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The effect of crude fiber on pregnant sows' and their piglets' performance

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ABSTRACT

The crude fiber content of the pregnant sows' diets can influence the performance, primarily the reproductive performance of the sow. Feeding the pregnant sows according to their nutritional requirements can increase the number of stillborn pigs and weaned pigs. Fibrous feed components decrease the digestibility and the absorption of the other nutrients. However, a given amount of crude fiber is required in the pregnant sows' diets because of their special physiological role. Three different feeds (control, basal diet plus fermentable corn silage and basal diet plus non-fermentable wheat straw) were fed with pregnant sows in two repetitions in order to determine the crude fiber requirement of the sows during this period. The number of stillborn and number of weaned piglets, as well as the feed-intake (including the energy and protein intake) during lactation increased in response to the fiber supplementation. These findings confirm the beneficial effects of crude fiber addition by supplementing the pregnant sows' ratios with corn silage or wheat straw.
(Keywords: sow, fiber, nutrition, reproduction)

INTRODUCTION

Several research data have demonstrated that the fiber supply of pregnant sows is important from many aspects. Insufficient fiber supply of sows during pregnancy can lead to constipation or MMA syndrome (*Fekete* and *Hullár*, 1996; *Fekete*, 1995). Fibrous feed components decrease the digestibility and the absorption of the other nutrients, thus the amount of crude fiber in the diet cannot exceed a certain level. However, a minimum amount of crude fiber is necessary in the pregnant sows' diets in order to prevent decreasing feed-intake during lactation, production of toxic gases or colonisation of bacteria in the intestine or oesophagalis stomach ulcer (*Fekete*, 1995). The fibrous, bulky diet decreases the density of the feed therefore this feed stays longer in the stomach, however it is moved along quickly by the intensive intestinal passage (*Schmidt*, 1995). Supplementation of pregnant sows' diets with a fiber source, especially with wheat straw has been proved to increase the reproductive performance of the sows (*Ewan et al*., 1996; *Reese*, 1997; *Mroz et al*., 1986; *Nelson et al*., 1992) or improve the feed-intake during lactation (*Farmer et al*., 1996).

Once the energy and protein demands of an animal are not met, its productive performance will decrease. For instance 22 g ileal digestible, equals to 26 g total lysine per kg is needed in the lactating sow's diet for maximizing the litter growth (*Pettigrew*, 2000). Increasing the dietary lysine level from 0.8 to 1.2% during lactation can increase litter weaning weight, litter weight gain and reduce weight loss in high producing sows (*Richert et al*., 1997).

The excessive energy intake and obesity can lead to hoof problems and to 'fat sow' syndrome (*Rozeboom*, 2000), to longer farrowing (*Bilkei*, 1990) as well as to decreased feed-intake and increased weight-loss during lactation, abnormal development of the mammary tissues and extra costs (*Goihl*, 1994; *Matte et al*., 1994; *Tokach et al*., 1999). After insemination, the flushing of the sows hast to be finished within 4 days, otherwise the mortality rate of the embryos will increase (*Fekete*, 1995; *Peet-Schwering* and *Hartog*, 1997; *Safranski*, 2000). However, fat supplementation during the last third period of pregnancy can increase the number of stillborn piglets and the performance of the lactating sow (*Halas* and *Babinszky*, 2000). *Tokach et al*. (1999) suggested that about 27.2 MJ ME/day and 1.95 kg feed should be given to a 200 kg sow, while the NRC (1998) advising 26 MJ/day and 250 g crude protein/day. The lactating sow requires 3.5-6.4 kg feed, and then 48-87 MJ and 31-58 g lysine per day (*NRC*, 1998).

The average crude fiber content of the pregnant sows' ratios is relatively low in the daily practice, causing serious losses in the reproduction and production cycle of the sow. The proper nutrient levels, including the adequate crude fiber levels should contribute to increase the number of piglets born alive and weaned and also to improve the feed-intake during lactation. The aim of our experiment was to compare the reproductive performance as well as the energy and the protein transformation of sows consuming a diet with low crude fiber content to those that were receiving wheat straw and corn silage supplementation as fiber sources.

MATERIALS AND METHODS

The trial was conducted at the model farm of the Research Institute for Animal Breeding and Nutrition in Herceghalom with 21 Large White sows after more than one parturition. *Table 1* and *Table 2* show the nutrient content of the daily ratios from day 2 up to 90 and then from 91 up to 113 of pregnancy, respectively.

Table 1

Nutrient content of the daily ratios (g) (between day 2 and 90 of pregnancy)

Treatment	Control	Trial treatments	
		Treatment 1	Treatment 2
	2.4 kg feed	1.4 kg feed + 2.5 kg corn silage	2.1 kg feed + 0.3 kg wheat straw
Dry matter	2112	2132	2109
Crude protein	275	225	250
Crude fiber	108	243	219
Crude fat	69.0	64.0	63.6
DEs, MJ/kg	30.6	27.4	27.6
Lysine	13.9	13.9	13.9
Ca	12.7	12.9	12.7
P	12.2	12.2	12.3

Three treatments were defined for the pregnancy period: the control diet with low crude fiber level, treatment 1 was equal to control (basal) diet but it was supplemented with a fermentable fiber source, corn silage (CS) and treatment 2 was equal to control diet but supplemented with a non-fermentable fiber source, wheat straw (WS). During pregnancy

sows received a controlled amount of feed. The crude fiber content in the two phases of the pregnant diets were 4.5% (control), 6.2% and 5.5% (CS); 9.1% and 8.2% (WS), respectively. The feed-intake during two lactations was monitored and metabolisable energy (ME) as well as lysine (reflecting the crude protein) intake were calculated. The dry matter, Ca, P, lysine, vitamin and trace mineral contents were the same in each diet. After farrowing sows in each treatment received the same lactating diet, *ad libitum*. Two pregnancy and two lactation periods of the sows had been investigated in this experiment. The following parameters were collected during the trial: a.) live weight of the sows during pregnancy and lactation, b.) number of live born piglets, weight of the litter, c.) number of piglets weaned and weaning weights of the piglets and d.) intake during lactation and its transformable energy and lysine content.

Table 2

Nutrient content of the daily ratios (g) (between days 91 and 113 of pregnancy)

Treatment	Control	Trial treatments	
		Treatment 1	Treatment 2
	3.0 kg feed	2.4 kg feed + 1.4 kg corn silage	2.7 kg feed + 0.3 kg wheat straw
Dry matter	2640	2616	2637
Crude protein	344	311.3	319
Crude fiber	135	209	247
Crude fat	85.8	82.2	80.7
DEs, MJ/kg	38.3	35.8	35.2
Lysine	17.4	17.4	17.5
Ca	15.9	15.7	15.8
P	15.3	15.4	15.4

The statistical analyses on the variants have been prepared and the preliminary results confirm that the differences found between the experimental treatments are related to the individual treatments. Some trials are still in progress, thus further analyses have to be done.

RESULTS AND DISCUSSION

The major findings of the experiment are summarized in *Table 3* and *4*. *Table 3* shows the effect of different fiber supplementation during pregnancy on the sows' and piglets' performance in the first period (first pregnancy and first lactation) of the trial. In the first period the weight gain during pregnancy was the highest in the control group (41 kg) and lowest in the corn silage fed group (28 kg) but the lactational weight-loss was also the greatest in the latter (CS) group (17%). The number of stillborn and weaned piglets, as well as the average litter size were consequently higher in the experimental groups. *Tritton et al*., (1996) reported, that voluntary feed intake during lactation is unaffected by lysine or energy content of the diets, but the sow body-weight loss during lactation can decline with increasing ME content up to 13.25 MJ/kg in first litter sows. However, the increasing ME levels during lactation in the first period of the experiment was followed by increasing sow weight loss. The lowest feed and ME intake during lactation was observed in the control group. *Table 4* shows the effect of different fiber supplementation during pregnancy on the sows' and piglets' performance in the second period.

Table 3

The effect of different fiber supplementation during pregnancy on the sows' and their piglets' performance in the first period of the experiment

Treatments	Control		Treatment 1 corn silage		Treatment 2 wheat straw	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Weights of sows, before insemination, kg	192	4.7	196	31.7	194	27.6
Weights of sows, on d. 108 of pregnancy, 1st period, kg	233	25.0	224	25.9	226	32.3
Weight gain during pregnancy, kg	41	29.2	28	12.4	32	10.9
Weight of sows, end of 1st lactation	204	10.7	186	26.8	192	35.7
Weight gain during lactation, kg	-29	20.4	-38	16.3	-34	29.6
Live born piglets per sow, n	8.6	1.3	9.7	2.5	9.9	2.0
Average litter size, kg	13.2	3.1	17.0	6.1	14.9	4.4
Weaning weights of piglets, kg	6.6	2.0	7.5	0.9	6.5	0.8
Number of piglets weaned, n	8.0	1.6	8.6	1.7	9.0	1.4
Number of days until weaning, d.	30	2.7	31	1.0	30	1.6
Interval between weaning and maiting, d.	4.6	0.8	4.1	0.6	5.2	0.8
Feed intake of the lactating sows, kg	4.4	0.3	5.2	0.4	4.9	0.6
ME intake of the lactating sow, MJ	53.2	3.9	63.1	4.8	60.3	7.1
Lysine intake of the lactating sow, g	41	3.1	48	3.5	46	5.2

Table 4

The effect of different fiber supplementation during pregnancy on the sows' and their piglets' performance in the second period of the experiment

Treatments	Control		Treatment 1 corn silage		Treatment 2 wheat straw	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Weights of sows, end of 1st period, kg	196	30.0	181	24.0	176	13.1
Weights of sows, on d. 108 of pregnancy, 2nd period, kg	237	30.1	219	9.9	233	14.7
Weight gain during pregnancy, kg	41	18.8	38	19.6	57	9.4
Weight of sows, end of 2nd lactation	205	24.7	193	16.8	211	17.7
Weigh gain during lactation, kg	-32	9.2	-26	16.4	-22	8.9
Live born piglets per sow, n	8.0	2.3	8.6	3.1	8.6	3.2
Average litter size, kg	13.6	2.9	14.3	4.9	15.2	6.3
Weight of stillborn piglets, kg	1.7	0.2	1.7	0.1	1.7	0.2
Weaning weights of piglets, kg	8.1	1.1	7.8	1.3	7.7	0.9
Number of piglets weaned, n	8.0	2.3	8.0	2.8	8.4	3.5
Number of days until weaning, d.	33	4.8	33	2.6	31	6.3
Feed intake of the lactating sows, kg	4.6	0.3	4.9	0.4	4.8	0.4
ME intake of the lactating sow, MJ	56.4	4.5	60.0	5.0	58.5	4.8
Lysine intake of the lactating sow, g	43	3.5	45	3.6	44	3.5

The highest lactational weight-loss was seen in the control group during this period. Furthermore, the number of piglets born alive and the litter size were consequently higher in the experimental groups. Feed intake in the control group was slightly lower than in the two treatments.

In case of feeding a corn-soybean meal based diet, the dietary total lysine requirement is 52 g for lactating sows (*Pettigrow* and *Yang*, 1997), thus probably the lysine demand of the lactating sows in this trial was not fully met. However, the energy demand during pregnancy was satisfied as 29.5-37.8 MJ/day ME is recommended for fifth parity pregnant sow between 28th and 112th days of pregnancy (*Peet-Schwering* and *Hartog*, 1997). The mean interval between weaning and mating was longer for sows that had been restricted in their food intake during lactation (*Mullan* and *Williams*, 1989) and similarly in this experiment, the corn silage supplementation with the highest feed-intake was paired by shortest weaning to mating interval. *Matte et al*. (1994) found no correlation between the length of the interval and feeding the pregnant sow with a bulky diet, while *Farmer et al*. (1996) found positive response.

The positive response to the fibrous feed supplementation can be explained by bacterial digestion of the cellulose in the large intestine and the energy derived from that (*Schoknecht*, 1997; *Varel* and *Yen*, 1997; *Fernandez et al*., 1986; *Reese*, 1997). The weight loss of the sows during lactation was about of 10-16% that is considered as a normal rate (*Halas* and *Babinszky*, 2000).

CONCLUSIONS

Most of the investigated parameters, shown in *Table 3* and *4*, have demonstrated that the crude fiber supplementation of the pregnant sows' diets improved the reproductive performance of the sows and increased the feed-intake during lactation, including the energy and the protein intake. The weight-loss of the sows was by 18% (CS) and 31% (WS) less then in the control group in the second experimental period, however, just the opposite tendency was observed in the first period. Feed-intake during lactation was the lowest in the control group and the highest in the group fed with corn silage in both periods. The numbers of piglets born and weaned were significantly higher in the experimental groups, however the weaning weights of piglets were higher in the control group. For these beneficial reasons, the crude fiber content of sows' diets during pregnancy should be increased from the most common 3-5% up to 8-9% (*Fekete* and *Hullár,* 1996*).* Corn silage and wheat straw are recommended for pregnant sows as they have positive effects on sows' performance.

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