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Increasing food intake in late gestation improved sow condition throughout lactation but did not affect piglet viability or growth rate

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Abstract

Increasing sow food intake in late gestation prevents loss of sow fatness prior to farrowing. However, this may result in reduced food intake and greater overall fat loss during lactation and has also been associated with increased incidence of agalactia. In this experiment 78 Camborough sows (parities 1 to 3) were given food at one of two levels: either 1·15 × maintenance energy (normal-N sows, 2·3 (s.e. 0·03) kg/day) or 2·00 × maintenance energy (high-H sows, 3·9 (s.e. 0·04) kg/day) from day 100 of gestation until farrowing. Lactation food intake, changes in sow live weight and backfat thickness and piglet growth rates were then measured. Diet digestibility in early lactation was measured using a chromium III oxide marker in the food. There was no change in backfat thickness in late gestation in H sows (0·2 (s.e. 0·25) mm), whereas N sows lost backfat during this period (1·6 (s.e. 0·23) mm, $P < 0{\cdot}001$*). There was no difference in lactation food intake between the two groups (6·5 (s.e. 0·13) kg/day) and differences in backfat thickness at parturition were maintained through to weaning. H sows did not show increased incidence of agalactia compared with N sows. There was no difference in diet digestibility between the two treatment groups. Food intake level in late gestation did not affect piglet birth weights, growth rates or mortality. It is concluded that the main benefit of increasing sow food intake in late gestation was to reduce sow backfat loss during the reproductive cycle.*

Keywords: *food intake, lactation, pregnancy, sows.*

Introduction

Elsley *et al*. (1971) demonstrated that the pattern of feeding during gestation had no effect on sow or piglet performance and it therefore became conventional to feed sows at a flat rate throughout gestation. However, more recent work suggests that there may be crucial periods during gestation when food intake may have profound effects on sow and litter performance (e.g. Pharazyn *et al*., 1991; Dwyer, 1994). Sows which do not receive an increased food allowance in late gestation will become catabolic and lose body reserves, primarily fat, in the last 2 to 3 weeks of pregnancy (Cole, 1990). This is the period of maximum foetal growth and therefore when the nutrient requirements of the pregnant sow are greatest. However, efforts to increase piglet birth weight by increasing sow food intake during this period have had little success (Hillyer and Phillips, 1980; Sterling and Cline, 1986). Cromwell *et al*. (1989) did find that sows receiving increased food intake in late gestation gave birth to larger litters of heavier birth weight piglets with subsequently higher weaning weights but these effects only became significant after sows had received increased food intake in late gestation for at least two consecutive parities. Therefore it is possible that this is a long-term effect mediated through improved body condition of the sow rather than an immediate effect of maternal nutrition in late gestation on the developing foetus. It has frequently been demonstrated that increasing sow food intake in gestation reduces food intake in lactation (e.g. Salmon-Legagneur and Rerat, 1962; Mullan and Williams, 1989). However, a short period of increased feeding at a time when sows would otherwise be catabolic may not have a detrimental effect on lactation food intake. Rather it might be expected that higher feeding levels in late gestation could better prepare the digestive system of the sow for high food intakes during lactation. Increasing diet bulkiness in gestation has been shown to increase lactation food intake (Matte *et al*., 1994; Farmer *et al*., 1996) through up-regulation of the sow digestive system. However, increasing food intake in late gestation may also increase the incidence of agalactia (Persson *et al.*, 1989). It has been suggested that nutritional deprivation in early lactation can affect the fertility of the sow after weaning (Tokach, 1991; Koketsu, 1994). If sows enter lactation in a catabolic state as the result of receiving a constant daily allowance throughout gestation this may also have negative effects on subsequent sow fertility. Follicles which ovulate after weaning may first emerge from the primordial pool of follicles during late gestation so that the metabolic state of the sow during this period may affect the integrity of the emerging follicles (Foxcroft *et al.*, 1995) and hence subsequent fertility. Based on the literature reviewed we hypothesized that increasing the feeding level of sows from day 100 of gestation would: prevent sow fat loss in late gestation; not increase piglet birth weight; increase the incidence of agalactia; increase food intake and food digestibility in early lactation; and improve subsequent reproductive performance. In this experiment we chose to increase food intake from day 100 onwards because this is the period during which the sow becomes catabolic (Cole, 1990). Increasing sow intake for longer than this might reduce her food intake during lactation.

Material and methods

All procedures used in this experiment were approved by the University of Alberta Animal Care Committee to ensure adherence to Canadian Council of Animal Care Guidelines.

Seventy-eight Camborough sows (Pig Improvement (Canada) Ltd, Acme, AB, Canada), parities 1 to 3, were given food at 1·15 × maintenance energy levels until day 100 of gestation. From day 100 of gestation until farrowing sows were randomly allocated within parity either: to remain on a normal food intake (1·15 × maintenance energy-N sows), or to receive a high food intake (twice maintenance energy-H sows).

Maintenance requirement was assumed to be 460 kJ digestible energy (DE) per kg body weight$^{0·75}$ (National Research Council, 1988). Sows that remained in the trial for more than one parity were assigned to alternate treatments in successive parities, giving a total of 117 sow records but this led to unequal numbers of sows on each treatment. The allocation of sows to treatment is shown in Table 1. The daily allowance was offered once daily at 08:00 h. The gestation diet contained (per kg) 12·6 MJ DE, 137 g crude protein and 5·6 g lysine. During gestation the sows were housed in individual stalls at a room temperature of 20°C ± 2°C. On day 109 of gestation sows were moved into individual farrowing crates. Farrowing stalls were totally slatted and had covered creep areas containing heat lamps and plastic curtains. Room temperature was maintained at 18°C ± 2°C. After farrowing all sows were given *ad libitum* throughout a 25 (s.e. 0·3) day lactation period a diet containing (per kg) 13·7 MJ DE, 154 g crude protein and 7·4 g lysine. Dry food was available to the sows at all times. Food refusals were weighed back every morning and fresh food weighed into the trough morning and evening. Individual food intake was recorded daily. Sows had access to water at all times.

Table 1 *Distribution of sows from different parities to high or normal food intakes in late gestation*

Food intake level	Parity			Total
	1	2	3	
Normal	27	19	17	63
High	20	21	13	54
Total	47	40	30	117

All sows were weighed on day 98 of gestation, within 24 h of farrowing and at weaning. Backfat was measured on each of these days using an ultrasonic probe (Scanoprobe 11, Scanco, Ithaca, NY) at the last rib and 65 mm from the mid line (P2).

Litter size was standardized across treatments within 24 h of parturition. On the day of birth, piglets received an iron supplement, their teeth and tails were clipped and their ears were notched. Male piglets were castrated at 7 days of age. Piglets were weighed within 6 h of birth and then at 1, 2, 6 and 20 days of age and at weaning. Piglets had access to creep food from 20 days of age and to water at all times. Intake of creep food was not recorded.

Digestibility trial

Diet digestibility was measured using a chromium III oxide marker in 28 sows (13 H sows (two of parity 1, seven of parity 2 and four of parity 3) and 15 N sows (three of parity 1, six of parity 2 and six of parity 3)) over two periods between days 95 and 100 of gestation and days 2 to 7 of lactation. Chromium III oxide was thoroughly mixed into diets at a level of 5·0 g/kg. Sows received the chromium III oxide supplemented diets from day 90 of gestation until day 7 of lactation. Housing and management were otherwise the same as for all other sows on this experiment. Faecal samples were collected *per rectum* twice daily from each sow during each collection period. Faecal samples were frozen immediately after collection and stored at –20ºC until they were freeze-dried. Representative food samples were taken for each period. Food samples and freeze dried faecal samples were ground through a 1-mm sieve. Faecal samples were bulked together for each sow for days 95 to 100 of gestation, days 2 to 4 of lactation and days 5 to 7 of lactation. Food samples and bulked faecal samples were then analysed for chromium III oxide (Fenton and Fenton, 1979), dry matter and gross energy (Association of Official Analytical Chemists, 1990). Nitrogen content was analysed using an FP-428 Nitrogen Determinator, System: 601-700-900 (LECO Corporation, St Joseph, Michigan).

Digestibility measurements made between days 95 and 100 of gestation i.e. before the H *v.* N food intake treatments began, provided a base line for each sow so that each was its own control. Those made in early lactation were used to estimate the residual effect of high level feeding in late gestation on digestibility in the post-parturient period.

Statistical analyses
Data for sow food intake, live weight (LW), fatness, changes in LW and fatness, pre-treatment digestibility, piglet number, LW and growth rate were analysed using analyses of variance. Sources of variation were treatment (H or N food intake during the last 2 weeks of gestation), parity (P = 1, 2, or 3) and interactions between treatment and parity and sow within treatment × parity (error term). Although some sows were studied over more than one parity they were considered as different individuals in each parity. Preliminary analyses indicated no significant treatment × parity interactions and therefore only main effect least-square means are presented. Comparisons among parity least-square means were made using Fisher's protected least significant difference (Ott, 1992). All computations were made using the MANOVA operation of SYSTAT (Wilkinson, 1990).

Data for digestibility during period 1 and period 2 of lactation were analysed using analyses of variance with sources of whole plot variation of replicate (r = 1, 2, 3 or 4), treatment (food intake in late gestation), parity (P = 1, 2 or 3), treatment × parity, covariate of pre-treatment digestibility, sow within replicate × treatment × parity (error term), split plot variation of the periods (pd = 1 or 2) and period × food intake, period × parity and period × treatment × parity interactions.

Initial analyses established few treatment differences and therefore step-wise multiple regressions across the complete data set were used to study relationships between chosen parameters (Wilkinson, 1990).

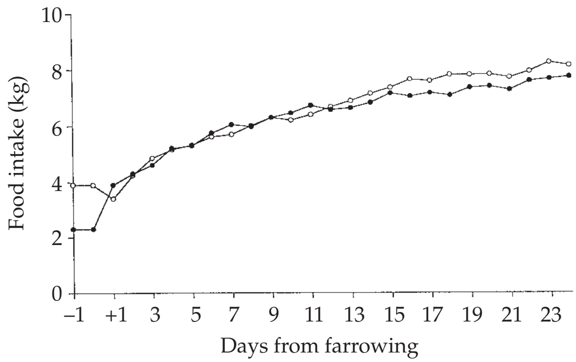

Figure 1 Lactation food intake of sows given high (❍) or normal (●) food intakes in late gestation.

Results

There were no significant interactions between treatment and parity for any of the variables measured in this experiment.

Daily food intakes of H and N sows during late gestation and lactation are illustrated in Figure 1. From day 100 of gestation until farrowing mean daily intakes of H and N sows were 3·9 (s.e. 0·04) and 2·3 (s.e. 0·03) kg/day, respectively ($P < 0{\cdot}001$). There was no difference in total lactation food intake between the two treatment groups (6·5 (s.e. 0·13) kg/day). H sows tended to eat less food than N sows on the 1st day of lactation, 3·3 *v.* 4·0 kg respectively ($P = 0{\cdot}08$). Food intake increased throughout lactation with sows averaging 5·1 (s.e. 0·16) kg/day in week 1, 6·6 (s.e. 0·20) kg/day in week 2 and 7·5 (s.e. 0·20) kg/day in week 3 of lactation.

Parity 2 and 3 sows ate more than parity 1 sows throughout lactation ($P < 0{\cdot}001$), 7·1 (s.e. 0·21) kg/day *v.* 5·6 (s.e. 0·17) kg/day overall, respectively, although this effect was least on day 1 of lactation when food intake of parity 3 sows was not significantly greater than that of parity 1 sows. Patterns of food intake throughout lactation were similar for all three parities.

Multiple regression analysis of food intake data produced the following equation:

$$\begin{aligned}&\text{food intake during lactation (kg/day)}\\&= 5{\cdot}29\ (\text{s.e. } 0{\cdot}651) + 0{\cdot}88P\ (\text{s.e. } 0{\cdot}167)\\&- 0{\cdot}08\ B_f\ (\text{s.e. } 0{\cdot}029) + 0{\cdot}56\ LITWG_{20}\ (\text{s.e. } 0{\cdot}233)\\&(R^2 = 0{\cdot}383,\ P < 0{\cdot}001)\end{aligned} \tag{1}$$

where P = parity; B_f = P2 backfat thickness at farrowing (mm); $LITWG_{20}$ = average daily litter live-weight gain (kg) to day 20.

Litter-weight gain was used as a measure of milk production since it has been demonstrated that there is a strong relationship between milk production and litter gain (e.g. Noblet *et al.*, 1990).

Equation 1 shows that mean daily food intake during lactation increased with increasing sow parity and litter weight gain (increased milk production) and decreased with increasing sow fatness. Parity was a better predictor of food intake than sow live weight. Sow backfat thickness at farrowing affected mean daily feed intake ($P < 0{\cdot}01$) in addition to the effect of parity but its influence on actual food intake was small, food intake declining by only 85 g/day for an increase of 1 mm in sow backfat thickness at farrowing. Food intake from day 100 of gestation to farrowing was not a predictor of average daily food intake throughout the lactation period.

When regressions were computed for food intake in each of the first 3 weeks of lactation it was found that litter growth rate, an indicator of milk production, became significantly correlated with food intake as lactation progressed and that sow fatness was no longer correlated with food intake by week 3. Parity was an important determinant of food intake in all weeks of lactation. Level of feeding from day 100 of gestation to farrowing affected food intake in week 3 of lactation. Increases of 1 kg/day in food intake from day 100 of gestation until farrowing resulted in a corresponding increase in food intake of 0·34 kg/day in week 3 of lactation:

$$\text{food intake during week 1 of lactation (kg/day)} = 4{\cdot}76 \text{ (s.e. } 0{\cdot}476) + 0{\cdot}87P \text{ (s.e. } 0{\cdot}153) - 0{\cdot}08B_f \text{ (s.e. } 0{\cdot}026) \quad (R^2 = 0{\cdot}241, P < 0{\cdot}001) \tag{2}$$

$$\text{food intake during week 2 of lactation (kg/day)} = 5{\cdot}17 \text{ (s.e. } 0{\cdot}644) + 0{\cdot}80P \text{ (s.e. } 0{\cdot}198) - 0{\cdot}08B_f \text{ (s.e. } 0{\cdot}031) + 0{\cdot}77LITWG \text{ (s.e. } 0{\cdot}218) \quad (R^2 = 0{\cdot}315, P < 0{\cdot}001) \tag{3}$$

$$\text{food intake during week 3 of lactation (kg/day)} = 5{\cdot}54 \text{ (s.e. } 1{\cdot}220) + 1{\cdot}10P \text{ (s.e. } 0{\cdot}333) - 0{\cdot}02LWT_f \text{ (s.e. } 0{\cdot}008) + 0{\cdot}99LITWG \text{ (s.e. } 0{\cdot}278) + 0{\cdot}34GFI \text{ (s.e. } 0{\cdot}178) \quad (R^2 = 0{\cdot}380, P < 0{\cdot}001) \tag{4}$$

where LWT_f = live weight at farrowing (kg); LITWG = litter live-weight gain for respective week (kg); GFI = sow food intake from day 100 of gestation until farrowing (kg/day)

Changes in live weight and backfat

At the start of the experiment (day 98 of gestation) there was no difference in live weight or backfat between the two treatment groups (mean live weight was 206·0 (s.d. 2·98) kg and mean P2 backfat thickness was 19·4 (s.d. 0·44) mm). N sows lost an average of 3·9 kg live weight and 1·6 mm backfat between day 98 and farrowing, whilst H sows gained 3·9 kg live weight and 0·2 mm backfat ($P < 0{\cdot}001$, Table 2).

Table 2 *Changes in live weight (LW) and backfat thickness† during late gestation and lactation in sows given high or normal food intakes in late gestation*

	High		Normal	
	Mean	s.e.	Mean	s.e.
LW at day 98 (kg)	202·9	2·44	208·7	2·21
P2 backfat at day 98 (mm)	19·2	0·62	19·5	0·57
LW gain: breeding to day 98 (kg)	53·4	2·12	55·0	1·96
Farrowing LW (kg)	207·8	2·96	205·2	2·75
Farrowing P2 (mm)	19·5	0·63	18·0	0·58
LW gain: breeding to farrowing (kg)	57·6	2·47	51·2‡	2·30
LW gain: day 98 to farrowing (kg)	3·9	1·44	–3·9***	1·39
P2 backfat gain: day 98 to farrowing (mm)	0·2	0·25	–1·6***	0·23
LW gain: farrowing to weaning (kg)	–8·5	2·17	–3·1§	2·05
P2 gain: farrowing to weaning (mm)	–2·7	0·29	–2·2	0·27
LW gain: day 98 to weaning (kg)	–4·2	2·55	–7·4	2·38
P2 gain: day 98 to weaning (mm)	–2·6	0·39	–3·8*	0·36

† P2 gain = gain in P2 backfat thickness.
‡ $P = 0{\cdot}058$.
§ $P = 0{\cdot}075$.

Sows from both treatments lost similar amounts of backfat during lactation so that from day 98 to weaning H sows lost an average of 1·2 mm less fat than N sows ($P < 0{\cdot}05$). H sows tended to lose more weight during lactation than N sows ($P = 0{\cdot}075$) so that overall live-weight loss between day 98 of gestation and weaning was similar for both treatments (Table 2).

Piglet performance

Piglet birth weight was not affected by food intake in late gestation and there were no significant differences in any other aspect of piglet performance between the two treatment groups (see Table 3). Sows produced an average of 11·1 (s.e. 0·27) piglets per litter of which 0·7 (s.e. 0·12) were stillborn. After cross-fostering to balance litter size, sows had an average of 9·4 (s.e. 0·17) piglets. Weight gain in the

Table 3 *Piglet performance data for sows given high or normal food intakes in late gestation*

	High		Normal	
	Mean	s.e.	Mean	s.e.
Total born	11·2	0·40	11·1	0·37
Stillborn	0·8	0·18	0·6	0·16
Weight of litter at birth (kg)	16·5	0·56	16·4	0·51
Birth weight of liveborn piglets (kg)	1·53	0·035	1·52	0·032
Weight gain in first 2 days of life (kg)	0·22	0·028	0·23	0·026
Litter size after cross-fostering	9·6	0·27	9·3	0·25
Live-weight gain to 7 days of age (kg)	1·16	0·060	1·15	0·055
Daily piglet live-weight gain to 20 days (kg/day)	0·243	0·008	0·244	0·008
No. of piglets weaned	8·6	0·298	8·4	0·266
Mean piglet weight at weaning (kg)	7·9	0·19	8·0	0·16
Daily piglet live-weight gain to weaning (kg/day)	0·256	0·006	0·257	0·005
Mortality	13·7	2·10	17·0	1·93

first 2 days of life averaged 113 (s.e. 9·0) g/day per piglet, 244 (s.e. 4·2) g/day over the first 20 days and 257 (s.e. 5·1) g/day from birth to weaning. Sows weaned an average of 8·5 (s.e. 0·19) piglets with a mean weight of 7·9 (s.e. 0·14) kg.

There was no clinical incidence of agalactia in this experiment. Nine sows had litters which averaged zero or negative weight gains in the first two days of life: of these, five were H sows (two parity 1, one parity 2 and two parity 3) and the remaining four were N sows (two parity 1, one parity 2 and one parity 3). These sows were not characterized by low food intake, high temperature or poor subsequent litter growth rates.

Table 4 *Diet digestibility in early lactation for sows given high or normal food intakes in late gestation*

	High		Normal	
Digestibility	Mean	s.e.	Mean	s.e.
Dry matter				
Pre-treatment (late gestation)	0·789	0·0048	0·787	0·0042
Days 2-4 of lactation	0·784	0·0076	0·773	0·0067
Days 5-7 of lactation	0·778	0·0066	0·765	0·0058
Crude protein				
Pre-treatment (late gestation)	0·772	0·0073	0·776	0·0064
Days 2-4 of lactation	0·812	0·0088	0·793	0·0080
Days 5-7 of lactation	0·806	0·0086	0·785	0·0078
Energy				
Pre-treatment (late gestation)	0·793	0·0052	0·790	0·0046
Days 2-4 of lactation	0·785	0·0083	0·776	0·0073
Days 5-7 of lactation	0·780	0·0072	0·769	0·0064

Digestibility

Diet digestibility for H and N sows are shown in Table 4. There was no difference in digestibility between treatment groups either during the pre-treatment period or during early lactation.

Dry-matter digestibility averaged 0·780 (s.e. 0·42) between days 2 and 4 of lactation and 0·768 (s.e. 0·45) between days 5 and 7 of lactation. Corresponding digestibility coefficients over the same time periods were 0·804 (s.e. 0·61) and 0·788 (s.e. 0·68) for crude protein and 0·782 (s.e. 0·46) and 0·770 (s.e. 0·48) for energy. There was no difference in digestibility between the two time periods.

Subsequent reproductive performance

There was no difference in the subsequent reproductive performance of sows regardless of how they were given food in late gestation (Table 5). Sows gave birth to an average of 12·3 (s.e. 0·32) piglets in their next litter following an average weaning to oestrus interval of 5·4 (s.e. 0·47) days. There was also no difference in weaning to oestrus interval between parities (Table 6). Subsequent litter size of parity 1

Table 5 *Subsequent reproductive performance of sows given high or normal food intakes in late gestation*

	High		Normal	
	Mean	s.e.	Mean	s.e.
Weaning to oestrus interval (days)	5·3	0·94	6·9	0·88
Subsequent litter size	12·2	0·51	12·4	0·45

Table 6 *Subsequent reproductive performance of sows of parities one, two and three*

	Parity					
	1		2		3	
	Mean	s.e.	Mean	s.e.	Mean	s.e.
Weaning to oestrus interval (days)	6·8	0·86	5·9	1·09	5·6	1·34
Subsequent litter size	11·1*	0·46	12·8	0·52	12·9	0·75

sows was about 1·7 piglets less than that of higher parity sows ($P < 0·05$).

Regression analysis showed no relationship between any of the parameters measured and weaning to oestrus interval. Subsequent litter size was positively correlated with food intake in the 3rd week of lactation, parity and sow weight gain during the previous gestation. However regression analysis showed that food intake in the 3rd week of lactation was the major influence on subsequent litter size with numbers born increasing by more than half a pig for each extra kg/day of food intake during week 3 of lactation:

$$\text{subsequent litter size} = 3·09 \text{ (s.e. } 1·973) + 0·65\text{FI}_{wk3} \text{ (s.e. } 0·034) + 0·96\text{P (s.e. } 0·460) + 0·04\text{GWG (s.e. } 0·018) \quad (R^2 = 0·275, P < 0·001) \qquad (5)$$

where: FI_{wk3} = mean food intake during week 3 of lactation (kg/day); GWG = gestation weight gain (kg).

Food intakes in weeks 1 and 2 of lactation were not correlated with subsequent litter size, nor were live-weight and backfat changes in the sow during lactation.

Discussion

Changes in live weight and fatness

Increasing sow food intake for the last 16 days of gestation succeeded in preventing sow backfat loss in late gestation and this improved body condition was maintained through to weaning. Despite this there was no difference in lactation performance between treatments, nor in subsequent reproductive performance. It is generally recognized that sows which are able to maintain body condition between parities have a longer reproductive life (Whittemore, 1993). Therefore, although preservation of backfat did not confer an immediate advantage in litter performance it is likely that maintenance of sow backfat thickness in the long term would increase sow longevity in the breeding herd.

Lactation food intake and digestibility

Long-term increases in gestation feeding reduce lactational appetite (Salmon-Legagneur and Rerat, 1962). However, we found that increasing food intake from day 100 of gestation did not decrease food intake in lactation, proving that short-term increases in food intake at a time when sows would otherwise be catabolic is not detrimental to subsequent lactation food intake. This is in agreement with the work of Sterling and Cline (1986), Cromwell *et al.* (1989) and Neil (1996). In our experiment, not only was there no indication of decreased food intake during lactation in the H sows but there was a positive correlation between food intake in late gestation and food intake in the 3rd week of lactation. Clearly increasing food intake for the last 2 weeks of gestation can be used to improve sow body condition without risking a drop in lactation food intake.

It is widely accepted that food intake in lactation is negatively correlated to sow backfat thickness at farrowing (O'Grady *et al.*, 1985; Mullan and Williams, 1989; Matzat, Hogberg *et al.*, 1990). In this experiment sow condition at farrowing did indeed negatively affect food intake but this was a small effect, amounting to a reduction in food intake of 85 g/day for every increase of 1 mm in P2 backfat, which was only apparent for the first 2 weeks of lactation (see equations 2 and 3). Thereafter the demands for milk production, i.e. litter growth rate, determined sow food intake (equation 4).

Increasing food intake from day 100 of gestation failed to increase food intake or diet digestibility in early lactation in contrast to the work of Matte *et al.* (1994).

Agalactia

There was no difference between treatments in the incidence of agalactia even though high intakes were offered right up to farrowing. The University of Alberta pig herd is not characterized by a high incidence of agalactia suggesting that in such herds high intakes prior to farrowing will not interfere with lactation performance. However Swedish workers have shown that increased feeding levels in late gestation did increase agalactia in herds which already had a high incidence of the problem (Persson *et al.*, 1989).

Piglet birth weight

Piglet birth weight was not increased by increasing food intake from day 100 of gestation. This is in agreement with the results of Hillyer and Phillips (1980), Pond *et al.* (1981) and Sterling and Cline (1986). In contrast, Cromwell *et al.* (1989) obtained an increase of 39 g in piglet birth weight in response to high intake feeding in late gestation but this was only seen after sows had been on the treatment for two or more consecutive parities. It is likely that this is a long term benefit of increasing food intake in gestation. Sows which received high intakes in late gestation through successive parities were heavier than those which did not. The increased birth weights may have been caused by the increased live weight of the sows rather than by high feeding level in late gestation *per se.*

Piglet performance

Level of food intake in late gestation did not influence growth rate from birth to weaning. This is in agreement with the findings of Hillyer and Phillips (1980), Pond *et al.* (1981) and Sterling and Cline (1986). Therefore, it seems that the metabolic state of the sow at farrowing is not critically important in determining her ability to establish and maintain lactation. All sows became catabolic during lactation but their ability to adapt to this situation was not affected by their metabolic state at farrowing. Cromwell *et al.* (1989) recorded an increase in growth rate of 130 g per piglet over 21 days (6·2 g/day) for sows which had received extra food in late gestation but again this was observed only in sows which had been on the treatment for two or more gestation-lactation cycles and may have resulted from improved body condition, larger sow size and heavier piglet birth weight.

Subsequent reproductive performance

In the current experiment, in which sows were weaned after a 25-day lactation, the metabolic state of the sow immediately prior to farrowing did not appear to affect subsequent reproductive performance. It has been suggested that the metabolic status of the sow 3 weeks prior to weaning affects her subsequent fertility (Tokach, 1991; Koketsu, 1994). If this is so then the metabolic status in late gestation may be more significant for very early weaned sows, i.e. weaned at or before 14 days after farrowing.

Food intake in the third week of lactation was a significant predictor of subsequent litter size whilst food intake in the first 2 weeks of lactation was not correlated to ensuing reproductive performance. This finding supports the work of Zak *et al*. (1997). Their work, investigating the effects of pattern of feeding in lactation, has shown that the more nearly a period of food restriction is associated with weaning and the more detrimental it will be.

Conclusions

Increasing food intake from day 100 of gestation until farrowing reduced backfat loss between day 98 of gestation and weaning without reducing lactation food intake or increasing the incidence of agalactia. Therefore in herds which are not prone to agalactia this management practice should be applied routinely. Although increased feeding in late gestation did not affect piglet birth weight, growth rate or mortality when applied over one parity, other work suggests that the benefits gained in improved sow condition may be reflected in improved piglet performance and sow longevity if the treatment is maintained over several parities. Sow food intake in the week before weaning was positively correlated with subsequent litter size emphasizing the importance of maximizing sow food intake during this period.

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