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Summary and Implications

The metabolic responses of sows fed a corn-soybean meal or a corn-soybean meal-10% tallow diet were measured. The addition of tallow to lactating sows diets had no effect on feed or energy intake. In addition, there were no effects on the concentrations of glucose, nonesterified fatty acids (NEFA), insulin, or glucagon. No differences in either the time spent consuming feed or the number of meals consumed were observed. Finally, no linear association between eating time and area under the curve for insulin was observed for sows consuming either diet. These results show the addition of tallow to lactation diets does not affect the concentrations of glucose, NEFA, insulin or glucagon in the fed state.

Introduction

In previous research (Nebraska Swine Report, 1995) we have reported several behavioral and physiological responses to the addition of tallow to lactating sow diets. Although there were no differences in feed or energy intake, the addition of tallow resulted in increased rate of feed consumption and decreased the percentage of time spent consuming feed. Fasting concentrations of glucose were increased and nonesterified fatty acids (NEFA) and glucagon were decreased in sows fed the tallow diet.

The objective of the following experiment was to measure changes in feed and energy intake and meal patterns associated with the addition of tallow to lactation diets. In addition, nonfasting (fed) concentrations of hormones and metabolites were measured.

Methods

Eight first-litter crossbred gilts were used. Gilts were randomly and equally allotted within room (two rooms) to receive either a corn-soybean meal (C-SBM) or a corn-soybean meal-10% tallow diet (Tallow, Table 1). Dietary treatments were initiated after parturition. Sow weight postpartum averaged 389 lb. Farrowing room temperature averaged 72° F and continuous lighting was provided. Sow and litter weights were obtained after parturition and on d 21 of lactation. Feed intake was

Table 1. Diet composition (as-fed basis)[a]

Ingredient, %	C-SBM	Tallow
Corn	67.90	56.80
Soybean meal, 46.5%	28.00	29.00
Dicalcium phosphate	2.10	2.30
Salt	.50	.50
Limestone	.40	.30
Vitamin mix	1.00	1.00
Trace mineral mix	.10	.10
Tallow	——	10.00
Formulated composition		
Metabolizable energy, Mcal/lb	1.48	1.69
Crude protein, %	18.8	18.3
Lysine, %	1.02	1.02
Calcium, %	.88	.89
Phosphorous, %	.76	.77

[a]Diets are corn-soybean meal (C-SBM) and corn-soybean meal-10% tallow (Tallow).

measured daily for 21 days. Litter size was standardized within 3 days of parturition.

On d 7 and 21 of lactation, meal patterns were measured continuously from 6:00 a.m. to 2:00 p.m. Sows were considered to be feeding when observed chewing with their head in the feeder. Meals were considered to be periods of feeding separated by at least 20 minutes. All feeding periods meeting this criterion were considered to be meals.

Catheters were inserted into the vena cava to enable frequent blood collection. Blood was collected every 15 minutes from 6:00 a.m. to 2:00 p.m. on d 7 and 21 of lactation. Plasma was separated and analyzed for insulin, glucagon, glucose, and NEFA.

Average hormone and metabolite concentrations were calculated from values obtained at all time points. Areas under the curve (AUC) for insulin are the sum of the average concentrations of two consecutive samples multiplied by the elapsed time. All samples collected on d 7 and 21 were used to calculate AUC for insulin.

Data were analyzed as a randomized complete block. Because of catheter failure, one sow each on d 7 and 21 was not included in the data set.

Results

There were no differences in feed or energy intake (Figure 1). Numerically, both feed and energy intake were lower (23 and 10%, respectively) in sows fed the Tallow diet than in sows fed the C-SBM diet.

Because of the small number of sows on each treatment, sow and litter performance was averaged across treatments. These data are included to aid in interpretation of hormone and metabolite responses. On average, sows lost 39.3 lb during lactation. Litter weight gain averaged 109.1 lb and litter size at weaning was 9.7 pigs.

No differences in the time spent consuming feed or the number of meals consumed were observed (Table 2).

Average concentrations of glucose or NEFA were not affected by diet (Table 3). Glucose concentrations decreased from d 7 to 21 in sows fed both diets (P = .01). Although there was no effect of day of lactation on NEFA

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Table 2. Meal patterns of gilts fed a corn-soybean meal (C-SBM) or a corn-soybean meal-10% tallow (Tallow) diet[a]

Criteria	Day 7 C-SBM	Day 7 Tallow	Day 21 C-SBM	Day 21 Tallow	P[b] (Diet)	P (Day)	SE[c]
No. of sows	3	4	4	3			
Time spent consuming feed, min	40.50	37.78	42.00	39.88	NS	NS	8.63
Number of meals consumed	3.25	4.88	4.00	4.13	NS	NS	.79

[a]Responses were measured from 6:00 am to 2:00 pm
[b]NS is not significant (P > .05)
[c]SE = standard error

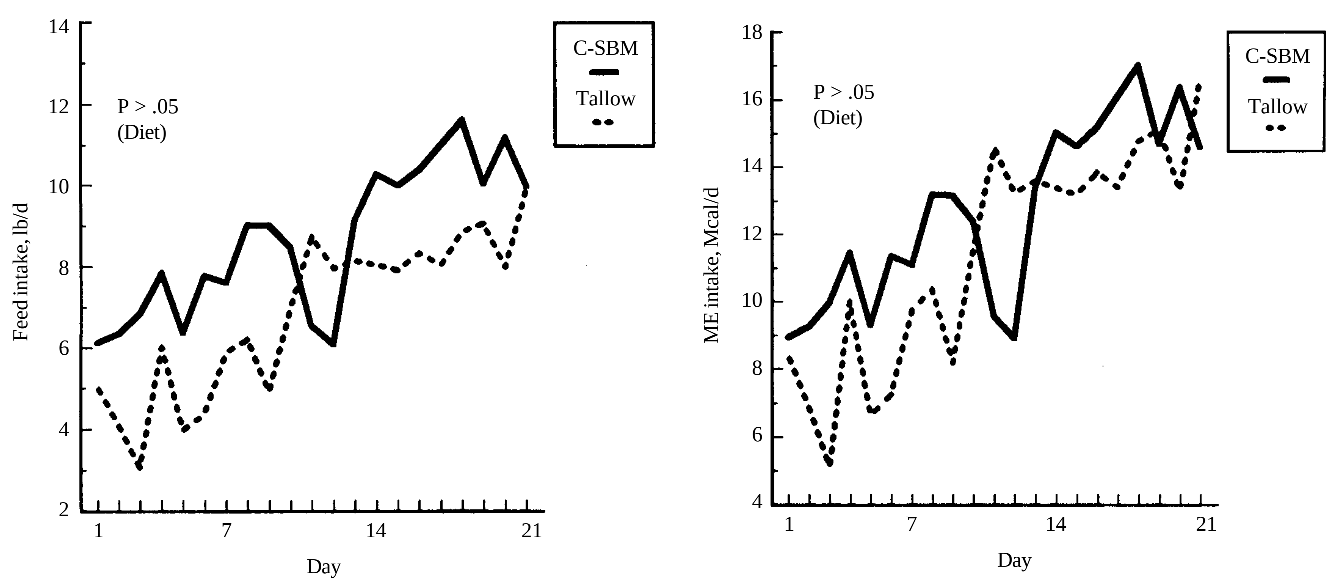

Figure 1. Feed and energy intake of sows fed either a corn-soybean meal (C-SBM) or a corn-soybean meal-10% tallow (Tallow) diet.

Table 3. Average hormone and metabolite concentrations of gilts fed a corn-soybean meal (C-SBM) or a corn-soybean meal-10% tallow (Tallow) diet[a]

Criteria	Day 7 C-SBM	Day 7 Tallow	Day 21 C-SBM	Day 21 Tallow	P[b] (Diet)	P (Day)	SE[c]
No. of sows	3	4	4	3			
Glucose, mmol/L	5.24	5.39	4.55	4.90	NS	.01	.17
NEFA[d], uEq/L	415.92	703.53	352.22	418.50	NS	NS	82.99
Insulin, pmol/L	199.39	202.19	201.34	178.18	NS	NS	27.57
Glucagon, ng/L	68.17	67.88	65.24	78.73	NS	NS	9.71
Insulin:Glucagon, mol:mol	11.58	12.26	13.64	10.24	NS	NS	3.04

[a]Concentrations are averages of samples drawn every 15 min from 6:00 am to 2:00 pm
[b]NS is not significant (P > .05)
[c]SE = standard error
[d]NEFA is nonesterified fatty acids

concentration, there was a 37% decrease from d 7 to 21 of lactation. Average concentrations of insulin, glucagon, and the insulin:glucagon ratio were not affected by diet or day of lactation (Table 3).

No correlation was detected between AUC for insulin and time spent eating (r = .38, Figure 2).

Discussion

Feed and energy intake was lower in this experiment than in a previous experiment. Low feed and energy intakes were associated with increased sow weight loss.

Contrary to results of a previous experiment, no effect of diet on percentage of time spent consuming feed was observed. This may be due to the shorter period of time in which meal patterns were measured (8 versus 24 h).

Time spent consuming feed, when expressed as a percentage (8.3%), is similar to values reported previously over a 24-hour period. We expected the percentage of time spent consuming feed to be higher because previous research indicates that sows consume a larger proportion of meals during the day than at night.

There were several discrepancies in hormone and metabolite concentrations observed between this and a previous experiment. First, there were no effects of diet on average concentrations of glucose, NEFA, or glucagon in this experiment. Second, greater weight loss in the present experiment was associated with lower concentrations of glucagon and higher insulin: glucagon ratios. It is difficult to compare results of experiments where sows are in a fed versus a fasted state. Both feeding and energy balance affect hormones and metabolites in the fed state, whereas only energy balance affects hormones and metabolites in the fasted state. Whether hormone concentrations in the fed or fasted state are a better indicator of changes in metabolic status during lactation is unknown.

Average concentration of NEFA decreased from d 7 to 21 of lactation. This indicates a decrease in fat mobilization from body reserves as lactation progressed. The large sow weight losses during lactation indicate that body fat reserves may have been significantly depleted.

Several factors may have contributed to the low correlation between time spent feeding and AUC for insulin. First, time spent eating may not reflect feed intake across treatments. In a previous experiment, differences in rate of feed consumption were observed. Secondly, factors other than eating, such as energy balance, influence insulin concentration.

These results, and those of a previous experiment, indicate inconsistent responses in feed and energy intake to the addition of tallow to lactating sow diets. Changes in fasting hormones and metabolites previously observed in sows fed diets containing tallow were not observed in the fed state. Future work will examine hormone and metabolite profiles in response to feeding and investigate other metabolic signals that may influence feeding behavior or energy intake in lactating sows.

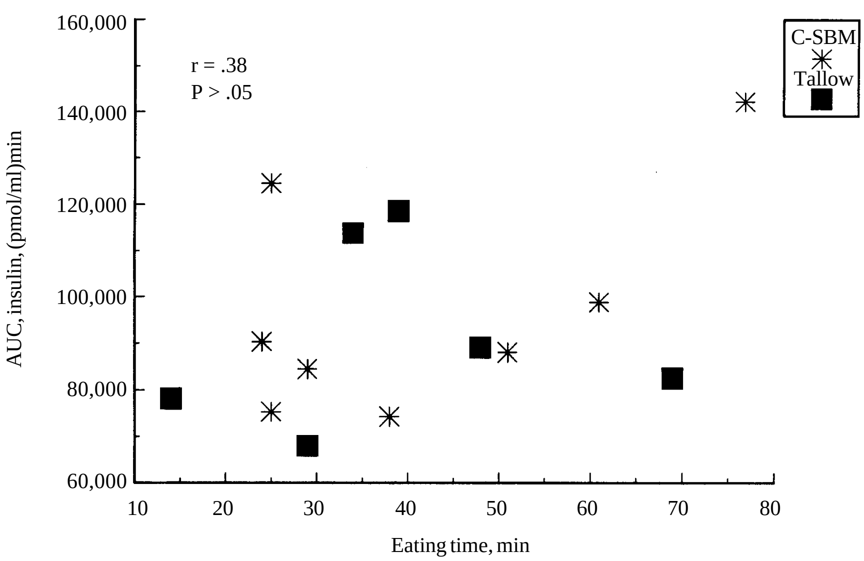

Figure 2. Correlation of area under the curve (AUC) for insulin to eating time for sows fed either a corn-soybean meal (C-SBM) or a corn-soybean meal-10% tallow (Tallow) diet.

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