PARTICLE SIZE OF CORN IN LACTATION DIETS FOR MIXED-PARITY SOWS

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Summary

A total of 107 mixed-parity sows (parities one to four) was used to determine the effects of particle size of corn in lactation diets on sow and litter performance. The sows were fed corn-soybean meal-based diets with targeted corn particle sizes of 1,500, 900, and 600 µm (actual means particle sizes of corn during the experiment were 1,600, 824 and 619 µm). Reducing mean particle size of the corn in lactation diets from 1,500 to 600 microns resulted in greater ADFI and water usage (linear effects, P<0.02), fewer days for return to estrus after weaning (linear effect, P<0.04), and less backfat loss (quadratic effect, P<0.03) for the sows.

Although the trends in pigs weaned per litter, piglet survivability, litter weaning weight, and litter weight gain were in the same direction as those for feed intake and water usage in the sows, the difference in measurements of litter performance was not statistically important among treatments (P = 0.15 or greater). Intakes of DM, N, and GE by the sows were increased by 9, 4, and 7% and apparent digestibilities of DM, N, and GE were increased by 6, 5, and 7%, respectively, as particle size of corn was decreased from 1,500 to 600 µm (linear effects, P<0.001). Finally, excretion of DM and N in the feces was decreased (linear effect, P<0.002) by 178 g/d and 5 g/d, respectively, as particle size of the corn on the sow diets was reduced. In conclusion, reducing particle size of corn did not affect litter performance but increased feed intake and digestibility of nutrients and reduced nutrient excretion in sows.

(Key Words: Sow, Particle Size, Lactation, Digestibility)

Introduction

The ever increasing productivity in sows results in greater and greater demand for digestible nutrient intake to support milk production. If this demand is not met by the diet, the sow mobilizes body reserves, which can result in a poor body condition at the end of lactation. Thus, longevity of the sows can be compromised, and turnover rate in the sow herd becomes a costly problem. Data from our lab indicate that reducing particle size of corn from 1,200 to 600 microns in diets for first-litter sows increased feed intake, digestibility of nutrient, and ME content of the feed. However, we continue to field questions about feed intake and performance of older sows when fed diets of small particle sizes. Thus, we designed an experiment to determine the effect of particle size of corn in lactation diets of mixed-parity sows.

Procedure

A total of 107 sows was used in a 21-d lactation experiment. The sows were fed 4 lb/d of a sorghum-based gestation diet for the first 110 days of pregnancy. Then they were moved to a farrowing facility and fed the corn-based experimental diets at 6 lb/d. After farrowing, the sows were allowed ad libitum consumption of feed and water. Cross-fostering was completed among litters within 48 hours after farrowing. Treatments were three corn particle sizes (approximately 1,500, 900, and 600 µm) with the coarsest particle size prepared in a roller mill and the other two

particle size treatments achieved with a hammermill. All other ingredients were the same in all experimental diets (Table 1). Each time the diets were processed, samples of ground corn and the complete diet were collected for particle size determination.

Table 1. Diet Composition[a]

Ingredient	%
Corn	68.25
Soybean meal	27.25
Monocalcium phosphate	2.00
Limestone	1.10
Salt	0.50
Vitamin premix	0.25
Mineral premix	0.15
Sow add pack	0.25
Chromic oxide	0.25

[a]Formulated to 1% lysine, 0.9% Ca, and 0.8% P.

Sows were weighed and scanned for backfat at farrowing and weaning. Water and feed consumption of the sows were recorded each week, and total litter weight and number of pigs were recorded after cross-fostering and at weaning. Finally, samples of feces were collection (one collection per sow) for moisture content and the chromic oxide (0.25%) added to the diets allowed calculation of nutrient digestibilities. All data were analyzed using the Proc Mixed Procedure of SAS with polynomial regression used to describe the shape of the response to reducing particle size in the lactation diets.

Results and Discussion

Analyses of the corn samples collected during the course of the experiment indicated that the particle size was 1,600, 824 and 619 µm for the 1,500, 900 and 600 µm treatments, respectively (Table 2). Thus, the particle sizes were reasonably close to the original targets. By decreasing particle size from the targets of 1,500 to 600 µm, ADFI (Table 3) and water usage were increased by approximately 9 and 42%, respectively (linear effects, $P<0.02$). Loss of backfat thickness for the sow was decreased (quadratic effect, $P<0.03$) as particle size decreased, and the trend for sow BW loss during lactation was in the same direction as that for fat loss, although for BW loss the effect was not statistically significant. Also, measurements of piglet growth and survivability were not different among sows fed diets with different particle sizes ($P=0.15$ or greater).

Table 2. Particle Size Analysis of Corn and Diet

	Particle size, µm		
Item	1,500	900	600
Corn			
No. of observations	7	7	7
Mean particle size	1,600	824	619
Standard deviation	2.21	2.59	2.44
Diet			
No. of observations	7	7	7
Mean particle size	1,282	847	702
Standard deviation	2.17	2.27	2.23

Apparent digestibility of DM and N were improved from 79.9 to 85.0% and 83.0 to 86.7% (linear effects. $P<0.001$) as particle size of corn was reduced from 1,500 to 600 µm (Table 4). These improvements in nutrient digestibility resulted in 19 and 18% decreases in excretion of DM and N (linear effects, $P<0.002$). These improvements in nutrient digestibility are consistent with the general trends in sow and litter performance that suggest better energy balance in the sows fed the diets with the more finely ground corn.

In conclusion, by decreasing particle size of corn we were able to increase water and feed intake. Also, sows fed diets with smaller corn particle sizes had less loss of backfat,

greater digestibilities of DM, N and GE, and returned to estrus more quickly. Thus, use of finely ground corn in lactation diets for multiparous sows is recommended to improve body condition of the sows at weaning and to reduce the environmental impact of swine production.

Table 3. Effects of Corn Particle Size on Sow and Litter Performance

	Particle size, µm				P <	
Item	1,500	900	600	SE	Linear	Quadratic
No. of observations	37	33	35			
Sow BW postfarrowing, lb	556	533	532	12	-[a]	-
Lactation BW loss, lb	23.2	12.4	17.4	8.4	-	-
Lactation fat loss, in	0.09	0.04	0.07	0.01	-	0.03
ADFI, lb	12.1	12.7	13.1	0.4	0.02	-
Water disappearance, gal/d	9.3	12.3	13.2	1.4	0.02	-
Initial pigs/litter	11.3	11.5	11.3	0.3	-	-
Pigs weaned/litter	9.9	10.2	10.4	0.3	-	-
Survivability, %	88.5	89.2	92.0	1.8	-	-
Litter weaning wt, lb	134.3	140.3	140.7	6.8	-	-
Litter wt gain, lb	97.5	102.4	104.5	6.4	-	-
Days to estrus	4.7	4.5	4.2	0.3	0.04	-

[a]Dashes indicate P=0.15 or greater.

Table 4. Effects of Corn Particle Size on Apparent Digestibility, Intake, and Excretion of Nutrients

	Particle size, µm				P <	
Item	1,500	900	600	SE	Linear	Quadratic
No. of observations	37	34	36			
Fecal moisture, %	70.5	70.0	69.8	1.0	-[a]	-
DM intake,kg/d	4.8	5.1	5.3	0.1	0.001	0.001
N intake, g/d	169	176	177	4	0.001	0.12
GE intake, Mcal/d	21.0	22.1	22.8	0.3	0.001	0.005
Apparent digestibility,%						
DM	79.9	83.3	85.0	1.1	0.001	-
N	83.0	85.7	86.8	1.0	0.001	-
GE	80.6	84.5	86.4	1.0	0.001	-
Fecal excretion of DM, g/d	970	844	791	57	0.001	-
Fecal excretion of N, g/d	28	25	23	2	0.002	-

[a]Dashes indicate P=0.15 or greater.