KSU

SUPPLEMENTATION OF SWINE DIETS WITH FAT

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After several years of intensive research, the addition of fat to swine diets continues to generate spirited discussion. The use of cereal grain-soybean meal diets in the swine industry is popular because of the plentiful supply and current low price of cereal grains. Fat is an excellent energy source for all classes of swine, with a value approximately 2.25 times that of carbohydrates.

Gestation Sow Diets

Fat may have its greatest potential as an energy source during late gestation. Increasing sow energy intake during late gestation by supplementing diets with fat (tallow, etc.) has been shown to slightly improve baby pig survival in one or more of the following ways:

(1) by increasing the energy density of sow colostrum and milk;

(2) by providing greater sow milk yield;

(3) by improving baby pig energy reserves in the form of carcass fat and liver glycogen.

In a comprehensive review of the effect of incorporating fat into sows' diets during late gestation, there was a 2.6% improvement in pig survival, which resulted in an increase in litter size at weaning of .3 pigs (Table 1). The greatest improvement in pig survival was found in herds with low (<80%) preweaning survival rate. Average pig birth weight appears not to be affected by fat supplementation. However, fat has been shown to especially increase the survival capability of pigs that are smaller than 1000 g at birth (Figure 1). Recent research has shown that for pigs with a birth weight of 850 grams, fat increased survival by 10%. This effect of supplemental fat can be equated to the increased survival capability of a pig weighing an additional 100 g at birth.

The exact mode of action by which added fat exerts its beneficial effect is unknown. The nutritional status of the pig at birth and during the first few hours is important, since the majority of the baby pig losses occur during the first 3 days after farrowing. Supplementing sow diets with 15% tallow has been shown to improve milk quality and milk production (Table 2). This additional energy provided by the sow may be critical to the newborn pig, if body energy reserves are limited. Additionally, the newborn pig has small quantities of readily available energy stored as glycogen in the liver and to a lesser extent in the heart and muscle. Energy reserves may be spared in the newborn pig, if total lipid content of colostrum is increased by fat supplementation of the dam. The improvement in energy status of the newborn pig from fat-supplemented sows has resulted in greater pig survival from birth to 2 days of age (Figure 2). The question of whether the dam, the pig, or both are responsible for improved survival from supplemental dietary fat remains to be fully answered.

A considerable amount of controversy exists to whether simply increasing feed intake during late gestation will improve pig survival. Since fetal growth increases rapidly during the latter portion of gestation, providing the sow with additional nutrients could improve pig birth weights, resulting in an increased number of pigs weaned per litter. The question arises as to whether additional grain or supplemental fat during late gestation will give the most economical response in improving pig survival. A recent experiment conducted by the author studied the influence of feeding either fat or additional corn to sows during late gestation on subsequent pig performance. Beginning on days 100 of gestation and until the day of farrowing, sows were fed 6.0 lb daily of a corn-soybean meal diet top-dressed with either 1.0 lb of fat or 2.25 lb of corn. Feeding fat to sows during late gestation increased the number of pigs weaned per litter by .4 pig compared to feeding additional corn (Table 3). These results indicate that feeding fat during late gestation to sows with a high energy intake increased pig survival more than when the same calories were provided with corn.

Lactating Sow Diets

The potential benefits of feeding fat during lactation are not as well established. Problems of sows losing large quantities of body fat and weight during lactation have resulted in failure of sows to return to estrus following weaning. Reproductive failure has been noted especially in sows following their first lactation. Research findings have shown that energy intake during lactation can have a direct influence on the interval from weaning to estrus. Providing supplemental fat during lactation will increase the total energy intake of the sow by 6-7% compared to a typical grain-soybean meal diet. The opportunity to increase the energy intake by lactating sows would appear to be of primary importance in the following situations:

(1) during hot weather when sows are especially prone to have poor appetites;

(2) when highly productive sows consume limited amounts of feed (less than 9.0 lb daily), despite having unlimited access to grain-soybean meal diets.

Young Pig Diets

Considerable changes have occurred in nutritional programs for nursery pigs in the last few years. A common problem in pigs weaned at 3 to 4 weeks of age has been a "postweaning check", which often results in pigs losing weight during the first week after weaning. Pigs weaned at 21 to 28 days of age and allowed to consume a grain-soybean meal diet will have a low feed intake with a considerable drop in energy intake during the first few days postweaning. Nursery pigs have shown a preference for a diet with added fat. A starter diet with 3% added fat improved daily gain and feed efficiency in pigs weaned at 3 weeks of age (Table 4). Recent research has shown that relatively high (7.5%) levels of dietary fat can be effectively utilized by 21-day weanling pigs, regardless of weaning weight

(Table 5). The beneficial effects of adding fat to starter diets on voluntary feed intake has been found to increase energy intake of the weaned pig, resulting in improved live weight gain. These results suggest that young pigs prefer a diet that contains some fat and apparently utilize this energy quite well for growth.

Growing-Finishing Diets

The use of animal fats in growing-finishing swine diets is largely dictated by the differential between the cost of energy from grain and fat. There have been several experiments over the past two decades where the effects of adding animal fat to growing-finishing swine diets on average daily gain, feed efficiency, and carcass merit have been studied. Fat from various sources can be used to increase the energy density of swine diets, since it contains 2.25 times the energy concentration of carbohydrates. Research has consistently shown that when energy concentration increases in the diet, feed intake decreases without adversely affecting gain, resulting in a subsequent improvement in feed efficiency (Table 6). However, adding fat to growing-finishing swine diets has not consisently shown an improvement in average daily gain. In fact, it appears that an increase in daily gain may not be seen until the added fat level is approximately 5%. The effect of adding fat to swine diets on pig carcass composition appears to be related to the level of fat in the diet. At high levels (>5%), dietary fat has an adverse effect on carcass quality. However, small amounts (2-3%) of added fat have little or no adverse effect on carcass composition.

The inconsistent effect on average daily gain of adding fat to swine diets may be related to methods of formulating diets with added fat. Pigs eat to meet their energy needs. Thus, if the energy density (added fat) of the diet is increased, growing-finishing swine do not have to eat as much per day to satisfy their energy requirements. The net result is a reduction in the daily feed intake with fat supplementation. This would suggest that nutrients other than those providing energy (protein, etc.) may need to be increased in the diet maximize the use of added fat.

Two studies have been conducted at Kansas State University to evaluate the importance of a constant calorie:protein ratio when adding fat to swine diets. The first experiment studied the effects of fat level and calorie:protein ratio on performance and carcass composition of 44 lb pigs fed diets containing 0, 3, 6, 9, or 12% added fat with a constant calorie:protein ratio. A second experiment evaluated the 6, 9, or 12% added fat without adjusting the calorie:protein ratio (fat substituted for grain in the basal diet). Pigs fed diets containing various fat levels with constant calorie:protein ratio had similar average daily gains (Table 7). Feed intake decreased and feed efficiency improved ($P<.05$) as fat level increased when a constant calorie:protein ratio was maintained. Pigs fed a diet containing 9% added fat without adjusting the calorie:protein ratio gained slower and required more feed per unit of gain than pigs fed a diet containing 9% added fat with a constant calorie:protein ratio. These studies demonstrate the importance of a constant calorie:protein ratio when fat is added to swine diets.

One of the most important characteristics of fat may be its ability to reduce feed dust. Changes in rearing methods of swine have solved many production problems, but may have created other problems that merit immediate attention. For example, moving pigs from pasture rearing into intensified confinement units may have resulted in environmental hazards to both pigs and man. It seems that confinement facilities, either environmentally regulated with total mechanical ventilation or naturally ventilated, are experiencing dust problems for an extended period of time throughout the year. A recent study reported that 2% added fat to swine diets reduced dust generation at feeder filling time by 17.6%. A comprehensive series of experiments was completed recently at the University of Nebraska to evaluate the effect of dietary fat on dust levels in confinement facilities. Two naturally ventilated, modified open front (MOF) units were used to study the influence of 0% (WO/T) or 5% added tallow (W/T) to corn-soybean meal diets on facility dust concentrations. Adding 5% tallow to growing-finishing swine diets resulted in a 50% reduction in aerial dust levels in confinement facilities, regardless of season of the year (Figure 3). This advantage might give justification for adding fat to growing-finishing swine diets beyond the improvement in swine performance previously mentioned. Since hog-house "dust" is mostly "feed dust", fat can play an important role in improving air quality in swine confinement facilities.

Summary

Based on available research on adding fat to sow diets, the following management tips can be given.

1. If preweaning pig survival is less than 85%, consider supplementing with fat during late gestation. Adding fat to sow diets should be most beneficial in herds with considerable variation in pig birth weights.

2. When utilizing fat in late gestation sow diets, a producer should feed a minimum of 2.5 lb of total added fat, spread over a minimum of 5 days to improve subsequent pig survival.

3. During lactation, individually top-dress sow diets with .5-.6 lb of fat if feed intake is less than 9.0 lb daily or if body weight loss during lactation is excessive.

The following management suggestions would be given for utilizing fat in nursery and growing-finishing swine diet formulation.

1. In nursery diets, include 3-5% added fat to stimulate feed intake and prevent a postweaning weight check.

2. In growing-finishing diets, a maximum of 5% added fat should be included to improve feed efficiency and average daily gain, without adversely influencing carcass quality. In diets formulated with added fat, increases in other nutrients (protein, etc.) other than energy may be needed to maximize fat utilization.

3. Fat can aid in reducing dust losses and control feed dust during diet preparation and feeding. The fact that simply adding 5% fat to the diet can reduce aerial-dust levels by 50% is an additional justification for using fat in swine diets.

Fat is an excellent energy source, which produces efficiency gains and certainly should be considered for growing-finishing swine. Economics will be the most important factor determining the quantity of fat added in a swine feeding program.

Table 1. Effect of Feeding Fat During Late Gestation on Sow and Litter Performance.[a]

Criteria	Control	+ Fat	Difference
Pigs born alive/litter	10.0	9.9	-0.1
Pigs weaned/litter	8.1	8.4	+0.3
Survival (%)			
All pigs	82.0	84.6	+2.6
Low birth wt. pigs[b]	42.1	59.2	+17.1

[a]Moser and Lewis, 1980.
[b]Pigs weighing less than 2.2 lb at birth.

Table 2. Effect of High Energy Diets on Milk Yield and Milk Consumption in Sows.[a]

Criteria	Control	+ Fat	Difference
Fat in colostrum (%)	7.3	9.1	+1.8
Fat in milk (%)	9.1	10.1	+1.0
Milk Yield (lb/day)			
Pettigrew (1978)	8.4	9.9	+1.5
Boyd (1979)	19.1	20.7	+1.6

[a]Moser and Lewis, 1980.

Table 3. Effect of Source of Sow Energy Intake During Late Gestation on Subsequent Pig Performance.[ab]

Criteria	Corn[c]	Fat[d]	Difference
No. of litters	70	70	
No. of pigs equalized, day 1	9.9	10.0	+.1
Pigs weaned litter	8.3	8.7	+.4
Survival (%)	84.3	87.0	+2.7
Pig performance (lb)			
Pig birth wt.	2.9	2.9	
Pig 21 day wt.	10.8	11.2	+.4
Litter 21 day wt.	92.8	95.5	+2.7

[a]Nelssen et al., 1984.
[b]All sows fed 6.0 lb daily of a corn-soybean meal basal diet.
[c]Corn was top-dressed on the sows' feed at 2.25 lb for 14 days prior to farrowing.
[d]Fat was top-dressed on the sows' feed at 1.0 lb actual fat per day for 14 days prior to farrowing.

Table 4. Effect of Fat Addition to Starter Diets.[a]

Criteria	Level of Lard	
	0%	3%
Daily gain, lb	.46	.53
Daily feed intake, lb	1.01	1.06
Feed/Gain	2.23	2.06

[a]Iowa State University.

Table 5. Effect of Supplemental Fat in the Diets of Light and Heavy Weight Weanling Pigs.[ab]

Item	Light Weight		Heavy Weight	
	Basal	+ Fat	Basal	+ Fat
No. pigs	81	81	81	81
Initial wt, lb	9.9	9.9	14.1	1.41
Final wt, lb	21.0	22.4	32.1	30.8
Daily gain, lb				
0 to 7 day	.11	.07	.15	.11
7 to 14 day	.24	.26	.44	.40
14 to 21 day	.57	.57	.81	.79
21 to 28 day	.77	.88	1.17	1.08
0 to 28 day	.42	.44	.64	.59
Daily feed, lb				
0 to 7 day	.29	.29	.44	.40
7 to 14 day	.51	.46	.77	.70
14 to 21 day	.84	.77	1.25	1.17
21 to 28 day	1.30	1.23	1.87	1.67
0 to 28 day	.73	.68	1.08	.97
Feed to gain ratio				
0 to 28 day	1.76	1.58	1.69	1.64

[a]Mahan and Maxson, 1984.
[b]Weaned at 21 days of age.

Table 6. Effect of Adding Animal Fat to Growing-Finishing Swine Diets.[a]

	Metabolizable Energy (Kcal/lb) and Fat Addition % (Tallow)					
	1473	1526	1578	1630	1683	1735
Item	0	2.6	5.2	7.9	10.5	13.0
Av. daily gain, lb[b]	1.59	1.63	1.65	1.67	1.69	1.62
Av. daily feed, lb[c]	5.67	5.49	5.25	5.16	4.81	4.67
Feed/Gain	3.57	3.37	3.18	3.07	2.85	2.88
Backfat, in	1.43	1.32	1.37	1.41	1.41	1.49
Ham-loin, % of hot carcass	41.80	42.00	42.40	41.40	41.60	41.10

[a]Moser, 1977.
[b]Quadratic effect of energy level (P<.05).
[c]Linear effect of energy level (P<.05).

Table 7. Influence of Level of Added Fat and Calorie:Protein Ratio on Performance of Young Pigs.[a]

Fat Level %	Calorie:Protein ratio[b]	Daily Gain[c] lb	Daily Feed Intake[cd] lb	Feed:Gain[cd]	ME (Kcal) consumed daily[cd]
0	19.2	1.25	2.40	1.90	3571
3	19.2	1.34	2.31	1.73	3607
6	19.2	1.32	2.35	1.76	3607
9	19.2	1.36	2.31	1.70	3879
12	19.2	1.34	2.05	1.54	3509
15	19.2	1.25	1.91	1.51	3390
6	21.5	1.28	2.53	2.00	4141
9	22.6	1.17	2.18	1.85	3793
12	23.8	1.03	2.02	1.95	3664

[a]Each value is the mean of two pens of 7 pigs each with an initial weight of 28.0 lb.
[b]Kcal of metabolizable energy per gram of protein.
[c]Calorie:protein ratio significant (P<.05).
[d]Fat level significant (P<.05).

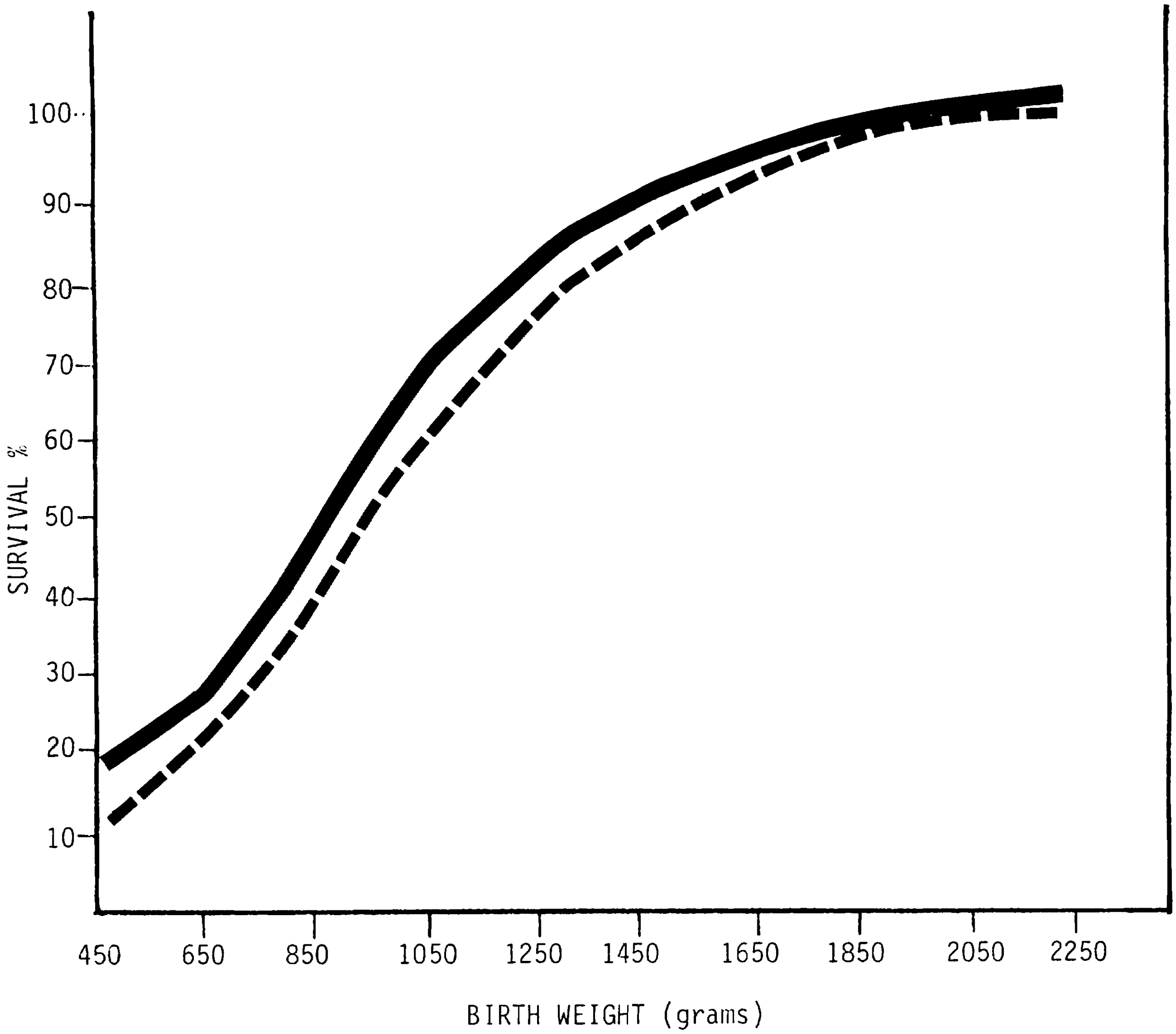

Figure 1. Piglet survival as a function of birth weight for dams receiving control (——) or 15% supplemental fat (———) diets during late gestation and lactation.

Cieslak et al., 1984

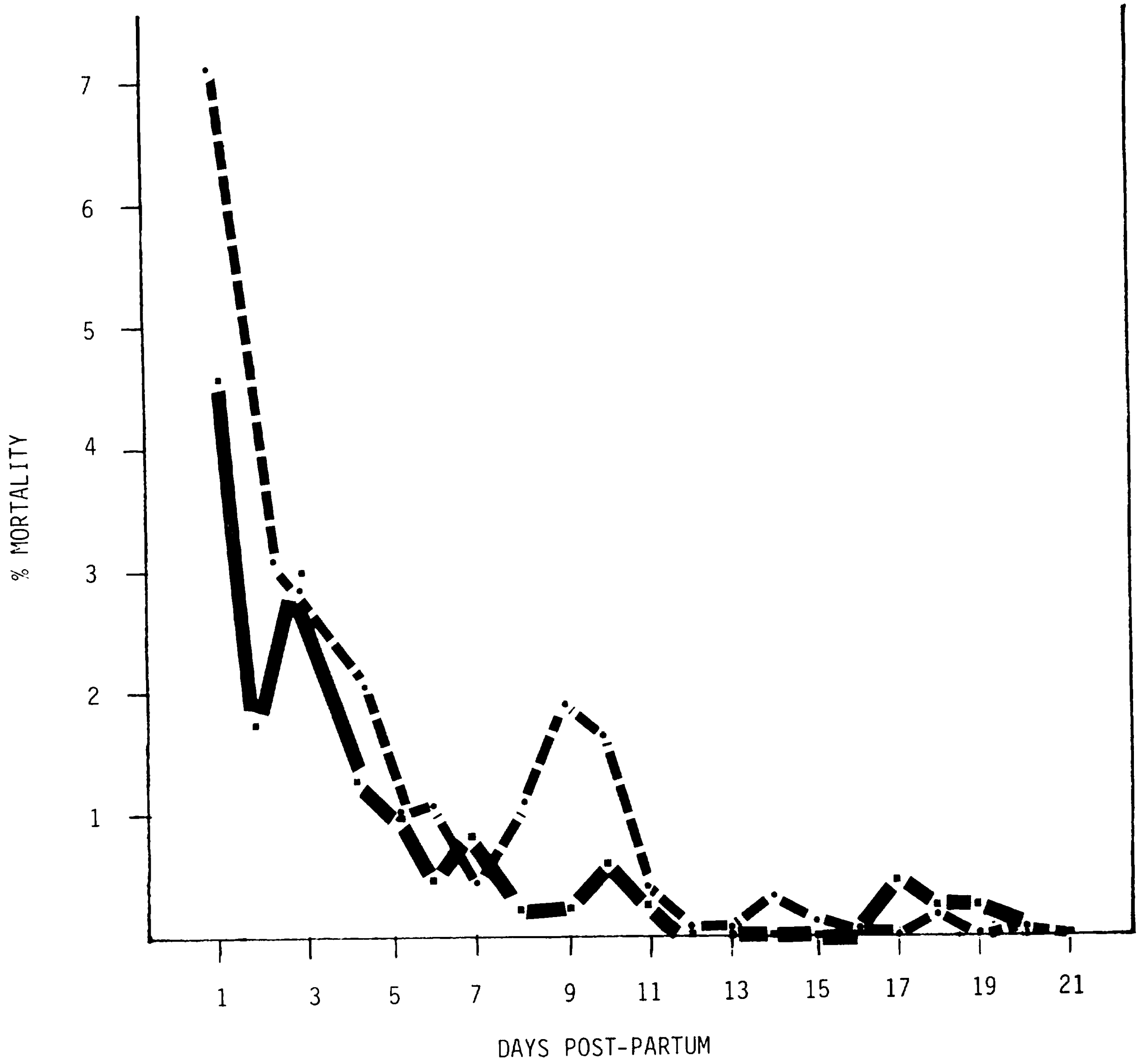

Figure 2. Daily percentage mortality of piglets plotted against time for dams receiving control (-----) or 15% supplemental (——) diets during late gestation and lactation.

Cieslak et al., 1984

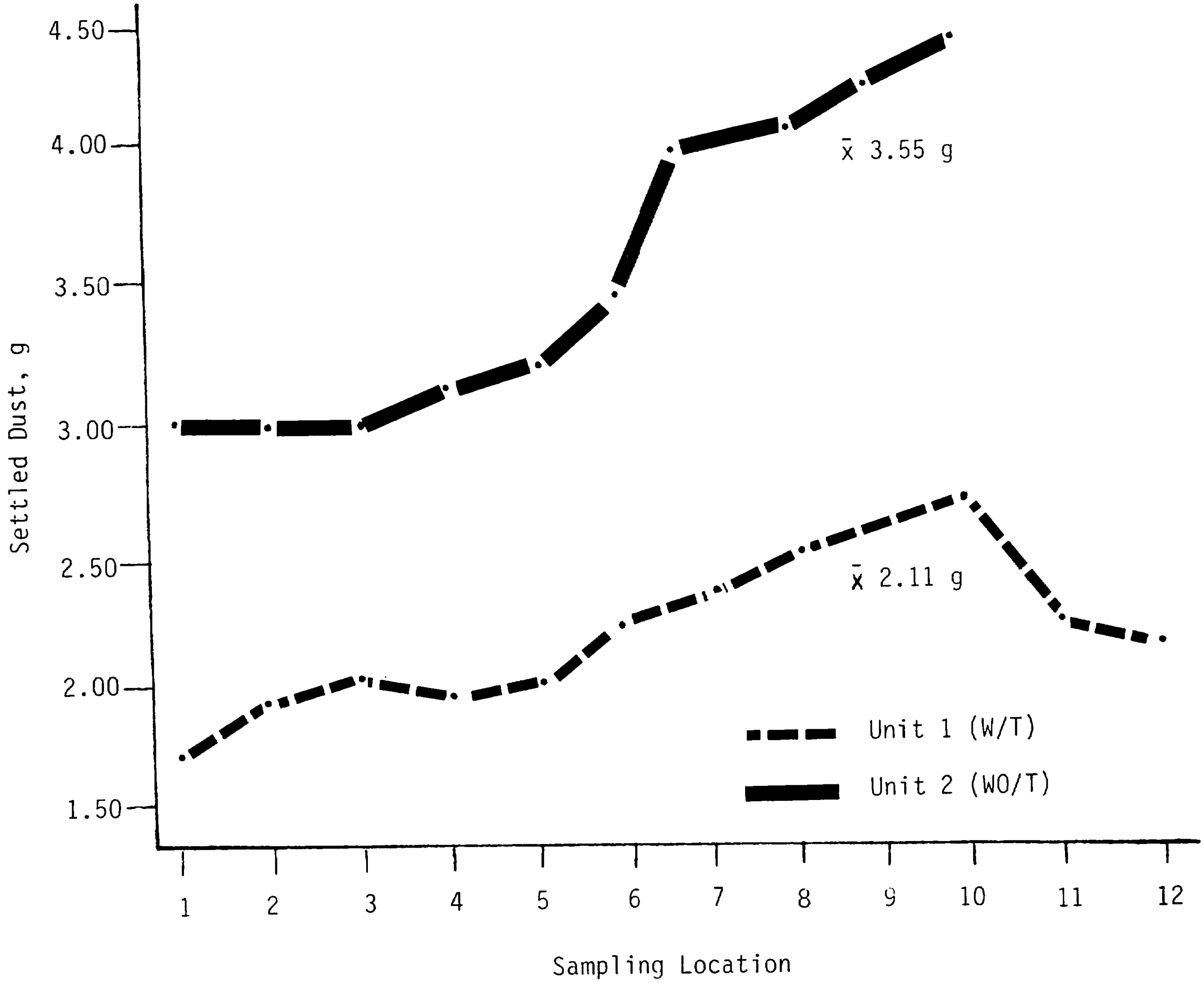

Figure 3. Effect of Added Fat on a Settled Dust Concentration Difference between two units (P<.01).

Peo and Chiba, 1984