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Effects of increased feed intake in early gestation on sow farrowing performance and offspring carcass characteristics

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EFFECTS OF INCREASED FEED INTAKE IN EARLY GESTATION ON SOW FARROWING PERFORMANCE AND OFFSPRING CARCASS CHARACTERISTICS[1]

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Summary

Three hundred and ninety-four PIC sows were used to determine the effects of increased feed intake during two critical stages of fetal development on farrowing performance and offspring carcass characteristics. Sows were fed 8 lb/d for one of three periods, d 10 to 30, d 30 to 50, or d 10 to 50 of gestation in comparison to a control level of 4 lb/d. Treatments did not affect the number of pigs farrowed. Sows fed 8 lb/d of complete diet from d 10 to 30 of gestation tended to have offspring with heavier hot carcass weight (P = .16) compared to offspring of other sows. Sows fed 8 lb/d of feed from d 30 to 50 produced offspring with greater backfat and decreased percentage lean than offspring of other sows. Effects observed in the carcass characteristics are inconsistent with previous findings, and more research is needed to determine the reason why these responses occurred.

(Key Words: Gestation, Feed Intake, Offspring.)

Introduction

Recent research indicates the possibility of manipulating maternal diet or other management practices during key stages of fetal development to realize more of the pig's genetic potential for lean growth. Treatments have varied from administration of exogenous somatatropin to increased feed intake. Unfortunately, results have varied even within treatment method. Whatever the treatment method, the improvements in pig performance are thought to be due to alterations in the development of fetal muscle fibers. These changes are important, because they set the upper limit of the pig's potential for lean deposition. Muscle fiber formation is such that the primary fibers (slow-twitch, red) develop a structural scaffolding for later formation of secondary muscle fibers (fast-twitch, white).

Research from Europe observed that increased feed intake from d 25 to 50 of gestation resulted in offspring that grew faster and more efficiently than control offspring. Also, previous research at Kansas State University reported that feeding either 8 lb/d of complete diet or 4 lb/d of complete diet with an additional 4 lb/d of ground corn from d 30 to 50 of gestation resulted in offspring that were heavier and leaner at slaughter than control offspring; however, the number of pigs born decreased. Although both experiments suggest that increasing feed intake for gestating sows during a window of d 25 to 50 of gestation will improve offspring performance, additional research is needed to determine if a different feeding period might have a greater influence on performance. Therefore, the objective of

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this experiment was to determine if increased feed intake during two key periods of early fetal development would alter the number of pigs born alive and/or carcass characteristics of the offspring.

Procedures

A total of 394 sows (PIC Cambrough sows × 326 boars) on a 3,000 sow commercial farm in southwest Minnesota was assigned randomly to one of four treatments based on the feed intake during different times of gestation. Sows received an increased amount of feed (8 lb/d) for one of three periods during gestation; d 10 to 30, 30 to 50, or 10 to 50. Control sows were fed 4 lb/d from d 0 to 100 gestation. The design covered the two critical periods identified for influencing muscle fiber number: embryonic (d 10 to 30), when germ layer differentiation leads to development of tissues and organs, and early fetal (d 30 to 50), just before secondary muscle differentiation. Sows were allotted to treatment at breeding and fed 4 lb/d of a complete gestation diet until d 10 (d 0 defined as the onset of estrus). All sows were provided 4 lb/d from d 50 to 100 and 6 lb/d from d 100 to 114 of gestation.

Maternal plasma samples were collected from 20 sows per treatment on d 50 of gestation, then subsampled and frozen for later determination of total and free insulin-like growth factor-I (IGF-I) and insulin. Sow farrowing data analyzed included numbers of pigs born alive, stillborn, and mummified per litter. After weaning, sows were monitored for days to estrus and subsequent fertility.

Pigs in a subsample of litters (25 per treatment) were weighed at birth. Within-litter variation of birth weight was evaluated using Levene's test, which tests the residual difference for each pig weight compared to litter average by analysis of variance.

Pigs were ear notched at birth according to the maternal treatment in gestation and then were standardized across treatments. At weaning, pigs were mixed within sex and moved to offsite nurseries. Pigs were moved to finishing buildings at 63 days of age. As pigs reached market weight (260 lb), they were sorted and marketed by treatment and sex for a total of eight different marketing groups (i.e., a load of barrows or gilts from each individual treatment). At the slaughter plant, experimental pigs were processed at the beginning of the day to decrease the potential variation in Fat-O-Meter™ measurements. Individual carcass measurements were obtained on 1,835 pigs.

Table 1. Gestation Diet Composition[a]

Ingredient	Percent
Corn	74.9
Soybean meal (46.5%)	15.6
Alfalfa meal	5.0
Other vitamin and trace mineral additions	4.5
Total	100.0

[a]Formulated to contain .7% lysine, 1.0% Ca, and .90% P.

Results and Discussion

The number of pigs born was similar for sows provided increased feed during either treatment phase of gestation and control sows. Chance differences were observed in age of the sows used in this experiment (with sows fed 8 lb/d in gestation tending to be older, P<.10; Table 2); therefore, parity was used as a covariate to equalize differences. In a previous experiment, a decrease in the number of pigs born alive was observed when sows were fed 8 lb/d of complete feed from d 30 to 50 of gestation; however, this was not observed in the current experiment. No differences (P>.10) occurred in the number of pigs born stillborn or mummified.

No differences were observed (P>.10; Table 3) in either pig or litter birth weight or pig birth weight variation.

Free IGF-I (not bound by binding proteins) was elevated (P<.05; Table 4) on d 50 in plasma of sows fed increased feed from d 30 to 50 and d 10 to 50 of gestation but not d 10 to 30; however, sows fed 8 lb/d from d 10 to 30 had been fed 4 lb/d for the previous 20

days. Total IGF-I was not different for the various treatments, nor was the percentage of IGF-I that was in the bound form (approx. 98% bound). Insulin was elevated (P<.01) on d 50 of gestation, and sows fed 8 lb/d from d 30 to 50 had the highest values.

Pigs from sows fed increased feed from d 30 to 50 of gestation were less lean and had a higher amount of backfat at slaughter. A trend (P = .16) existed for increased hot carcass weight in offspring from sows fed increased feed from either d 10 to 30 or d 30 to 50 of gestation. Results of this experiment suggest that feeding sows 8 lb/d from d 10 to 30 of gestation tends to increase hot carcass weight of barrow offspring. However, in contrast to previous research, we observed that increased feed from d 30 to 50 of gestation decreased (P<.05; Table 5) percentage lean and fat-free lean index and increased (P<.05) backfat depth of offspring. Feeding sows 8 lb/d of complete diet from d 10 to 50 resulted in offspring with carcass characteristics similar (P>.10) to those of control offspring.

The analysis of subsequent farrowing rate showed no differences from feed intake level during gestation. Also, no differences in the number of pigs born, born alive, stillborn, or mummified per litter were observed when sows were fed increased feed in the previous gestation compared to control sows. A increase in the length to return to estrus was observed (P<.05; Table 6) when sows were fed 8 lb/d from d 10 to 50 of gestation.

Previously, we observed that sows fed 8 lb/d from d 30 to 50 of gestation produced offspring that were leaner and heavier at slaughter than control offspring. However, this was not observed in the current experiment. In fact, the response was just the opposite, with increased fat depth and a lower percentage lean observed for offspring from sows fed 8 lb/d from d 30 to 50 of gestation. Although offspring from sows with high feed intake from d 30 to 50 had less lean, the increase in hot carcass weight was similar to that in the previous experiment. Increased hot carcass weight of the offspring may be consistent with work from Europe, where an improvement in ADG was observed for offspring of sows provided additional feed during gestation. Although no advantage in percentage lean was observed in the offspring of sows with increased feed intake from d 10 to 50 of gestation, percentage lean was improved in offspring from sows fed 8 lb/d from d 10 to 30 of gestation.

Several differences exist between previous experiments and the current study. Differences in parity, weight of offspring at slaughter, and overall leanness of the offspring may have important effects. Sows in the current experiment were older, and hot carcass weight was lighter (approximately 20 lbs). Because the offspring in the current experiment were considerably lighter than the animals in the first experiment, they were leaner and this might have limited the treatments' abilities to enhance lean growth. Because of the unknown effects of parity and marketing age/weight, future research should address these questions.

Although a window of treatment at approximately d 10 to 30 of gestation may exist when increased feed intake would lead to improved muscle development of the fetal pig, more research is needed to assure the repeatability of this response.

Table 2. Effects of Increased Feed Intake during Gestation on Sow and Litter Performance

		8 lb/d of Feed from				
Item	Control	D 10-30	D 30-50	D 10-50	SEM	P<
Number of sows	104	97	95	98		
Avg. parity	3.52[b]	4.41[c]	3.87[b]	3.69[b]	.26	.07
No. pigs born[a]	10.28	10.59	9.99	9.81	.60	.48
No. pigs born alive[a]	8.78	9.16	8.53	8.08	.60	.23
No. pigs born stillborn[a]	.92	.90	.93	1.08	.16	.68
No. pigs born mummified[a]	.58	.54	.52	.65	.23	.93

[a]Means were adjusted for parity by covariate analysis.
[b,c]Means differ P < .05.

Table 3. Effects of Increased Feed Intake during Gestation on Litter Birth Weight and Pig Weight Variation within the Litter

		8 lb/d of Feed from				
Item	Control	D 10-30	D 30-50	D 10-50	SEM	P <
No. litters	17	19	14	21		
No. pigs per litter	8.94	9.26	9.29	9.71	.67	.82
Avg. pig birth weight, lb	3.07	3.43	3.46	3.20	.18	.32
Avg. litter birth weight, lb	30.85	32.57	32.80	31.58	1.90	.86
Residual variation in birth weight, lb[a]	.45	.44	.63	.48	.07	.16

[a]Lower values would indicate less variation of weight within the litter.

Table 4. Effects of Increased Feed Intake during Gestation on Blood Metabolites[a]

		8 lb/d of Feed from				
Item	Control	D 10-30	D 30-50	D 10-50	SEM	P <
No. sows	19	21	17	18		
Total IGF-I, ng/ml	59.5[a]	50.1[a]	74.9[b]	67.5[a]	8.85	.20
Free IGF-I, ng/ml	1.31[ac]	1.18[b]	1.62[c]	2.05[d]	.24	.01
Percent IGF-I bound, %	98.2	99.3	98.5	98.1	.57	.34
Insulin, ng/ml	.78[ab]	.63[b]	1.04[c]	.84[ac]	.09	.01

[a]Means differ at P<.10.

Table 5. Effect of Increased Feed Intake during Gestation on Offspring Carcass Performance

		8 lb/d of Feed from				
Item	Control	D 10-30	D 30-50	D 10-50	SEM	P <
Gilt Offspring	188	294	237	244		
Age, d	186.3	186.2	186.8	186.9	.44	.40
Hot carcass weight, lb[c]	184.4	186.1	187.4	183.5	1.56	.16
Backfat, mm[d]	12.85[a]	13.01[a]	13.79[b]	13.21[a]	.24	.01
Percentage lean, %[d,e]	57.86[a]	57.79[a]	57.30[b]	57.67[ab]	.16	.01
Loin depth, mm[d]	57.87[a]	58.33[a]	57.62[a]	57.86[a]	.48	.03
Fat free lean index[d,e]	51.83[a]	51.75[a]	51.37[b]	51.66[a]	.11	.01
Barrow Offspring	198	246	228	200		
Age, d	186.5	186.8	187.0	187.0	.43	.40
Hot carcass weight, lb[c]	185.1	188.1	184.4	184.9	1.52	.16
Backfat, mm[d]	16.67[a]	16.33[a]	17.77[b]	16.77[a]	.23	.01
Percentage lean, %[d,e]	55.29[a]	55.60[a]	54.50[b]	55.28[a]	.16	.01
Loin depth, mm[d]	55.32[a]	55.80[a]	53.99[b]	55.44[a]	.47	.03
Fat-free lean index[d,e]	49.99[a]	50.15[a]	49.45[b]	49.94[a]	.11	.01

[a,b]Means differ at P<.05.
[c]Means were adjusted for age at market by covariate analysis.
[d]Means were adjusted for hot carcass weight by covariate analysis.
[e]Represent calculated plant values.

Table 6. Effects of Increased Feed Intake during Gestation on Sows' Subsequent Farrowing Performance[a]

		8 lb/d of Feed from				
Item	Control	D 10-30	D 30-50	D 10-50	SEM	P <
Number of sows	66	57	56	52		
Return to estrus, d	5.86[b]	5.76[b]	5.74[b]	7.76[c]	.84	.04
Farrowing rate, %	85.6	83.8	89.5	79.0	7.61	.59
No. pigs born	9.2	10.06	10.26	9.52	.67	.37
No. pigs born alive	8.05	8.93	8.72	8.73	.61	.48
No. pigs born stillborn	.73	.70	.95	.62	.18	.35
No. pigs born mummified	.42	.44	.59	.17	.23	.39

[a]Means were adjusted for parity by covariate analysis.
[b,c]Means differ P < .05.