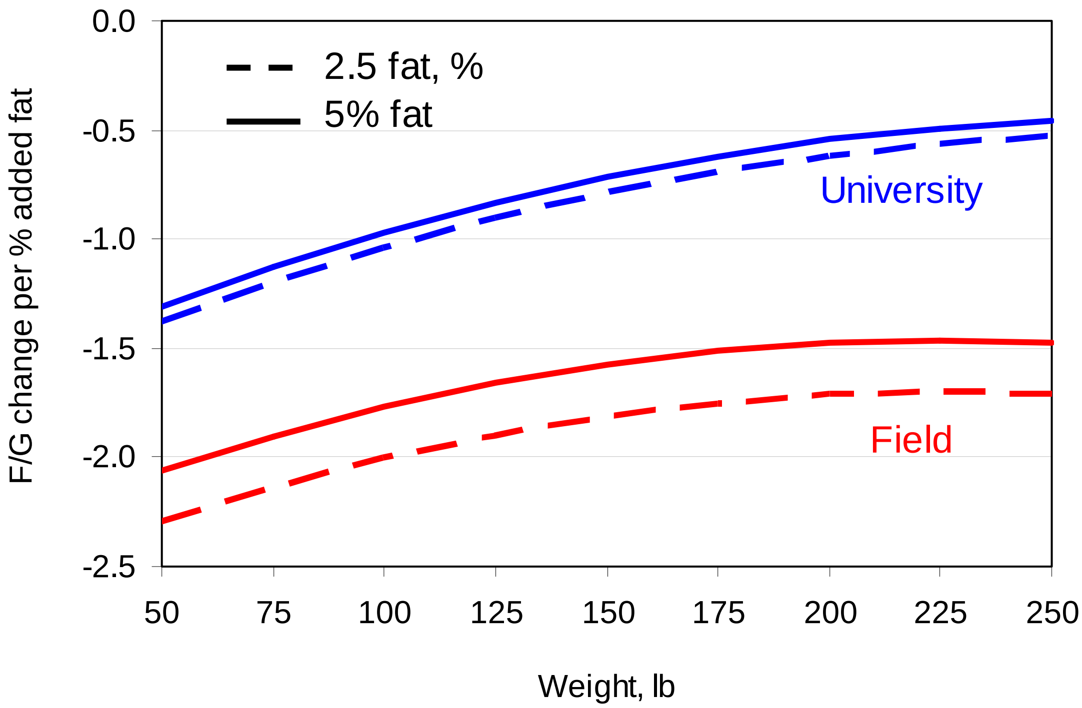

Figure 3. Impact of Study Location on F/G Response to Increased Energy Density by Adding Fat to a Corn Soybean Meal Diet.

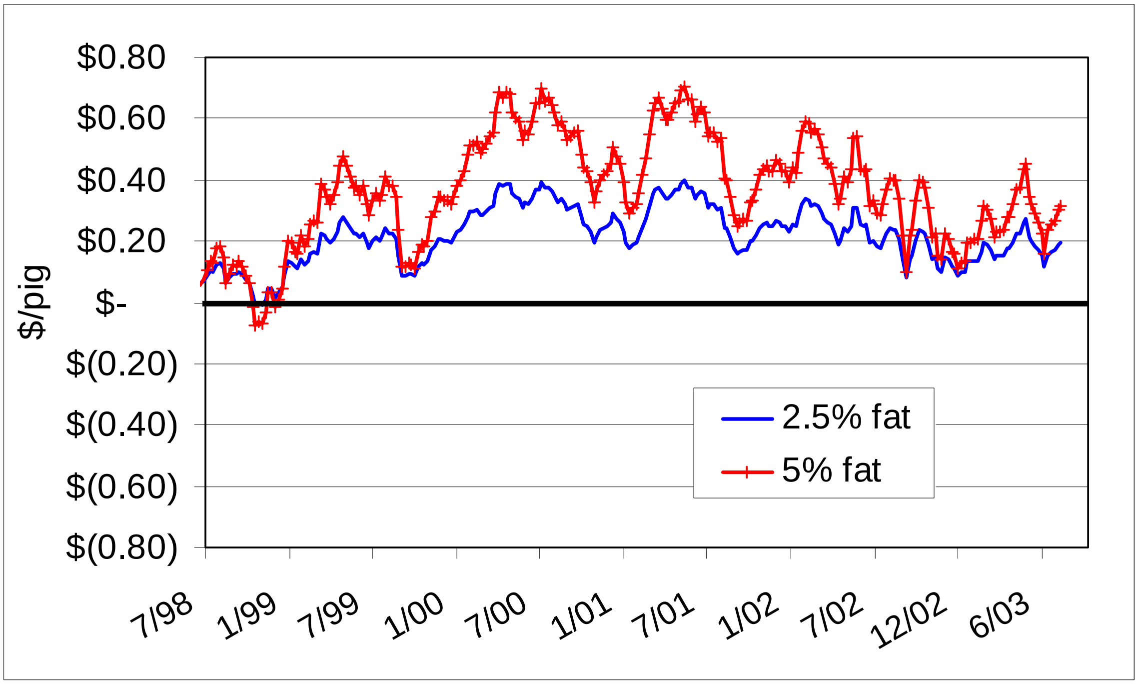

Figure 4. Net Return per Pig to Fat Addition from 70 to 120 lb.

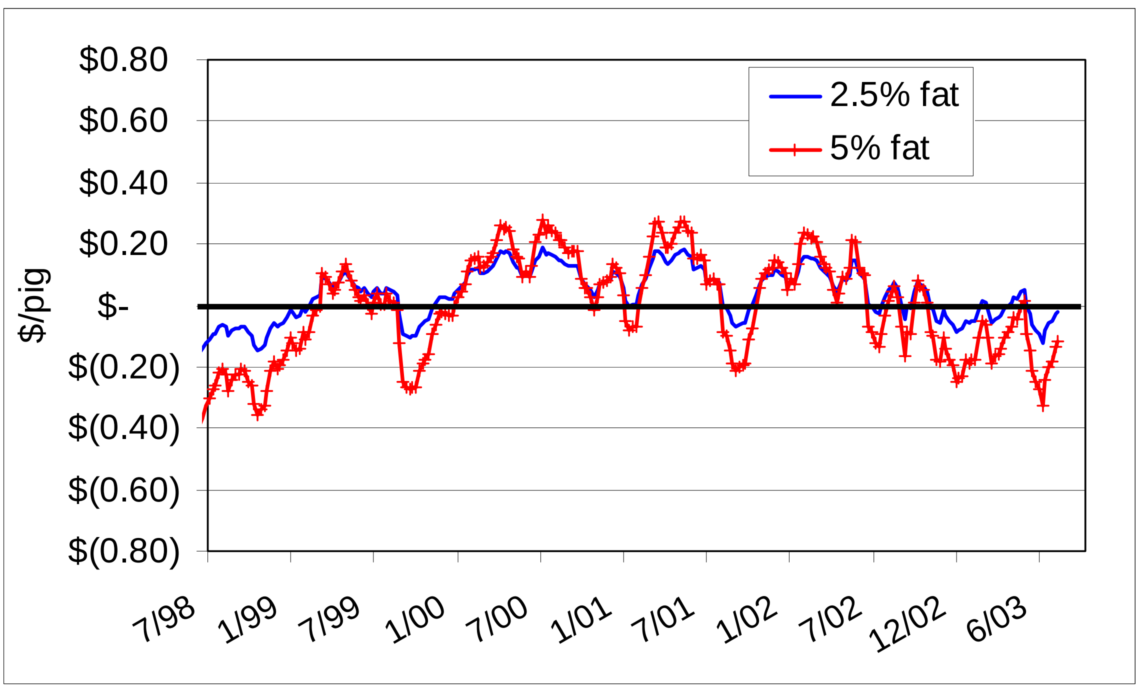

Figure 5. Net Return per Pig to Fat Addition from 230 to 265 lb.

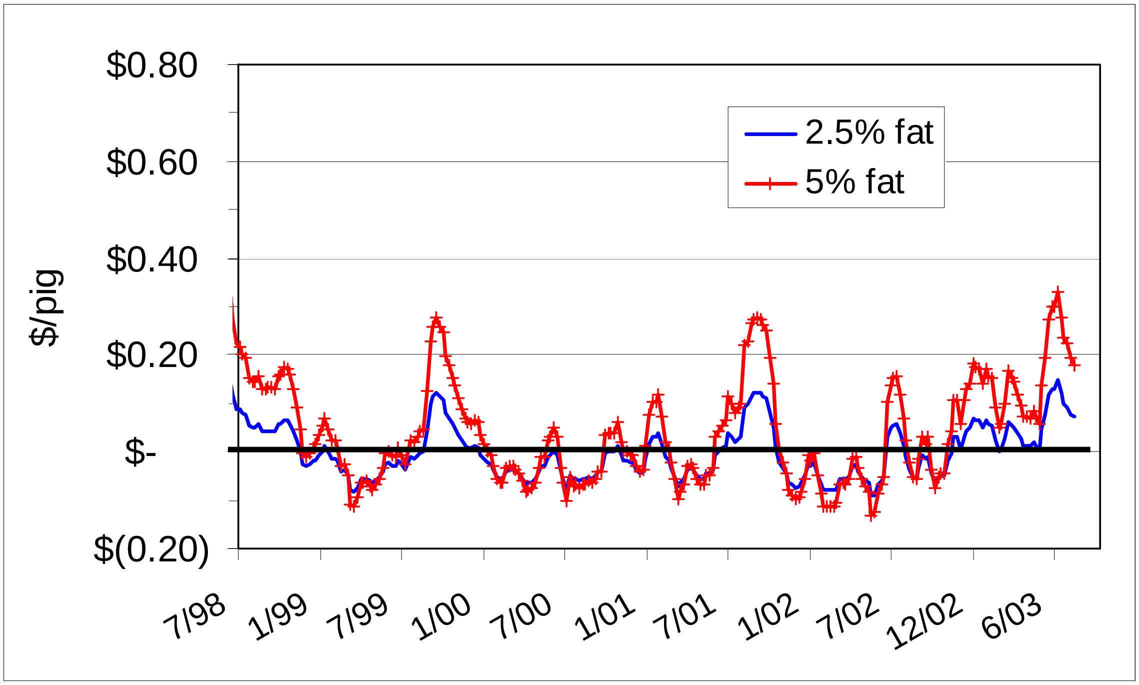

Figure 6. Increase in Feed Cost to Fat Addition from 70 to 120 lb.

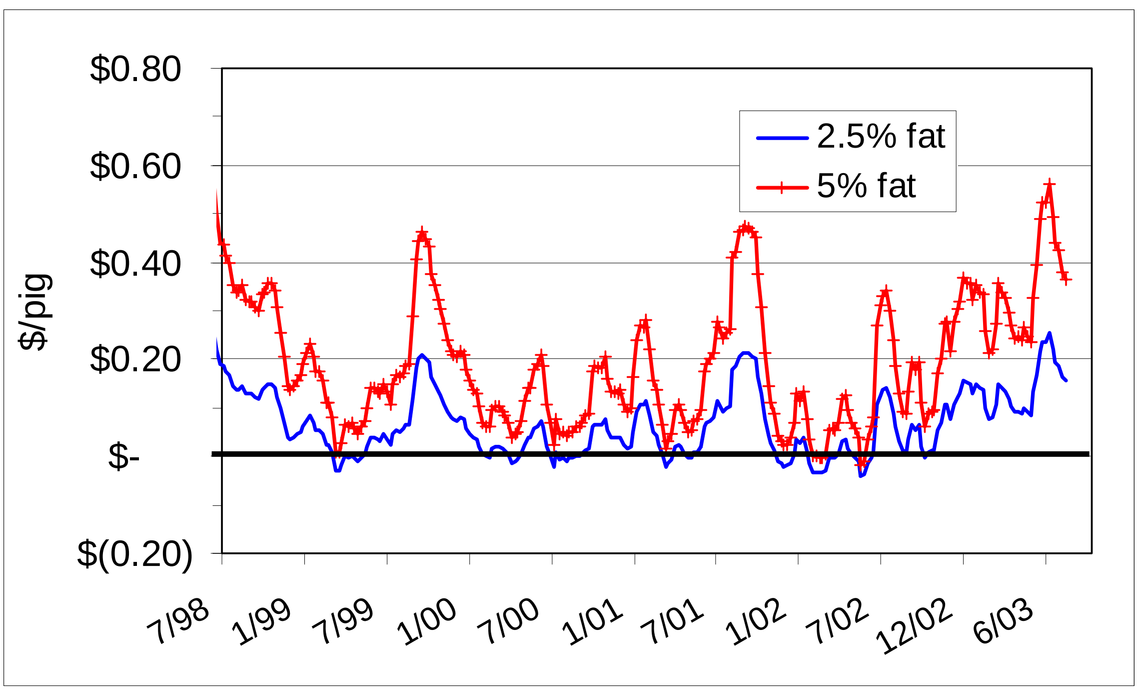

Figure 7. Increase in Feed Cost to Fat Addition from 230 to 265 lb.