EFFECTS OF SOURCE AND LEVEL OF SUPPLEMENTAL ENERGY ON REPRODUCTIVE PERFORMANCE OF SOWS

Steve Christianson, Gary L. Allee,
Jim L. Nelssen, and D. Steven Pollmann

Summary

Three feeding trials utilizing 185 sows (149 primiparous and 36 multiparous) were conducted to evaluate the effects of feeding various levels and sources of supplemental energy during lactation and from weaning to rebreeding on sow reproductive performance. Sows fed tallow (5% or 10%) during lactation had reproductive performance similar to sows fed the basal milo-soybean meal diet. Ad libitum feed intake was not affected by the addition of tallow for either the last week of lactation or for the entire three week lactation. However, daily digestible energy (DE) intake was increased with the addition of tallow to diets. Survival rate of pigs was not significantly affected by adding 5% tallow for the entire lactation period. Adding extra energy (cornstarch or fat) to sow diets following weaning did not improve reproductive performance. However, sows on the higher energy diets tended to show estrus earlier than sows fed the basal diet.

Introduction

Anestrus and extended intervals from weaning to breeding are major problems facing swine producers as they strive to obtain maximum production. Failure to breed seems to be more common for primiparous than for multiparous sows, especially during summer and early fall. Loss of body weight during lactation seems to be a factor in sows failing to recycle. Adding supplemental fat has been suggested as a means to get sows to consume more energy and thereby decreasing the interval from weaning to remating. The trials reported herein were conducted to evaluate the effects of feeding various levels and sources of supplemental energy during lactation and from weaning to rebreeding on sow reproductive performance.

Procedures

Three experiments were conducted to evaluate the effects of adding supplemental energy sources to sow diets following weaning. Trial 1 compared cornstarch and tallow as supplemental energy sources. Trial 2 examined various levels of added tallow. Trial 3 evaluated tallow and soybean oil as supplemental energy sources. In addition, tallow added to the lactation diet was evaluated in Trials 1 and 3.

Sows used in the lactation studies were assigned randomly to treatments. For the weaning-to-breeding studies, all sows were weaned after a 3-wk lactation (range of 16 to 30 days) and allotted to treatments by weight, backfat, parity, and previous treatment (if any). Sows were housed in individual stalls (21 x 66 in) in an environmentally controlled gestation barn located at the KSU Swine Center. Each stall had an individual feeding bowl and a nipple waterer.

All sows were checked for estrus beginning 3.5 days postweaning. This was accomplished by moving the sows to a 12 x 14 ft pen and introducing a boar. Sows were heat checked in this manner twice daily (9 am and 4 pm) until found in estrus. All sows not showing estrus by day 12 after weaning were considered anestrus and removed from the breeding herd. All sow showing estrus were bred twice by artificial insemination at approximately 24 and 36 hours after standing heat was observed. At 30 days postbreeding, all pregnant sows were moved to outdoor lots for the remainder of the gestation period. Farrowing rate, number born alive, and total litter size were monitored in the subsequent farrowing for each of the feeding trials.

Sows in trials 1 and 2 were fed experimental diets until they were found in estrus. In trial 3, the sows remained on the experimental diets until 30 days postbreeding, at which time they were switched to the standard gestation diet. The composition of the diets, fed in meal form, is given in tables 1, 2 and 3. Tallow additions in the lactation diets were made at the expense of sorghum grain.

Trial 1. Thirty-three primparous sows were assigned at random to one of two lactation treatments, basal (control) and basal + 10% tallow, which were fed ad libitum for the last 7 days of tne lactation period. Following weaning, the sows were assigned by weight, backfat, and previous lactation treatment to one of three postweaning treatments. The three treatments were: 1) 3.0 lb basal diet (control), 2) control + 1.6 lb corn starch, and 3) control + .55 lb tallow. These diets were fed daily from weaning until estrus was detected.

Trial 2. This experiment consisted of two periods (July and August) using the same dietary treatments. The three treatments used were: 1) 3.0 lb basal diet (control), 2) control + .5 lb tallow (14% tallow), and 3) control + 1.0 lb tallow (25% tallow). These diets were fed daily from weaning until estrus was detected. Period I (July) of this experiment was conducted using 37 primiparous sows assigned to one of the three treatments using weight and backfat thickness as allottment criteria. Twenty-two second litter (multiparous) sows and nine primiparous sows were used during Period II (August). The sows used in this trial were not on any treatments during the preceeding lactation.

Trial 3. This experiment was divided into two periods (June = Period I, and July and August = Period II). The sows in both periods of this trial were fed one of three treatments: 1) 4.4 lb control diet, 2) 4.0 lb of a 10% tallow diet, or 3) 4.0 lb of a 10% soybean oil diet. Sows were fed this diet from weaning until 30 days postbreeding. In Period I (June), 14 multiparous sows (3rd and 4th parity) and 16 primiparous sows were used. Allotment was based on parity and weight. These sows were not on any treatment during the preceeding lactation. Sixty-four primiparous sows were used in Period II (July and August). They were assigned an ad libitum lactation treatment of the basal diet given in table 1, or basal + 5% tallow. Following weaning, sows were allotted to one of the same three treatments used in Period I, according to their weight and previous lactation treatment. Seven sows were not used on the postweaning treatments due to poor body condition.

Results and Discussion

Fat in the Lactation Diet

Trial 1. The influence of tallow addition during the last 7 days of lactation are shown in table 4. Sow performance, as indicated by postweaning interval and percent showing estrus, was not affected by the addition of tallow. Lactation feed intake, fed ad libitum, remained the same regardless of the diet consumed.

Pig survival (no. pigs weaned/no. pigs per sow at time of treatment) was not influenced by lactation treatment. Pig weaning weights did not differ between treatments, but total litter weight at weaning was higher for the tallow diet group (86.3 vs 79.0 lb) due to a numerical increase in the number of pigs weaned per sow. The subsequent litter size did not appear to be affected by the lactation diet that the sow received.

Trial 3. The influence of tallow addition throughout the entire lactation period are shown in table 5. Sows consuming the tallow diet tended to lose less weight than the control group (21.8 vs 30.4 lb). This can be attributed to the fact they were consuming 1612 kcal DE per day more than the sows on the control diet (14,289 vs 12,677 kcal DE/sow/day). Survival rate of the pigs was not statistically different between the two treatments. The control sows weaned slightly more pigs (8.3 vs 7.7) at the same weight, resulting in a heavier litter weaning weight than the sows fed tallow (89.1 vs 81.4 lb). This trial shows the same trend as trial 1, with the sows weaning the heaviest litters losing the most weight.

The postweaning interval was not affected by treatment, as the average interval length was similar, with no differences occurring in percentage showing estrus at 7 or 12 days. Farrowing rate and the subsequent litter size were similar for both treatments, with a slight numerical advantage for the sows fed tallow.

Energy Source in the Breeding Diet

Trial 1. The effects of the energy source in the diet from weaning to breeding on the reproductive performance of sows are shown in table 6. All sows in this trial consumed the total amount of feed offered. The results indicate that increasing the energy intake of the sows following weaning may shorten the weaning-to-breeding interval, although the difference was not significant ($P>.10$) in this trial.

Subsequent farrowing rate is numerically, although not significantly, lower for sows fed the control and cornstarch diets than for those fed the tallow diet. The higher energy cornstarch and tallow diets did result in a slight increase in the subsequent litter size over the control diet (7.5 + 7.3 vs 5.8 pigs).

Trial 2. The results of varying the level of tallow in the diet from weaning to breeding are shown in table 7. These sows were weaned and bred in July and August. The July group was made up of primiparous sows, with the August group being 2/3 multiparous and 1/3 primiparous. There were some incidences of feed refusal during the July trial, especially in the 25% tallow treatment. This feed refusal may have been diet related, but more likely was due to the high environmental temperatures, as the sows in the August group did not show the same pattern of feed refusal.

There was a significant parity influence on the postweaning interval, with the average days to estrus for the multiparous sows being 2.7 days earlier than that of the primiparous sows (3.7 vs 6.4 d). When parity is disregarded, the average postweaning interval was slightly shorter for sows fed the 25% tallow diet.

Trial 3. The influence of energy source on reproductive performance for both periods of this trial are shown in table 8. In period I, there was a significant parity difference in days to postweaning estrus in favor of the multiparous sows (4.3 vs 5.7 d), much as was seen in trial 2. However, since there was no interaction between breeding treatment and parity, data were pooled and showed similar intervals for the tallow and soybean oil diets, with a slightly longer interval for the control diet (4.8 & 4.9 vs 5.3 d). Percentage of females showing estrus within 7 days postweaning was similar for all treatments, but those fed the tallow and soybean oil-supplemented diets did tend to be earlier in returning to estrus, with a higher percentage showing heat by 5 days after weaning (80 vs 40%). Dietary treatment from weaning to breeding did not have a significant effect on the farrowing rate; however, the sows fed the soybean oil diet had larger litters in the subsequent farrowing than sows consuming the other two treatments. In Period II, the primiparous sows followed the same trend of feed refusal as was observed in trial 2. There were no significant differences between treatments in postweaning interval. The subsequent farrowing rate tended to favor the sows fed the soybean oil (P=.13), while litter size was larger for the sows fed the tallow diet.

Table 1. Composition of Basal Diet for Trial 1.

Ingredient	%
Sorghum grain, ground	72.60
Soybean meal (44%)	22.50
Dicalcium phosphate	2.50
Ground limestone	1.30
Salt	.50
Vitamin premix[a]	.50
Trace mineral[b]	.10
	100.00

[a]Each pound of premix contained: vitamin A, 400,000 IU; vitamin D_3, 30,000 IU; riboflavin, 450 mg; choline, 40 g; d-pantothenic acid, 1200 mg; niacin, 2500 mg; vitamin E, 2000 IU; vitamin B_{12}, 2.2 mg; menadione dimethylpyrimidinal bisulfite, 250 mg; ethoxyquinone, 2850 mg.

[b]Contained 5.5% Mn; 10% Fe; 1.1% Cu; 20% Zn; 0.15% I; 0.1% Co.

Table 2. Composition of Basal Diet for Trial 2.

Ingredient	%
Sorghum grain, ground	57.60
Soybean meal (44%)	22.50
Wheat starch	15.00
Dicalcium phosphate	2.50
Ground limestone	1.30
Salt	.50
Vitamin premix[a]	.50
Trace mineral[b]	.10
	100.00

[a]Each pound of premix contained: vitamin A, 400,000 IU; vitamin D_3, 30,000 IU; riboflavin, 450 mg; choline, 40 g; d-pantothenic acid, 1200 mg; niacin, 2500 mg; vitamin E, 2000 IU; vitamin B_{12}, 2.2 mg; menadione dimethylpyrimidinal bisulfite, 250 mg; ethoxyquinone, 2850 mg.
[b]Contained 5.5% Mn; 10% Fe; 1.1% Cu; 20% Zn; 0.15% I; 0.1% Co.

Table 3. Composition of Diets for Trial 3.

Ingredient	%		
	Control	Tallow	SB Oil
Sorghum grain, ground	80.80	63.26	63.26
Soybean meal	15.00	22.00	22.00
Tallow	-	10.00	-
Soybean oil	-	-	10.00
Dicalcium phosphate	1.25	1.41	1.41
Salt	.50	.56	.56
Vitamin premix[a]	.50	.56	.56
Trace mineral[b]	.10	.11	.11
	100.00	100.00	100.00

[a]Each pound of premix contained: vitamin A, 400,000 IU; vitamin D_3, 30,000 IU; riboflavin, 450 mg; choline, 40 g; d-pantothenic acid, 1200 mg; niacin, 2500 mg; vitamin E, 2000 IU; vitamin B_{12}, 2.2 mg; menadione dimethylpyrimidinal bisulfite, 250 mg; ethoxyquinone, 2850 mg.
[b]Contained 5.5% Mn; 10% Fe; 1.1% Cu; 20% Zn; 0.15% I; 0.1% Co.

Table 4. Effect of Adding Tallow to Diet for Last 7 Days of Lactation on Sow Reproductive Performance (Trial 1)

Item	Diet: 0% tallow 1477 DE Kcal/lb	Diet: 10% tallow 1681 DE Kcal/lb	SE[a]
No. sows	17	16	
Percentage showing estrus			
≤ 7 d	52.9	68.8	
≤ 12 d	82.4	81.3	
No. sows anestrus	3	3	
Sow performance			
Lact. feed intake, lb/d	9.24	9.46	.22
Daily DE intake, kcal	13,652	15,905	
Sow farrowing wt.[b], lb	345.8	365.6	
Sow weaning wt., lb	315.9	326.0	6.8
Lact. wt. change,[e] lb	29.9	38.9	3.5
Postweaning interval, d	6.4	6.4	.6
Farrowing rate[c], %	64.3	38.5	
Subsequent litter size[d]	6.7	7.0	1.4
Litter performance			
Survival rate, %[f]	81.8	93.9	3.5
No. weaned	8.3	8.9	.5
Weaning weight, lb	9.7	9.7	.22
Litter weaning wt., lb	79.0	86.2	5.1

[a] Standard Error.
[b] Weight of sow ≤ 24 h post farrowing.
[c] Percent of sows cycling which had a subsequent litter.
[d] Number pigs born alive.
[e] Significant (P<.10).
[f] Significant (P<.05).

Table 5. Effect of Adding Tallow to Diet for Entire Lactation Period on Sow Reproductive Performance (Trial 3)

Item	Diet: 0% tallow 1477 DE, Kcal/lb	Diet: 5% tallow 1584 DE Kcal/lb	SE[a]
No. sows	28	26	
Percentage showing estrus			
≤ 7 d	64.3	57.7	
≤ 12 d	75.0	80.8	
No. sows anestrus	7	5	
Sow performance			
Lact. feed intake, lb/d	8.58	9.02	.4
Daily DE intake, kcal	12,667	14,289	
Sow farrowing wt.[b], lb	375.3	375.5	
Sow weaning wt., lb	345.0	353.8	4.6
Lact. wt. change,[e] lb	-30.4	-21.8	2.1
Postweaning interval, d	6.1	5.9	.4
Farrowing rate[c], %	57.1	61.9	
Subsequent litter size[d]	7.6	8.3	.8
Litter performance			
Survival rate, %[f]	87.1	81.4	2.5
No. weaned[e]	8.3	7.7	.3
Weaning weight, lb	10.8	10.6	.4
Litter weaning wt., lb	89.1	81.4	3.5

[a] Standard Error.
[b] Weight of sow ≤ 24 h post farrowing.
[c] Percent of sows cycling which had a subsequent litter.
[d] Number pigs born alive.
[e] Significant (P<.10).

Table 6. Effect of Energy Source in Diet From Weaning to Breeding on Sow Reproductive Performance (Trial 1)[a]

Item	Diet			SE[b]
	Control	Cornstarch	Tallow	
No. sows	10	11	12	
Sows weaning wt., lb	313.1[e]	317.9[e,f]	333.1[f]	8.6
Avg. postweaning interval, d	7.5	5.9	5.9	.8
Percentage showing estrus				
≤ 7 d	50.0	54.5	75.0	
≤ 12 d	90.0	63.6	91.7	
No. sows anestrus	1	4	1	
Farrowing rate[c], %	44.4	42.9	63.6	
Subsequent litter size[d]	5.8	7.5	7.3	1.8

[a]Breeding diets fed until estrus detected.
[b]Standard error.
[c]Percent of sows cycling which had a subsequent litter.
[d]Number pigs born alive.
[e,f]Means in the same row with different superscripts differ significantly ($P<.10$).

Table 7. Effect of Energy Level in Diet From Weaning to Breeding on Sow Reproductive Performance (Trial 2)[a]

Item	Diet			
	Control	14% Tallow	25% Tallow	SE[b]
No. sows	22	24	22	
Sows weaning wt., lb	348.3	355.1	345.0	5.9
Avg. postweaning interval, d	5.04[e,f]	5.2[e]	4.58[f]	.37
Percentage showing estrus				
Multiparous ≤ 7 d	100	75.0	85.7	
≤ 12 d	100	87.5	85.7	
Primiparous ≤ 7 d	73.3	56.3	73.3	
≤ 12 d	80.0	75.0	80.0	
No. sows anestrus	3	5	4	
Farrowing rate[c], %	57.9	36.8	55.6	
Subsequent litter size[d]	11.0	9.5	8.7	1.6

[a]Breeding diets fed until estrus detected.
[b]Standard error.
[c]Percent of sows cycling which had a subsequent litter.
[d]Number pigs born alive.
[e,f]Means in the same row with different superscripts differ (P<.10).

Table 8. Effect of Energy Source in Diet From Weaning to 30 Days Postbreeding on Sow Reproductive Performance (Trial 3)[a]

Item	Control	Tallow	SB Oil	SE[a]
Period I[b]				
No. sows	10	10	10	
Sows weaning wt., lb	414.7	419.3	407.7	9.9
Avg. postweaning interval, d	5.28	4.75	4.86	.24
Percentage showing estrus				
≤ 5 d	40.0[g]	80.0[f]	80.0[f]	
≤ 7 d	90.0	100	90.0	
≤ 12 d	90.0	100	90.0	
No. sows anestrus	1	0	1	
Farrowing rate[d], %	66.7[f,g]	50.0[f]	55.6[g]	
Subsequent litter size[e]	8.7	6.7	10.5	1.2
Period II[c]				
No. sows	17	18	19	
Sows weaning wt., lb	372.5	372.5	374.9	6.8
Avg. postweaning interval, d	5.98	6.30	5.78	.50
Percentage showing estrus				
≤ 7 d	64.7	66.7	52.6	
≤ 12 d	70.6	88.9	73.7	
No. sows anestrus	5	2	5	
Farrowing rate[d], %	50.0[f]	50.0[g]	78.6[f]	
Subsequent litter size[e]	6.4[f]	10.6[g]	6.7[f]	1.3

[a]Standard error.
[b]No treatment during lactation; 14 multiparous sows and 16 primiparous sows.
[c]Half the sows received tallow during lactation; all were primiparous sows.
[d]Percent of sows cycling which had a subsequent litter.
[e]Number pigs born alive.
[e,f]Means in the same row with different superscripts differ ($P<.05$).