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Reproductive Performance, Milk Composition, Blood Metabolites and Hormone Profiles of Lactating Sows Fed Diets with Different Cereal and Fat Sources

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ABSTRACT : Different dietary cereal sources and fat types in the lactation diet were evaluated to investigate their effects on reproductive performance, milk composition, blood metabolites and hormones in multiparous sows. Twenty-four sows were randomly assigned to one of four treatments according to a 2×2 factorial arrangement of treatments. Each treatment had 6 replicates comprising 1 sow. Two cereal (corn or wheat) and two fat (tallow or soybean oil) sources were used to prepare iso-caloric and iso-nitrogenous diets. Sows fed corn-based diets lost less body weight ($p = 0.003$) and backfat thickness ($p = 0.034$), consumed more feed ($p = 0.032$) and had shorter wean-to-estrus interval ($p = 0.016$) than sows fed wheat-based diets. Fewer piglets and lower body weight of piglets ($p<0.05$) at weaning were noted in sows fed wheat-based diets than in sows fed corn-based diets. However, no significant effects ($p>0.05$) of dietary fat source and its interaction with dietary cereal source on sow body condition and reproductive performance were observed during lactation. Feeding of a corn-based diet improved ($p<0.05$) sow milk total solid, protein and fat, increased blood urea nitrogen ($p = 0.032$) and triglyceride ($p = 0.018$), and decreased blood creatinine ($p = 0.011$) concentration at weaning when compared with sows fed wheat-based diets. Sows fed corn-based diets had higher concentration of insulin ($p = 0.048$) and LH ($p<0.05$) at weaning than sows fed wheat-based diets. The results indicate that feeding corn-based diets to lactating sows improved sow body condition and reproductive performance compared with wheat-based diets regardless of fat sources. (**Key Words** : Cereal, Fat, Reproductive Performance, Sow)

INTRODUCTION

Cereal grains (corn and wheat) are the main dietary sources of carbohydrates for humans and animals (Yin et al., 2004). The chemical composition of cereals and cereal by-products includes high levels of starch, which is a major energy source of swine production systems (Huang et al., 2003). Although corn is the most widely utilized energy source in the swine industry, there are many suitable alternatives that can be used to meet the nutritional requirements of swine with the aim of reducing feed cost (Jones et al., 2002). One such alternative is wheat (Myer et al., 1999). Bryant et al. (1985) observed superior breeding and farrowing performance in sows fed corn-based diet than sows fed wheat-based diet, while no differences were detected in the lactation performance of sows fed with either corn or wheat-based diet from early gestation until the end of lactation. Similarly, Nyachoti et al. (2006) also did not notice any difference in sow and piglet performance when sows were fed either corn or wheat-based diet during lactation.

During lactation, weight loss due to fat and protein mobilization is common in sows (McNamara and Pettigrew, 2002). During lactation sows are unable to consume sufficient energy and protein to meet their requirements for maintenance and milk production, resulting in a severe negative energy and nitrogen balance (Parmley and McNamara, 1996). Addition of dietary fat may improve the negative energy balance of lactating sows, and increase milk production or fat content of sow milk (Averette et al., 1999; Tilton et al., 1999; Theil et al., 2004). The effect of feeding high-fat diets to sows during lactation on the growth rate of newborn piglets is inconsistent. Some researchers have reported increased weaning weights in

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response to dietary fat levels (Boyd et al., 1982), whereas others did not observe any effect (Kruse et al., 1977; Coffey et al., 1987). These discrepancies may be due to the variations in the amount of fat and its source as well as the length of feeding supplemental fat in the feed. In non-ruminants, the fatty acid pattern of dietary lipids is reflected in the fatty acid composition of tissues (Mitchaothai et al., 2007). Studies found that feeding tallow or lard increased the percentage of oleic acid, while corn or soybean oil increased the level of linoleic acid of sow milk (Trollerz and Lindberg, 1965; Miller et al., 1971). Therefore, it would be anticipated that the dietary fat type also affects the milk composition of sows.

Diet manipulation is known to have a profound influence on sow performance (Averette et al., 1999). However, choice of cereal grain as well as dietary fat type has received little attention as a factor affecting reproductive performance. Moreover, there is no research on the interaction of dietary grain sources and fat types in sows. Therefore, the present study was conducted to investigate the effects of different dietary fat sources on reproductive performance, milk composition, blood metabolites and hormones in lactating sows fed corn or wheat-based diets.

MATERIALS AND METHODS

Animals, diets and procedures

Twenty four Yorkshire×Landrace multiparous sows (parity: 3-5) were housed in individual stalls (2.10×0.70 m) in an enclosed building. Animals were provided free access to water through nipple waterers throughout the experiment. At the onset of estrus, sows were artificially inseminated with pooled semen from purebred Duroc boars. The Institutional Animal Care and Use Committee of Kangwon National University approved all experimental protocols.

After mating, all sows received an increasing amount (d 0 to 30: 1.8 kg/d; d 30 to 80: 2.2 kg/d; d 80 to 110: 2.8 kg/d) of a commercial gestation diet twice daily (ME: 13.7 MJ/kg; CP: 12.90%; lysine: 0.60%). Other nutrients met or exceeded the nutrient requirements as recommended by NRC (1998).

On d 110 of gestation, sows were moved to an environmentally controlled farrowing room and housed in individual farrowing stalls (2.20×1.65 m) until weaning. The farrowing stalls had a piglet creep area provided with a heat lamp. Sows were weighed and assigned randomly to one of four dietary treatments in a 2×2 factorial arrangement. Each treatment had 6 replicates comprising 1 sow. Iso-caloric and iso-nitrogenous lactation diets containing two different cereals (corn and wheat) and fat (tallow and soybean oil) sources were used. All other nutrients were prepared to meet or exceed the recommendations of NRC (1998). The composition of the experimental diets are listed in Table 1. Diets were formulated to contain 14.1 MJ ME/kg, 17.50% crude protein and 1.15% total lysine. During lactation, feed was provided three times daily. Starting from the day after farrowing, the ration was gradually increased by 1 kg per day until maximum ration was reached (2 kg+0.6 kg per piglet) about 7 days postpartum. Unconsumed feed was weighed daily to determine actual feed intake.

On the morning of weaning (d 21), sows were deprived of feed and moved into gestation stalls. After weaning, sows received their respective lactation diets until the end of estrus. Wean-to-estrus interval detection was monitored daily on 08:30, 15:30 and 22:30 by using boar stimuli. In order to calculate the wean-to-estrus interval, the beginning of the estrus period was characterized as the midpoint between the time of the first observed positive response to back pressure (immobilization reflex) and the previous period of estrus detection. The end of estrus was the midpoint between the time when a negative response to back pressure was first identified and the previous period of estrus detection.

Samples collection and measurements

Samples of experimental diets were collected and analyzed for crude protein, crude fat and calcium by the methods of AOAC (1990). Measurement of live weight and backfat thickness (P_2, 6 cm from the mid line at the head of the last rib) were determined on the day 2 of lactation and weaning. Backfat thickness was measured with an ultrasonic device (Agroscan A16, Angouleme, France). Backfat thickness for the left and right sides was measured, and the average was calculated and recorded. Approximately 20 ml of milk was collected from each sow on day 2 and 10 of lactation to evaluate composition. Samples were collected by infusing the sow with 10 IU of oxytocin via the jugular catheter and then manually milking the third and fourth anterior mammary glands on one side of the sow. Milk samples were immediately frozen at -20°C and analyzed by using an infrared milk analyser (Milko Scan 133B, Analyser; Foss Electric, Hillerød, Denmark). Piglets were not cross-fostered and were counted, and weighed at birth and weaning.

On the 2nd day of lactation and weaning, 5 ml blood samples were collected by jugular venipuncture at 10:00 am 2 h after feeding for the analysis of metabolites and hormones. Blood samples were collected in 10 ml vacutainer (Becton Dickinson Co., Franklin Lakes, NJ, USA) ice-cold tubes, placed on ice and centrifuged at 3,000×g for 20 min at 4°C. Then all serum samples were stored at -20°C until analysis. Multi-type reagents (Arkray Inc., Japan) were used to determine glucose, blood urea nitrogen, triglyceride, and creatinine by an automated

Table 1. Composition of experimental diets for lactating sows

Cereal source	Corn		Wheat	
Fat source	Tallow	Soybean oil	Tallow	Soybean oil
Ingredients (%)				
Corn	57.34	57.34	-	-
Wheat	-	-	68.16	68.16
Wheat bran	5.00	5.00	-	-
Soybean meal (45.0% CP)	25.77	25.77	19.93	19.93
Tallow	5.00	-	5.00	-
Soybean oil	-	5.00	-	5.00
Cane molasses	3.00	3.00	3.00	3.00
L-lysine (50%)	0.28	0.28	0.44	0.44
Choline chloride (50%)	0.05	0.05	0.05	0.05
Dicalcium phosphorus	1.59	1.59	1.47	1.47
Lime stone	1.22	1.22	1.20	1.20
Salt	0.50	0.50	0.50	0.50
Vitamin premix[1]	0.15	0.15	0.15	0.15
Mineral premix[2]	0.10	0.10	0.10	0.10
Chemical composition				
Metabolisable energy (MJ/kg)[3]	14.10	14.10	14.10	14.10
Crude protein (%)[4]	17.62	17.46	17.38	17.42
Crude fat (%)[4]	7.35	7.58	7.22	7.30
Lysine (%)[3]	1.15	1.15	1.15	1.15
Methionine+cysteine (%)[3]	0.59	0.59	0.59	0.59
Starch (%)[3]	36.26	36.26	39.45	39.45
Calcium (%)[4]	1.05	1.07	0.98	1.03
Available phosphorus (%)[3]	0.35	0.35	0.35	0.35

[1] Supplied per kg of diet: 7,500 IU vitamin A; 1,500 IU vitamin D_3; 45 IU vitamin E; 1.50 mg vitamin K; 0.75 mg vitamin B_1; 3.75 mg vitamin. B_2; 2.25 vitamin B_6; 0.015 mg vitamin B_{12}; 11.25 mg pantothenic; 15.00 mg niacin; 0.188 mg biotin; 1.50 mg folic acid.
[2] Supplied per kg of diet: 80 mg Fe; 8.50 mg Cu; 40 mg Mn; 12.50 mg Zn; 0.10 mg I; 0.20 mg Se.
[3] Calculated values. [4] Analyzed values.

chemistry analyzer (Spotchem EZ SP-4430, Arkray, Saitama, Japan). Swine insulin, follicle-stimulating hormone (FSH) and luteinizing hormone (LH) kits (Endocrine Technologies Inc., Netwark, California, USA) were used and their concentrations were determined in duplicate according to manufacturers instructions by ELISA using Biolog MicroStation system (Biolog Inc., Hayward, California, USA). The minimal detectable concentrations of insulin, LH and FSH were 0.5, 0.1 and 0.5 ng/ml, respectively. Intra- and interassay coefficient of variation for insulin, LH and FSH were 3.23 and 12.02, 3.31 and 16.36, 3.83 and 13.22%, respectively.

Statistical analysis

Statistical analysis was conducted by using the General Linear Model (GLM) procedure of SAS (SAS Institute, 1996) with a 2×2 factorial design contrast. The factorial treatment arrangement consisted of two dietary fat sources and two cereal sources. The treatments were the main effects and the individual sow and litter measurements were considered the experimental unit. To test the effects of dietary fat and cereal sources, the following model was used: $Y_{ijk} = \mu+\alpha_i+\beta_j+\alpha\beta_{ij}+\varepsilon_{ijk}$, where Y_{ijk} = the dependent variable; μ = overall mean; α_i = effect of dietary cereal sources (i = corn, wheat); β_j = effect of dietary fat sources (i = tallow, soybean oil); $\alpha\beta_{ij}$ = interaction effect of cereal and fat sources and ε_{ijk} = residual error. In the analysis of litter size, body weight, litter growth rate and average daily gain of pigs, the number of live-born pigs was included into the statistical model as a covariate. The p-values compared the differences between dietary cereal sources, fat sources, and their interaction. All statements of significance were based on probability at $p<0.05$.

RESULTS

Sow body condition

During lactation, the body weight (p = 0.027) and backfat thickness (p = 0.011) at weaning were lower, and loss in body weights (p = 0.003) and backfat thickness (p =

Table 2. Effect of dietary fat and cereal sources on the body condition and feed intake of lactating sows

Cereal source	Corn		Wheat		SEM[1]	p-value[2]		
Fat source	Tallow	Soybean oil	Tallow	Soybean oil		Cereal	Fat	Cereal×fat
Body weight (kg)								
Day 2 of lactation	255	256	253	252	1.78	0.429	0.924	0.846
Weaning	237	238	229	228	2.07	0.027	0.969	0.826
Change	-18.1	-18.2	-24.0	-24.3	1.04	0.003	0.899	0.937
Backfat thickness (mm)								
Day 2 of lactation	22.4	22.3	22.4	22.2	0.10	0.914	0.582	0.963
Weaning	19.3	19.2	18.6	18.7	0.12	0.011	0.832	0.740
Change	-3.0	-3.1	-3.7	-3.6	0.14	0.034	0.786	0.753
Feed intake (kg/d)	6.9	7.0	6.7	6.6	0.06	0.032	0.989	0.593

[1] SEM = Standard error of the mean.

[2] Probabilities definitions are: Cereal = Main effect of cereal sources, Fat = Main effect of fat sources, Cereal×fat = Cereal×fat source interaction.

0.034) were greater in sows fed wheat-based diets (Table 2). Sows fed corn-based diets consumed more feed (p = 0.032) when compared with sows fed wheat-based diets. However, the dietary fat sources had no effect on sow body condition.

Reproductive performance

The litter size and litter body weight at birth were not affected by the dietary treatments (p>0.05; Table 3). However, litter size (p = 0.031) and litter body weight (p = 0.020) at weaning were greater in piglets nursed by sows fed corn-based diets. Over the 21 d lactation, litters of sows fed corn-based diets grew 18.9% faster (2.20 vs. 1.85 kg/d; p = 0.003) than litters of sows fed wheat-based diets. Also the average daily gain per pig in sows fed corn-based diets was higher (238 vs. 229 g/pig; p = 0.012) when compared with sows fed wheat-based diets. In addition, feeding of corn-based diets significantly shortened (p = 0.016) the wean-to-estrus interval in sows. However, there was no effect (p>0.05) of dietary fat sources or cereal×fat interaction on reproductive performance during lactation.

Milk composition

The composition of colostrum and milk as affected by different dietary cereal and fat sources are presented in Table 4. Dietary cereal and fat sources had no effect on the composition of colostrum. However, higher concentrations of total solid (p = 0.018), protein (p = 0.045) and fat (p = 0.017) in milk were noticed in sows fed corn-based diet. The dietary fat sources did not influence the milk composition and there was no cereal×fat sources interaction on the composition of colostrum and milk.

Blood metabolites

The concentrations of serum metabolites were similar (p>0.05) at the day 2 of lactation (Table 5). Higher concentration of blood urea nitrogen (p = 0.032), and triglyceride (p = 0.018) and lower creatinine (p = 0.011) concentration were observed in sows fed corn-based diets at weaning. Dietary fat sources had no effect on the concentrations of blood metabolites, and no cereal×fat interaction effect (p>0.05) was noted at day 2 of lactation and weaning.

Table 3. Effect of dietary fat and cereal sources on the reproductive performance of lactating sows

Cereal source	Corn		Wheat		SEM[1]	p-value[2]		
Fat source	Tallow	Soybean oil	Tallow	Soybean oil		Cereal	Fat	Cereal×fat
Litter size								
Total born	11.7	11.5	11.3	11.5	0.28	0.785	1.000	0.785
Born alive	10.2	9.3	9.8	9.2	0.34	0.830	0.202	0.940
Weaning	9.2	9.2	8.0	8.2	0.25	0.031	0.853	0.943
Litter body weight (kg)								
Birth	13.0	12.9	13.0	12.8	0.57	0.893	0.914	0.808
Weaning	65.2	65.3	56.8	57.6	1.72	0.020	0.883	0.991
Litter growth rate (kg/d)	2.2	2.2	1.8	1.9	0.06	0.003	0.801	0.929
Average daily gain (g/pig)	237	239	229	229	2.10	0.012	0.781	0.971
Wean-to-estrus interval (d)	4.1	4.3	5.1	5.2	0.20	0.016	0.962	0.972

[1] SEM = Standard error of the mean.

[2] Probabilities definitions are: Cereal = Main effect of cereal sources, Fat = Main effect of fat sources, Cereal×fat = Cereal×fat source interaction.

Table 4. Effect of dietary fat and cereal sources on colostrum and milk composition of lactating sows

Cereal source	Corn		Wheat		SEM[1]	p-value[2]		
Fat source	Tallow	Soybean oil	Tallow	Soybean oil		Cereal	Fat	Cereal×fat
Colostrum (g/kg)								
Total solid	240.6	241.3	242.6	241.8	0.86	0.494	0.982	0.706
Protein	142.2	142.5	142.6	142.6	0.87	0.880	0.951	0.929
Fat	54.8	55.1	55.7	55.1	0.14	0.145	0.704	0.222
Lactose	34.8	35.0	35.5	35.3	0.24	0.466	1.000	0.819
Solid-non-fat	185.8	186.2	186.9	186.7	0.83	0.657	0.963	0.860
Milk (g/kg)								
Total solid	206.6	205.7	193.9	188.4	3.17	0.018	0.589	0.699
Protein	57.8	59.0	53.5	52.9	1.27	0.045	0.912	0.729
Fat	77.0	75.6	70.0	70.5	1.26	0.017	0.840	0.684
Lactose	63.0	62.4	61.7	56.3	2.87	0.544	0.622	0.696
Solid-non-fat	129.7	130.2	124.0	118.0	2.56	0.090	0.591	0.524

[1] SEM = Standard error of the mean.

[2] Probabilities definitions are: Cereal = Main effect of cereal sources, Fat = Main effect of fat sources, Cereal×fat = Cereal×fat source interaction.

Hormone profiles

The concentration of blood hormones as affected by dietary fat and cereal sources are presented in Table 6. The concentration of insulin and LH at day 2 of lactation, and FSH concentration at day 2 of lactation and weaning were not affected ($p>0.05$) by dietary fat or cereal sources. However, higher concentration of insulin ($p = 0.048$) and LH ($p = 0.006$) were noticed in sows fed corn-based diets at weaning.

DISCUSSION

The results of sow body condition and reproductive performance indicated that both sources of fat (tallow and soybean oil) had the identical effect as energy sources for use in sow diets, while corn-based diet was superior to wheat-based diet in improving sow body condition and litter performance. Sows fed corn-based diet lost less body weight and backfat than sows fed wheat-based diet during lactation, which might be due to the relative higher nutrients digestibility of corn than that of wheat although the diets were formulated to be iso-caloric and iso-nitrogenous (Lin et al., 1987; Rapp et al., 2001). Although, the apparent nutrient digestibility was not determined in our study, in a previous study, Nyachoti et al. (2006) had reported higher apparent total tract digestibilities of dry matter, nitrogen and energy in sows fed corn-based diets than sows fed wheat-based diets, while no differences were observed on the litter performance during lactation. In contrast with the findings of the present study, Bryant et al. (1985) had noted similar reproductive performance of lactating sows fed with corn or wheat-based diets. Sows that had greater weight and backfat losses during lactation experienced a higher incidence of delayed estrus following weaning than sows with less body weight and backfat loss. Lower feed intake in sows offered wheat-based diets might have resulted in shortage of

Table 5. Effect of dietary fat and cereal sources on blood metabolites of lactating sows

Cereal source	Corn		Wheat		SEM[1]	p-value[2]		
Fat source	Tallow	Soybean oil	Tallow	Soybean oil		Cereal	Fat	Cereal×fat
Day 2 of lactation (mg/dl)								
Blood urea nitrogen	16.1	16.1	16.2	16.2	0.11	0.904	0.942	0.981
Glucose	90.4	90.7	90.5	90.4	0.39	0.908	0.887	0.841
Triglyceride	54.4	54.5	54.7	54.5	0.60	0.923	0.987	0.876
Creatinine	2.1	2.1	2.1	2.2	0.02	0.502	0.373	0.974
Weaning (mg/dl)								
Blood urea nitrogen	17.5	17.4	16.9	16.7	0.15	0.032	0.717	0.784
Glucose	88.1	88.6	88.0	88.2	0.58	0.866	0.792	0.899
Triglyceride	31.6	31.8	29.1	29.9	0.46	0.018	0.541	0.716
Creatinine	1.7	1.8	1.9	1.9	0.03	0.011	0.689	0.279

[1] SEM = Standard error of the mean.

[2] Probabilities definitions are: Cereal = Main effect of cereal sources, Fat = Main effect of fat sources, Cereal×fat = cereal×fat source interaction.

Table 6. Effect of dietary fat and cereal sources on hormone profiles in lactating sows

Cereal source	Corn		Wheat		SEM[1]	p-value[2]		
Fat source	Tallow	Soybean oil	Tallow	Soybean oil		Cereal	Fat	Cereal×fat
Day 2 of lactation								
Insulin (μIU/ml)	23.31	23.35	23.26	23.30	0.191	0.914	0.923	0.994
FSH (ng/ml)	1.88	1.90	1.87	1.86	0.023	0.629	0.987	0.802
LH (ng/ml)	0.43	0.45	0.42	0.44	0.008	0.686	0.273	0.919
Weaning								
Insulin (μIU/ml)	16.76	16.61	16.23	16.26	0.109	0.048	0.756	0.675
FSH (ng/ml)	2.88	2.87	2.88	2.85	0.025	0.804	0.664	0.926
LH (ng/ml)	0.63	0.62	0.58	0.59	0.007	0.006	1.000	0.195

[1] SEM = Standard error of the mean.

[2] Probabilities definitions are: Cereal = Main effect of cereal sources, Fat = Main effect of fat sources, Cereal×fat = Cereal×fat source interaction.

nutrients required for milk production and consequently greater body fat reserves might have been mobilized (Noblet et al., 1998).

Different factors related to the type of fat used in sow diets may affect performance. Vegetable oils have higher apparent digestibility than animal fat sources (Jones et al., 1992) due to the higher proportion of unsaturated fatty acids (Freeman, 1969). In the present study, the different dietary fat sources had no effect on sow body conditions and litter performance, which might be due to the same amount of fat included in the diets. In agreement with the findings of the present study, Babinszky et al. (1992) did not notice any effect of adding 5% sunflower oil or animal fats to the diets of lactating sows on the litter size and live weight of piglets during suckling.

The gross milk composition was influenced by the dietary cereal sources. The sows fed corn-based diets had greater concentration of total solid, protein and fat than those fed wheat-based diets. The higher nutrient digestibility of corn than wheat, especially in energy utilization (Nyachoti et al., 2006), might have contributed to the difference in the milk composition. More energy could be utilized for sows fed corn-based diets, which resulted in improved milk composition when compared with sows fed wheat-based diets. These improved milk composition were associated with the greater litter performance of sows fed corn-based diet during lactation. Similarly, Yang et al. (2008) observed increased concentrations of milk fat in sows fed high energy diets (14.2 MJ ME/kg) as compared with low energy diets (13.7 MJ ME/kg).

The quantity of nutrients absorbed from the intestine largely determines the concentrations of circulating metabolites (van den Brand et al., 1998). Over time, the metabolic state affects the amount of protein and fat reserves accumulated, and thus the body weight and composition (King and Williams, 1984). When energy intake is inadequate, proteins can serve as an energy source (Park et al., 2008). An elevation of serum creatinine concentration is often used as an index of muscle catabolism, and when lactating sows are fed nutrients below the requirement, especially for energy and protein, body protein tissue is catabolized in an attempt to supply the nutrients to maintain milk production (Etienne et al., 1985). In the present study, the concentration of creatinine in blood was higher in sows fed wheat-based diets than sows fed corn-based diets at weaning, which indicated that muscle breakdown was higher in sows fed wheat-based diets during lactation. Blood triglycerides and urea nitrogen arise largely through digestion and absorption of fatty acids and protein present in the diet (Heo et al., 2008). It could be speculated that higher blood triglycerides could be used as energy fuel and urine nitrogen could be used as protein sources for the milk synthesis in the corn-based diets, and therefore contributed to the lower loss of body weight and backfat thickness, and better reproductive performance. Noblet et al. (1998) and Everts (1998) have also demonstrated the positive relationship between the concentrations of blood metabolites and performance of lactating sow.

Nutritional manipulation can modulate endocrinology of reproduction in lactating sows (Barb et al., 2001; Kauffold et al., 2008). In the present study, different dietary fat or cereal sources had no significant effect on insulin, FSH and LH profiles at day 2 of lactation. It seems unlikely that the variations in dietary cereal or fat intake within short period of feeding could change hormone profiles. van den Brand et al. (1998) observed enhanced plasma insulin concentration during 4.5 h after feeding different energy sources in gilts, while Koketsu et al. (1998) found no differences in insulin concentration in primiparous sows fed at different feeding levels. At weaning, the concentration of FSH was still unaffected, while the concentration of insulin and LH were higher in sows fed corn-based diets. Previous studies have suggested that the increased body weight loss during lactation is associated with a lower LH concentration (Kemp, 1998; van den Brand et al., 2000). In the present experiment, sows fed wheat-based diets had a greater body weight and backfat loss, which might have contributed to the lower LH circulating in blood. The more negative energy balance during lactation seems to depress the generation of an effective LH signal by the hypothalamus-pituitary axis during and after lactation (Tokach et al., 1992). The reduced LH concentrations are also reflected in the delayed wean-to-estrus interval in sows fed wheat-based diets. Previous studies by Kemp et al. (1995) and Zak et al. (1998) had observed high LH concentrations at weaning in sows with high energy intake.

Thus, the results of this study suggest that feeding of corn-based diets during lactation could improve sow body condition, reproductive performance and reduce the wean-to-estrus interval. However, the dietary fat sources (tallow vs. soybean oil) did not influence any of the measured variables and there was no interaction effect between dietary cereal and fat sources on any variable.

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