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Dietary energy intake during lactation and following weaning; effects on sow and litter performance (1985)

S A. Dulohery

Jim L. Nelssen

Duane L. Davis

DIETARY ENERGY INTAKE DURING LACTATION AND FOLLOWING WEANING; EFFECTS ON SOW AND LITTER PERFORMANCE[1]

Scott A. Dulohery, Jim L. Nelssen, and Duane L. Davis

Summary

The effect of energy intake during a 21-day lactation and from weaning to estrus on sow and litter performance was studied. Lactation treatments consisted of two energy intakes, either 8 (Low Energy; LE) or 16 (High Energy, HE) Mcal of metabolized energy (ME) per sow per day. Lactation diets were equivalent to daily feed intakes of 6 or 12 lb, respectively, of a grain-soybean meal diet. Energy intake from weaning to first estrus was either 5.5 (LE) or 11 (HE) Mcal of ME per sow per day, formulated to approximate feeding of 4 or 8 lb of a grain-soybean meal diet daily. Any sow in estrus by 30 days postweaning was artificially inseminated or hand-mated and fed 4 lb daily of a 14% grain-soybean meal diet during gestation. Sows remained on the same lactation-postweaning energy intakes during two parities. First and second parity sows fed 8 Mcal/day during lactation lost more ($P<.05$) weight and backfat during lactation compared to sows fed 16 Mcal of ME/day. Likewise, litters nursing sows fed LE weighed less at weaning. Regardless of lactation treatments, first-parity sows fed 11 Mcal/day from weaning to first estrus gained more backfat ($P<.05$) during the first 14 days postweaning and more weight ($P<.01$) during the initial 28 days postweaning compared to those fed 5.5 Mcal of ME/day. Slightly fewer first-parity sows fed LE during lactation were in estrus by 7 days postweaning compared to those fed HE. Increasing energy intake from weaning to first estrus had no effect on percentage of sows exhibiting estrus by 14 days postweaning. These results indicate that increasing the energy intake of first-litter sows during lactation or from weaning to estrus will minimize weight and backfat loss during the feeding period but will not substantially reduce the number of days from weaning to estrus in the first two parities.

Introduction

Anestrus and fertility problems are common for sows following their first lactation. Research has shown that sows suffering heavy losses of backfat during lactation are more likely to have a delayed first estrus following weaning. Any delay in estrus will increase farrowing interval and reduce reproductive efficiency. Other studies have reported that first-parity (primiparous) sows sustain unusually high weight losses during lactation, possibly because of their limited body fat stores, their increased nutrient demands for continued body growth, or their inability to consume adequate energy. Recent studies have reported the effects of

[1]The authors gratefully acknowledge support for this research by the National Pork Producers Council, Des Moines, IA.

energy intake during the first lactation. Our objectives were to study the long-term effects of lactation energy intake over the first two parities on sow, litter, and reproductive performance and to determine whether increasing energy intake between weaning and first estrus for first-litter sows affects subsequent sow productivity.

Experimental Procedure

One hundred four first-litter sows (Duroc x Yorkshire) were fed 4 lb daily of a 14% crude protein grain-soybean meal gestation diet until day 108 of gestation. On day 108, sows were moved to farrowing crates and were fed 5 lb daily of the low energy lactation diet (Table 1). At parturition, sows were assigned randomly to diets that provided energy intakes of 8 or 16 Mcal or ME per day (Table 1). The sows were fed the experimental diets during a 21-day lactation. All sows received the same daily allowances of protein, vitamins, and minerals, which met or exceeded the recommendations of the National Research Council (1979). Feed not consumed was weighed and recorded weekly.

Sow weight was recorded and sow backfat thickness measured ultrasonically[2] on the day of breeding, day 108 of gestation, day 21 of lactation, and on days 14 and 28 postweaning. Sow and pig weights were recorded within 24 hours after parturition. Litter size was equalized within a group of two sows assigned to the two lactation diets within 24 hours after parturition.

On the day of weaning, sows were moved to gestation stalls and randomly assigned (within lactation dietary treatment) to diets providing 5.5 or 11 Mcal of ME per day (Table 1). Sows were checked for estrus twice daily in the presence of a boar beginning on the third day after weaning. A sow was considered to be in estrus when she stood in response to hand pressure or mounting by a boar. Sows were mated or artificially inseminated twice and immediately placed on a 14% crude protein gestation diet (parity 2). Estrous detection continued for sows that had not exhibited estrus for a maximum of 30 days postweaning. Any sow not exhibiting estrus within 30 days after weaning was slaughtered and her reproductive tract examined.

Second parity sows remained on the same lactation-postweaning dietary treatments and the same data were collected as in parity 1. Following the second lactation, estrous detection tests were conducted for a maximum of 30 days postweaning, and the experiment as terminated.

Results and Discussion

The effect of energy intake during lactation on sow performance is shown in Table 2. Regardless of parity, sows fed high energy during lactation lost less ($P<.05$) weight and backfat by weaning compared to those fed low energy. This confirms previous research showing sows restricted in energy intake during lactation lose considerably more weight and backfat than more liberally fed sows.

[2]Scanoprobe, Ithaco Inc., Ithaca, NY 14850.

Primiparous sows fed 8 Mcal/day during lactation were lighter in body weight at weaning compared to those fed 16 Mcal/day. In both parities 1 and 2, breakdown of body fat and muscle tissue probably accounts for the high weight loss associated with energy restriction during lactation.

First-litter sows fed 8 Mcal/day during lactation gained more ($P<.05$) weight and backfat during the initial 28 days postweaning compared to sows fed 16 Mcal/day. A similar effect was observed following the second lactation, with sows fed 8 Mcal/day losing less weight by 28 days postweaning. Energy requirements for body maintenance following weaning also may be lower in sows previously restricted in energy intake during lactation. Therefore, a higher percentage of the postweaning energy intake may be available for body growth. This would allow sows fed 8 Mcal/day to replete body tissues more quickly following weaning compared to those fed 16 Mcal/day during lactation.

The effect of energy intake during lactation on pig performance is presented in Table 3. In each parity, sows fed 8 Mcal/day during lactation farrowed more ($P<.05$) total pigs and live pigs per litter. Lactating sows fed high energy consistently weaned heavier ($P<.05$) pigs and litters regardless of parity, and second parity sows weaned slightly heavier litters than primiparous sows.

Based on litter weaning weights, sow body tissue breakdown did not fully compensate for inadequate dietary energy intake during lactation. Differences in the number of pigs born in parity one between sows fed 8 Mcal vs 16 Mcal daily were explained by random chance, since sows were cared for and fed equally prior to the first parturition. Reasons for an increased number of pigs born to sows fed low energy during lactation are currently being examined. Pig survival was not affected by sow energy intake during lactation.

The results of energy intake from weaning to first estrus on sow and litter performance are shown in tables 4 and 5. Feeding primiparous sows 11 Mcal/day from weaning to first estrus resulted in less weight lost in the initial 14 days postweaning compared to those fed 5.5 Mcal/day. These differences in sow weight as affected by energy intake continued to widen through 28 days postweaning ($P<.05$), with the greatest difference occurring in the first parity. However, any differences in sow weight between postweaning dietary treatments were not apparent by day 108 of the second gestation. Regardless of postweaning treatment, first parity sows gained more weight during the initial 28 days postweaning than second parity sows.

Sows fed 11 Mcal/day from weaning to first estrus gained more ($P<.05$) backfat during the first 14 days after weaning than those fed 5.5 Mcal/day. First-litter sows fed 11 Mcal/day also gained slightly more backfat by 28 days postweaning. Results showed that feeding additional energy from weaning to estrus will partially compensate for sow body tissue losses during lactation.

The effects of energy intake during lactation and from weaning to estrus on percentage of sows in estrus by 7 and 14 days following weaning are presented in Tables 6 and 7. Slightly fewer first-parity sows fed 8 Mcal/day during lactation returned to estrus by 7 days postweaning than those fed 16 Mcal/day (51.9 vs 61.5%, respectively). However, the percentage of sows exhibiting estrus within 14

days after weaning was not influenced by energy intake during lactation. Sow energy restriction during lactation similar to that employed in our study has previously been shown to increase the interval to estrus in first-litter sows. Feeding additional energy from weaning to first estrus had no effect on percentage of sows in estrus by 7 and 14 days postweaning regardless of parity. However, a considerably lower percentage of first-litter sows were detected in estrus by 14 days postweaning compared to second parity sows, thus confirming the problem of anestrus in the first parity.

Providing first-litter sows with additional energy following weaning did not appear to improve reproductive performance in the first two parities. Therefore, factors other than postweaning energy intake were responsible for anestrus after the first litter was weaned. Undetermined environmental and(or) nutritional factors must account for the differences observed between first and second parity sows in our study. The interactive effects of nutrition, environment, and genetics must be fully understood to develop methods to improve reproductive efficiency of the first- litter sow.

Table 1. Composition of Diets during Lactation and following Weaning.

	Metabolizable Energy Intake/day			
	Lactation		Postweaning	
Ingredient, lb/day	8 Mcal	16 Mcal	5.5 Mcal	11 Mcal
Corn	1.25	1.25	.75	.75
Soybean meal (44%)	2.89	2.85	.96	.93
Wheat starch[a]	.13	3.86	1.08	3.68
Dried fat	.47	.94	.38	.75
Tallow	.13	.25	.10	.20
Limestone	.09	.09	.02	.02
Dicalcium phosphate	.24	.24	.11	.11
Salt	.05	.05	.02	.02
Vitamin premix[b]	.05	.05	.01	.01
Trace mineral[c]	.01	.01	.004	.004

[a]The authors gratefully thank Mid-West Solvents, Atchinson, KS 66002 for donation of the wheat starch.

[b]Each pound of premix contained: vitamin A, 800,000 IU; Vitamin D_3, 60,000 IU; riboflavin, 900 mg; choline, 92.2 g; d-pantothenic acid, 2400 mg; niacin, 5000 mg; vitamin E, 4000 IU; vitamin B_{12}, 4.4 mg; menadione dimethylpyrimidinal bisulfite, 310 mg; ethoxyquinone, 2850 mg.

[c]Contained 12.0% Mn; 10% Fe; 1.0% Cu; 15% Zn; 0.3% I; 0.1% Co.

Table 2. Effect of Dietary Energy Intake during Lactation on Sow Backfat and Weight Changes.[ab]

Item	Metabolizable Energy Intake/day			
	Parity 1		Parity 2	
	8 Mcal	16 Mcal	8 Mcal	16 Mcal
No. of litters	52	52	38	34
Weight gain during gestation, lb	142.1	143.4	113.7	101.4
Weight day 108 of gestation, lb	391.4	394.7	426.6	443.7
Weight change during lactation, lb[c]	-47.8	-22.7	-59.3	-22.0
Backfat change during lactation, in[c]	-.34	-.15	-.25	-.11
Weight change by 28 days postweaning, lb[c]	7.3	3.5	-.3	-6.3
Backfat change by 28 days postweaning, in[c]	.13	.05	.02	.01

[a]Lactation length, 21 days.
[b]Parity difference (P<.05).
[c]Effect of energy intake during parities 1 and 2 (P<.05).

Table 3. Effect of Dietary Energy Intake during Lactation on Litter Performance.[a]

Item	Metabolizable Energy Intake/day			
	Parity 1		Parity 2	
	8 Mcal	16 Mcal	8 Mcal	16 Mcal
No. of litters	52	52	38	34
Total pigs born[b]	10.0	9.2	10.1	8.4
Pigs born alive[b]	9.5	8.7	9.2	7.8
Pigs/litter after equalization	9.3	9.2	9.0	8.3
Pigs weaned/litter[bc]	8.9	8.8	8.7	7.9
Survival to weaning, %[bc]	96.0	95.4	95.9	95.1
Pig wt. at weaning, lb[b]	11.2	12.2	12.5	13.7
Litter wt. at weaning, lb[b]	98.5	105.9	106.7	107.5

[a]Lactation length, 21 days.
[b]Effect of energy intake during parities 1 and 2 (P<.05).
[c]Parity difference (P<.05).

Table 4. Effect of Dietary Energy Intake from Weaning to First Estrus on Sow Performance.

Item	Metabolizable Energy Intake (Mcal/day)			
	Parity 1		Parity 2	
	5.5	11.0	5.5	11.0
No. of sows	52	51	37	35
Weight gain during gestation, lb[a]	143.1	142.5	105.7	110.1
Weight on day 108 of gestation, lb[a]	393.3	392.8	432.3	437.3
Weight change during lactation, lb[a]	-34.8	-35.7	-46.1	-36.3
Backfat change during lactation, in	-.24	-.26	-.22	-.15
Weight change by 14 days postweaning, lb[b]	-5.9	.4	-7.0	1.3
Backfat change by 14 days postweaning, in[b]	.02	.07	.02	.03
Weight change by 28 days postweaning, lb[ab]	.2	11.0	-5.2	-1.1
Backfat change by 28 days postweaning, in[a]	.06	.13	.01	.02

[a]Parity difference (P<.05).
[b]Effect of postweaning energy intake (P<.05).

Table 5. Effect of Dietary Energy Intake from Weaning to First Estrus on Litter Performance.

Item	Metabolizable Energy Intake/day			
	Parity 1		Parity 2	
	5.5 Mcal	11 Mcal	5.5 Mcal	11 Mcal
No. of sows	52	51	37	35
Total pigs born	9.6	9.6	9.8	8.7
Pigs born alive	9.2	9.0	8.9	8.1
Pigs/litter after equalization	9.3	9.2	9.0	8.3
Pigs/litter, weaned[a]	8.8	8.8	8.7	7.9
Survival to weaning, %[a]	95.8	95.5	96.4	94.6
Pig wt. at weaning, lb[a]	11.7	11.6	12.9	13.2
Litter wt. at weaning lb	102.8	101.5	110.2	103.8

[a]Parity difference (P<.05).

Table 6. Effect of Dietary Energy Intake during Lactation on Percentage of Sows in Estrus Postweaning.

Item	Metabolizable Energy Intake/day			
	Parity 1		Parity 2	
	8 Mcal	16 Mcal	8 Mcal	16 Mcal
No. of sows	52	52	38	34
Percent of sows in estrus by:				
7 days after weaning	51.9	61.5	89.5	91.2
14 days after weaning	75.0	75.0	97.4	100.0

Table 7. Effect of Dietary Energy Intake after Weaning on Percentage of Sows in Estrus Postweaning.

Item	Metabolizable Energy Intake/day			
	Parity 1		Parity 2	
	5.5 Mcal	11 Mcal	5.5 Mcal	11 Mcal
No. of sows	52	51	37	35
Percent of sows in estrus by:				
7 days after weaning	57.7	55.8	86.5	94.3
14 days after weaning	75.0	75.0	97.3	100.0

Table 8. Effect of Dietary Energy Intake during Lactation and following Weaning on First Parity Sow and Litter Performance.

Item	Lactation: Weaning to First Estrus:	Metabolizable Energy Intake (Mcal/day)			
		8		16	
		5.5	11.0	5.5	11.0
No. of litters		26	26	26	26
Sow weight and backfat changes					
Weight gain during gestation, lb		141.4	142.8	144.8	142.1
Weight day 108 of gestation, lb		391.1	391.9	395.4	393.9
Weight change during lactation, lb		-47.3	-48.3	-22.8	-22.6
Backfat change during lactation, in		-.33	-.35	-.14	-.16
Weight change by 28 days postweaning, lb		2.0	12.8	-1.8	9.1
Backfat change by 28 days postweaning, in		.09	.18	.03	.08
Litter performance					
Total pigs born		10.1	9.9	9.2	9.2
Pigs born alive		9.7	9.3	8.7	8.8
Pigs/litter after equalization		9.2	9.3	9.3	9.2
Pigs/litter, weaned		8.8	8.9	8.9	8.7
Survival to weaning, %		95.9	96.0	95.7	95.0
Pig wt. at weaning, lb		11.3	11.1	12.2	12.1
Litter wt. at weaning, lb		98.5	98.6	107.3	104.5
Estrous response					
Percent of sows in estrus by:					
7 days after weaning		46.2	57.7	69.2	53.8
14 days after weaning		73.1	76.9	76.9	73.1

Table 9. Effect of Dietary Energy Intake during Lactation and following Weaning on Second Parity Sow and Litter Performance.

Item	Lactation: Weaning to First Estrus:	Metabolizable Energy Intake (Mcal/day)			
		8		16	
		5.5	11.0	5.5	11.0
No. of litters		20	18	17	17
Sow weight and backfat changes					
Weight gain during gestation, lb		112.4	115.0	98.1	104.8
Weight day 108 of gestation, lb		423.5	429.6	442.0	445.5
Weight change during lactation, lb		-64.1	-54.6	-27.1	17.0
Backfat change during lactation, in		-.30	-.21	-.13	-.09
Weight change by 28 days postweaning, lb		-.9	.4	-9.9	-2.6
Backfat change by 28 days postweaning, in		.01	.04	.02	0.0
Litter performance					
Total pigs born		11.1	8.9	8.2	8.5
Pigs born alive		10.1	8.4	7.7	7.8
Pigs/litter after equalization		9.6	8.4	8.4	8.2
Pigs/litter, weaned		9.3	8.1	7.9	7.8
Survival to weaning, %		97.5	94.2	95.1	95.1
Pig wt. at weaning, lb		11.9	13.1	14.0	13.4
Litter wt. at weaning, lb		109.9	103.2	110.5	104.4
Estrous response					
Percent of sows in estrus by:					
7 days after weaning		85.0	94.4	88.2	94.1
14 days after weaning		95.0	100.0	100.0	100.0