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Fetal and maternal responses to high feed intake from day 29 to 45 of gestation

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Fetal and maternal responses to high feed intake from day 29 to 45 of gestation

Abstract

Parity-four sows were fed either 4.0 lb/d (control, n = 6) or 14.0 lb/d (high, n = 9) of feed from d 29 to 45 of gestation. On d 45 of ges~tion, sows were slaughtered and uteri collected for fetal and placental measurements. High-feed-intake sows gained more weight from. d 29 to 45 compared to control sows. Providing feed in excess of established requirements to gestating sows from d 29 to 45 of gestation increased IGF-I concentrations in maternal plasma and decreased crown-rump length variation of the fetus. Increased feed intake resulted in a removal of the correlation between average fetal weight and number of fetuses per sow. We postulate that the increased maternal IGF-I or other maternal responses to high feed intake altered the maternal limit on fetal growth at this stage of gestation.; Swine Day, Manhattan, KS, November 20, 1997

Keywords

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FETAL AND MATERNAL RESPONSES TO HIGH FEED INTAKE FROM DAY 29 TO 45 OF GESTATION[1]

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Summary

Parity-four sows were fed either 4.0 lb/d (control, n = 6) or 14.0 lb/d (high, n = 9) of feed from d 29 to 45 of gestation. On d 45 of gestation, sows were slaughtered and uteri collected for fetal and placental measurements. High-feed-intake sows gained more weight from d 29 to 45 compared to control sows. Providing feed in excess of established requirements to gestating sows from d 29 to 45 of gestation increased IGF-I concentrations in maternal plasma and decreased crown-rump length variation of the fetus. Increased feed intake resulted in a removal of the correlation between average fetal weight and number of fetuses per sow. We postulate that the increased maternal IGF-I or other maternal responses to high feed intake altered the maternal limit on fetal growth at this stage of gestation.

(Key Words: Feed Intake, Fetal Growth, Insulin-Like Growth Factor.)

Introduction

Embryonic diversity within a litter contributes to the variation in birth weights and subsequent variation in finishing age. The ability to decrease variation in birth weight can provide great economic savings in all-in, all-out production systems. Birth weight variation may result from variations in nutrient flow from the sow to the fetuses during gestation. For example, fetuses with smaller placentas are likely to be smaller at birth because they receive fewer nutrients and have less capacity to remove waste products.

Previous research indicates that fetuses with longer implantation lengths tend to be heavier in weight. Therefore, the objective of our study was to determine whether feeding sows 14 lb/d of diet from d 29 to 45 of gestation would affect fetal and placental development.

Procedures

Fifteen (PIC Line C-15) parity-four sows were allotted to receive either 4 or 14 lb/d of a gestation diet from d 29 to 45 after insemination. All sows were housed in gestation stalls in an environmentally controlled gestation barn. Sows were fed at 8:00 a.m. and ad libitum sows were fed again at 8:00 p.m.. All sows had ad libitum access to water throughout the experiment. Sows fed ad libitum were provided 6 lb feed in morning and 8 lb feed in evening. Sows were weighed at d 29 and 45 of gestation.

Blood samples were collected from sows 2 hours after each feeding (10:00 a.m. and 10:00 p.m.) on d 43 of gestation, and plasma was harvested and frozen for later analysis of insulin-like growth factor I (IGF-I) and insulin.

Reproductive tracts were collected as sows were processed at a commercial processing facility. Placental volume was estimated by collecting allantoic and amniotic

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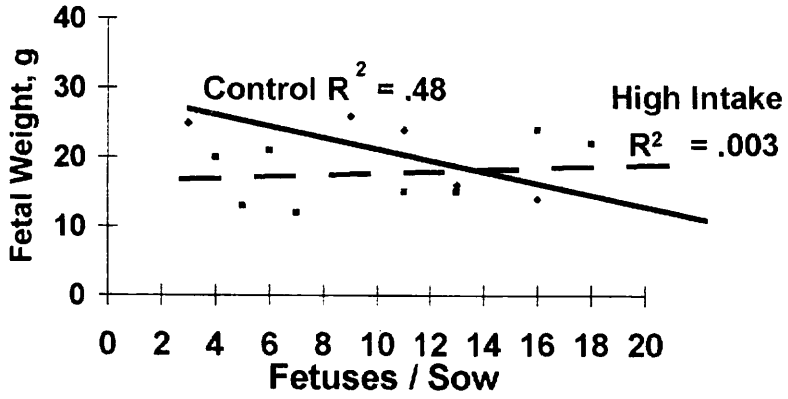
fluids after puncturing the membranes. Placental weight, fetal weight, and fetal crown-rump length were measured.

Data were analyzed using the GLM procedure of SAS. Variation about selected means was tested by calculating the residuals for each observation (e.g., absolute value of the difference between the observation and the mean weight of entire litter). Residuals were evaluated for treatment variation by analysis of variance. Smaller residual means would indicate that the litter had less variation in fetal weight.

Results and Discussion

High-feed-intake sows gained more weight from d 29 to 45 compared to controls. No differences were detected in number of fetuses, mummies, length of unoccupied uterus, implantation length, allantoic and amniotic fluid volumes, placental and fetal weight, and crown-rump length ($P > .10$). No differences were observed between the fetuses from sows fed control or a high level of feed intake in fetal weight or placental weight variation. However, crown-rump length variation was decreased in sows fed 14 lb of feed when compared to control sows. High-feed-intake sows had greater IGF-I concentrations in plasma than controls on d 43. As expected, a negative relationship between fetal number and fetal weight was observed for control sows (wt = -1.02 × fetal no + 32; $R^2 = .48$). However, a similar relationship was not observed for fetuses from high-intake sows ($R^2 = .003$). This suggests that the maternal limit on fetal growth had been altered (Figure 1).

In summary, providing 14 lb/d of feed from d 29 to 45 of gestation increased IGF-I concentrations in maternal plasma and decreased crown-rump length variation of the fetus. We believe that increasing the feed intake during early gestation altered the nutrient flow to the developing fetuses, possibly resulting in improved fetal growth. We postulate that the increased maternal IGF-I or other maternal responses to high feed intake altered the maternal limit on fetal growth at this stage of gestation.



Control (wt = -1.02 x fetal no. + 32.01)
High intake (wt = 0.08 x fetal no. + 18.03)

Figure 1. Effect of High Feed Intake from d 29 to 45 of Gestation on Fetal Pig Development.

Table 1. Effects of Increased Feed Intake from d 29 to 45 of Gestation on Sow and Fetal Performance

	Feed Intake, lb/d			
Item	4	14	CV	P<
No. sows/treatment	6	9		
Sow weight gain, lb	9.5	74.8	74.9	.01
No. fetuses	9.8	11.3	45.3	.57
No. mummies	3.3	2.7	74.1	.57
No. unoccupied space	4.2	3.9	69.9	.85
Implantation length, mm	57.4	40.5	49.4	.19
Allantoic fluid volume, ml	32.5	34.1	62.4	.88
Fetal weight, g	21.1	18.4	28.9	.38
Fetal weight variation, g	1.9	2.0	93.5	.81
Placental weight, g	64.0	61.4	31.7	.81
Placental weight variation, g	18.3	15.6	76.6	.21
Crown-rump length, mm	69.3	67.2	9.8	.57
Crown-rump length variation, mm	4.8	3.2	115.5	.03
IGF-I in peripheral sow blood,ng/ml[a]				
a.m.	27.2	64.2	19.8	.01
p.m.	32.4	77.1	19.8	.01
Insulin in peripheral sow blood,ng/ml				
a.m.	37.6	67.6	48.4	.01
p.m.	37.1	68.9	48.4	.01
Fetal IGF-I and insulin, d 45, ng/ml				
IGF-I	4.1	5.2	38.1	.24
Insulin	80.4	68.4	74.3	.72

[a]No a.m. vs p.m. effects or interactions were detected (P>.20).