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Colophon

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Extra dietary starch in late-pregnant sows fed a high fibre diet: effect on litter weight at birth

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Summary

An experiment with 141 multiparous pregnant sows was conducted to investigate whether the supply of glucogenic energy at the end of pregnancy may be insufficient for an optimal growth of the foetuses in sows that are fed a diet with a high level of non-starch polysaccharides (NSP) and a low level of starch. Sows were fed one of three diets from day 85 of pregnancy until parturition:

1. Sows were fed a high NSP low starch diet. The daily intake of starch and sugar was 500 g.
2. Sows were fed the same diet in the same amount as the sows in treatment 1 plus an extra daily amount of 500 g starch from wheat starch (is glucogenic energy). This means that the sows were fed 0.58 kg/d extra wheat starch (is 6.73 MJ glucogenic NE) during the last month of pregnancy.
3. Sows were fed the same diet in the same amount as the sows in treatment 1 plus an extra daily amount of 200 g soya oil (is 6.73 MJ lipogenic NE). This treatment was added because otherwise it will not be clear whether energy or glucogenic energy is the limiting factor.

From day 1 of day 85 of pregnancy all sows were fed the high NSP low starch diet. During lactation all sows were fed the same lactation diet. Effects on litter performance, on changes in body weight and backfat thickness of the sows, and on feed intake during lactation were studied.

The supply of extra dietary starch or extra dietary fat in late-pregnant sows that were fed a high NSP low starch diet did not increase litter weight at birth. This suggests that sows that were fed the high NSP low starch diet received sufficient glucogenic energy for foetal development. The number of stillborn piglets was numerically higher in sows that received extra dietary fat at the end of pregnancy. Sows that were fed extra dietary starch or extra dietary fat increased more in weight and backfat thickness during late pregnancy than sows that were fed the high NSP low starch diet. Decreases in weight and backfat thickness during lactation were similar for the three experimental treatments. Voluntary feed intake during lactation was slightly decreased in sows that were fed extra starch or extra fat in late pregnancy.

The present study shows that late-pregnant sows can be fed a high NSP low starch diet without adverse effects on litter weight at birth. A daily intake of 500 to 600 g starch and sugar in late-pregnant sows seems sufficient for optimal growth of the foetuses.

Contents

1 Introduction

On most pig farms pregnant sows are fed restrictedly to maintain optimal body condition and productivity. Food restriction, however, is identified as one of the major factors associated with the development of stereotypic behaviour in sows (Lawrence, 1995). In several European countries legislation has been introduced to improve the welfare of pigs. In the Netherlands sows without piglets should be group housed and they should get some roughage every day. Ad libitum feeding is one of the options to comply with the obligation of providing some roughage every day. However, ad libitum feeding with the usual low fibre diets is not possible because of the high feed intake capacity of sows with its concomitant obesity (Petherick and Blackshaw, 1989). Brouns et al. (1995) concluded that a diet with a high level of sugar beet pulp could provide an acceptable level of energy intake if used in an ad libitum feeding system for dry sows. Sugar beet pulp has a high content of fermentable non-starch polysaccharides (NSP). The effects of ad libitum feeding of pregnant sows on reproductive performance and on live weight gain and backfat gain is currently investigated in several countries. Ad libitum feeding of a diet with a high level of fermentable NSP may reduce birth weight of piglets compared to restricted feeding of a low fibre diet (Fisker and Sørensen, 1999). Two mechanisms might be involved. Firstly, the lower birth weight could be explained by a shortage of protein in the sow because with fermentation in the large intestine microbes may be competing with the sow for dietary protein. This results in a disbalance in energy and protein for the sow. Secondly, the lower birth weight could be explained by a deficiency in glucogenic energy, especially at the end of pregnancy. In diets with a high NSP content the starch content is low. Some vital processes e.g. maintenance of brain tissues but also foetal development require glucose (Père et al., 2000). Diets high in NSP might provide insufficient glucogenic energy sustaining optimal foetal growth at the end of pregnancy. Information regarding both mechanisms is lacking. The present trial focuses on the second mechanism. In the trial sows were fed extra dietary starch (glucogenic energy) in late pregnancy or extra fat (lipogenic energy). The latter treatment was added because otherwise it will not be clear whether energy or glucogenic energy is the limiting factor.
The aim of the trial was to investigate whether the supply of glucogenic energy at the end of pregnancy is insufficient for an optimal growth of the foetuses in sows that are fed a high NSP low starch diet during pregnancy. The Institute of Sugar Beet Research, Danisco and the NOVEM financially supported the trial.

2 Material and methods

The trial was carried out at the experimental farm in Rosmalen from June 2000 to June 2001 with 141 multiparous (parity 3) rotation cross breeding sows. The rotation cross breeding was a combination of Dutch Landrace, Large White and Finnish Landrace. Sows were in the experiment during 1 parity (from weaning until weaning). During pregnancy sows were housed individually in boxes of 2.00 m x 0.64 m. During lactation sows were housed individually in farrowing units with six pens of 2.20 m x 1.80 m each. About ten days before parturition sows were moved to the farrowing unit. Piglets were weaned at an age of 27 days.

2.1 Experimental treatments

From weaning until day 85 of pregnancy all sows were fed the same high NSP low starch diet. From day 85 of pregnancy until parturition three experimental treatments were compared:

1 *High NSP low starch diet:* Sows were fed a high NSP low starch diet. The daily intake of starch and sugar was 500 g. This is the theoretical calculated minimum daily amount that is necessary for maintenance and for protein deposition (Verstegen, 2000).
2 *Extra starch diet:* Sows were fed the same diet in the same amount as the sows in treatment 1 plus an extra daily amount of 500 g starch from wheat starch (is glucogenic energy). A daily amount of 1,000-g starch and sugar is what pregnant sows are usually fed. The starch content and net energy (NE) value of 1 kg wheat starch were 860 g and 11.6 MJ (CVB, 2000), respectively. This means that the sows were fed 0.58 kg/d extra wheat starch (is 6.73 MJ glucogenic NE) during the last month of pregnancy.
3 *Extra fat diet:* Sows were fed the same diet in the same amount as the sows in treatment 1 plus an extra daily amount of 200 g soya oil (is 6.73 MJ lipogenic NE).

2.2 Feeding and water supply

Experimental diets

From day 85 of pregnancy until parturition sows were fed a high NSP low starch diet (treatment 1), an extra starch diet (treatment 2) or an extra fat diet (treatment 3). The extra starch diet contained 85.4% of the high NSP low starch diet and 14.6% wheat starch. The extra fat diet contained 94.5% of the high NSP low starch diet and 5.5% soya oil. The three experimental diets were produced in one batch from the same batches of ingredients and stored in a freezing unit. The ingredients and calculated chemical composition of the three experimental diets are presented in appendix 1. From parturition until weaning all sows were fed the same lactation diet (appendix 1). Piglets were fed a commercial creep feed.

Feeding level and supply of drinking water

Pregnant sows were fed twice a day at 8.00 h and at 15.00-h. From day 1 until day 60 and from day 61 until day 85 of pregnancy, all sows were fed 2.5 and 2.9 kg/d, respectively, of the high NSP low starch diet. From day 85 of pregnancy until parturition sows in treatment 1 were fed 3.4 kg/d. Sows in treatment 2 were fed 3.98 kg/d (3.40 kg of the high NSP low starch diet and 0.58 kg wheat starch). Sows in treatment 3 were fed 3.60 kg/d (3.40 kg of the high NSP low starch diet and 0.20 kg soya oil). During lactation sows were fed ad libitum. The daily supplies of feed, starch + sugar, NSP and fat from day 85 of pregnancy until parturition are presented in table 1.

Table 1 Daily supplies (g) of feed, starch, non-starch polysaccharides (NSP) and fat from day 85 of pregnancy until parturition

	High NSP low starch diet	Extra starch diet	Extra fat diet
Feed	3,400	3,980	3,600
Starch + sugar	510	1010	510
NSP	1,670	1,670	1,670
Crude fat	177	177	375

During pregnancy drinking water was supplied twice a day during 1 hour. Each drinking period started at feeding time. In the farrowing unit drinking water was supplied unrestrictedly by a nipple in the trough.

2.3 Experimental design

Every three weeks about 50 sows were weaned at the experimental farm in Rosmalen. At the day of weaning 10 to 12 multiparous sows were randomly assigned to the experiment. At day 85 of pregnancy sows were assigned to one of the three experimental treatments based on parity number and crossbreed (type of rotation cross) of the sow. Sows that returned to oestrus after first insemination were excluded from the trial.

2.4 Data collection

Experimental diets were sampled once a month. The monthly samples were pooled per 3 months. Feed was analysed every 3 months for dry matter, crude protein, crude fat, crude ash, starch and sugar. The starch content was analysed enzymatically as described by Brunt (2000).
Individual body weight of the sows was measured at day 84 of pregnancy (day before the experimental period started), at the day they were moved to the farrowing unit and at the day of weaning (end of the experiment). On the same days backfat thickness was measured at three points 5 cm left of the median (middle of the back of the sow). The distance between the shoulder and the last rib was divided in three equal parts to create four points. At the last three points backfat thickness was measured ultrasonically.
At parturition number of live born piglets, number of stillborn piglets, birth weight of live born piglets, and birth weight of stillborn piglets were registered. At weaning number of weaned piglets, weaning weight of the piglets, and creep feed intake of the litter were registered. Moreover, piglet mortality was measured. Feed intake per sow was recorded from day 85 of pregnancy until parturition and from parturition until weaning.

2.5 Statistical analysis

Increase in weight and backfat thickness of the sows from day 84 of pregnancy until the day they were moved to the farrowing unit, decrease in weight and backfat thickness in the farrowing unit, feed intake of the sows during lactation, birth weight of live born piglets, birth weight of stillborn piglets, litter weight at birth (= birth weight of live born piglets + birth weight of stillborn piglets), weaning weight of the piglets, and feed intake of the piglets were analysed with the GLM procedures of SAS (1994). Number of live born piglets and number of stillborn piglets were analysed by expressing them as a fraction of total born (= live born + stillborn + mummies) piglets using logistic regression (Oude Voshaar, 1995). Number of weaned piglets was analysed as a fraction of live born piglets after fostering.

The following model was used:

$$Y_{ijk} = \mu + parity_i + crossbreed_j + diet_k + e_{ijk}$$

where Y_{ijk} = dependent variable; μ = overall mean; $parity_i$ = fixed effect of parity i (i = 4: parity 3, parity 4, parity 5, parity 6), crossbreed j = fixed effect of crossbreed (j = 3); diet k = fixed effect of experimental diet k (k = 3); e_{ijk} = error term.
The following covariables were used:

Dependent variable	**Covariable**
Increase in weight of the sow	Weight at day 84 and number of total born piglets
Increase in backfat thickness	Backfat thickness at day 84 and number of total born piglets
Decrease in weight of the sow	Weight at day 84 and number of weaned piglets
Decrease in backfat thickness	Backfat thickness at day 84 and number of weaned piglets
Birth weight of live born piglets	Number of total born piglets
Birth weight of stillborn piglets	Number of total born piglets
Litter weight at birth	Number of total born piglets
Weaning weight of piglets	Number of weaned piglets and weaning age

Piglet mortality was analysed using the chi-square test.

3 Results

3.1 Composition of experimental diets

The results of the chemical analyses of the experimental diets are presented in table 2.

Table 2 Analysed chemical composition of the experimental diets (g/kg)

	High NSP low starch diet	Extra starch diet	Extra fat diet
Number of samples	4	4	4
Dry matter	890	893	903
Crude protein	128	113	123
Crude fat	52	44	96
Starch	80	162	80
Sugar	78	68	73

In all the experimental diets, the calculated and analysed amounts of dry matter, crude protein and sugar were similar. In the high NSP low starch diet and in the extra fat diet, the analysed amounts of starch were 8 and 11 g/kg higher than the calculated amounts, respectively, whereas in the extra starch diet the analysed amount of starch was 25 g/kg lower than the calculated amount. In the high NSP low starch diet and in the extra starch diet, the calculated and analysed amounts of crude fat were similar. In the extra fat diet, the analysed amount of crude fat was 8 g/kg lower than the calculated amount.

3.2 Sow litter performance

In table 3, litter performance of the sows is shown.

Table 3 Litter performance of sows that were fed a high NSP low starch diet, an extra starch diet or an extra fat diet from day 85 of pregnancy until parturition

	High NSP low starch diet	Extra starch diet	Extra fat diet	SEM[1]	Significance[2]
No. of litters	48	51	42		
No. of total born piglets	12.6	13.2	13.0	0.4	n.s.
Live born piglets (% of total born)	95.0[a]	92.9[ab]	91.0[b]	1.3	#
Stillborn piglets (% of total born)	4.3[a]	5.1[ab]	7.7[b]	1.1	#
Birth weight of live born piglets (kg)	1.399	1.439	1.390	0.026	n.s.
Birth weight of stillborn piglets (kg)	1.089	1.072	1.051	0.095	n.s.
Litter weight at birth (kg)	17.58	17.92	17.15	0.34	n.s.
Weaned piglets (% after fostering)	89.1	88.7	88.0	1.3	n.s.
Weaning weight of piglets (kg)	7.82	7.89	7.90	0.12	n.s.
Piglet mortality (%)	10.9	11.3	12.6		n.s.

[1] SEM = pooled standard error of mean (gives an indication of the accuracy of the estimate of the variable measured)
[2] Significance: # = ($p < 0.10$); n.s. = not significant
[a,b] means with different superscript are significantly different

The percentage of live born piglets was higher and the percentage of stillborn piglets was lower in sows fed the high NSP low starch diet than in those fed the extra fat diet. The number of total born piglets, birth weight of the piglets, litterweight at birth, weaned piglets and weaning weight of the piglets did not differ among sows that were fed the high NSP low starch diet, the extra starch diet or the extra fat diet at the end of pregnancy.

3.3 Weight and backfat thickness of sows

In table 4, increase in weight and backfat thickness of the sows from day 84 of pregnancy until the day they were moved to the farrowing unit and the decrease in weight and backfat thickness in the farrowing unit are presented.

Table 4 Weight and backfat thickness of sows that were fed a high NSP low starch diet, an extra starch diet or an extra fat diet from day 85 of pregnancy until parturition

	High NSP low starch diet	Extra starch diet	Extra fat diet	SEM[1]	Significance[2]
Number of sows	48	51	42		
Weight at day 84 of pregnancy (kg)	226.0	225.2	228.7	5.3	n.s.
Increase in weight[3] (kg)	17.5[a]	22.0[b]	23.0[b]	0.8	***
Decrease in weight[4] (kg)	33.3	37.1	34.4	1.9	n.s.
Backfat at day 84 of pregnancy (mm)	14.2	14.5	14.8	0.9	n.s.
Increase in backfat thickness[3] (mm)	1.1[a]	1.8[ab]	2.3[b]	0.3	*
Decrease in backfat thickness[4] (mm)	2.8	3.3	3.4	0.3	n.s.

[1] SEM = pooled standard error of mean (gives an indication of the accuracy of the estimate of the variable measured)
[2] Significance: n.s. = not significant; * = ($p < 0.05$); *** = ($p < 0.001$)
[3] Increase in weight and backfat thickness is increase from day 84 of pregnancy until the day sows were moved to the farrowing unit
[4] Decrease in weight and backfat thickness is decrease in the farrowing unit
[a,b] Means within a row without a common superscript letter differ

Live weight gain from day 84 of pregnancy until the day sows were moved to the farrowing unit was higher in sows that were fed the extra starch diet or the extra fat diet than in sows that were fed the high NSP low starch diet. Sows that were fed the extra fat diet increased more in backfat thickness than sows that were fed the high NSP low starch diet whereas the increase in backfat thickness of the sows that were fed the extra starch diet was in between.
The decreases in weight and in backfat thickness in the farrowing unit did not differ among sows that were fed the high NSP low starch diet, the extra starch diet or the extra fat diet at the end of pregnancy.

3.4 Feed intake of sows and piglets

In table 5, feed intake from day 85 of pregnancy until parturition, feed intake of the sows during lactation and feed intake of the piglets are presented.

Table 5 Feed intake (kg) of piglets and sows that were fed a high NSP low starch diet, an extra starch diet or an extra fat diet from day 85 of pregnancy until parturition

	High NSP low starch diet	Extra starch diet	Extra fat diet	SEM[1]	Significance[2]
Number of sows	48	51	41		
ADFI[3] from day 85 of pregnancy until parturition	3.38	3.89	3.54		
ADFI of sows during lactation:					
Week 1	3.97	3.97	3.90	0.12	n.s.
Week 2	6.68	6.58	6.45	0.14	n.s.
Week 3	7.64[a]	7.08[b]	7.12[b]	0.16	*
Week 4	7.67[a]	7.30[b]	7.74[a]	0.15	#
Week 1 – 4	6.45[a]	6.14[b]	6.24[ab]	0.11	#
Total feed intake per piglet (kg)	0.28	0.29	0.29	0.02	n.s.

[1] SEM = pooled standard error of mean (gives an indication of the accuracy of the estimate of the variable measured)
[2] Significance: n.s. = not significant; # = ($p < 0.10$); * = ($p < 0.05$)
[3] ADFI = average daily feed intake
[a,b] Means within a row without a common superscript letter differ

In all experimental treatments the realised daily feed intake was somewhat lower than the planned daily feed intake from day 85 of pregnancy until parturition because some sows did not eat all their feed. During lactation, the feed intake of the sows that were fed the high NSP low starch diet at the end of pregnancy was highest whereas the feed intake of the sows that were fed the extra starch diet at the end of pregnancy was lowest. The feed intake of the sows that were fed the extra fat diet was in between. The feed intake in weeks 1 and 2 of lactation did not differ among sows that were fed the high NSP low starch diet, the extra starch diet or the extra fat diet at the end of pregnancy. In week 3 of lactation, feed intake of the sows that were fed the high NSP low starch diet at the end of pregnancy was higher than the feed intake of the sows that were fed the extra starch diet or the extra fat diet. In week 4 of lactation, feed intake of the sows that were fed the extra starch diet at the end of pregnancy was lowest. Feed intake of the piglets did not differ among the experimental treatments.

4 Discussion

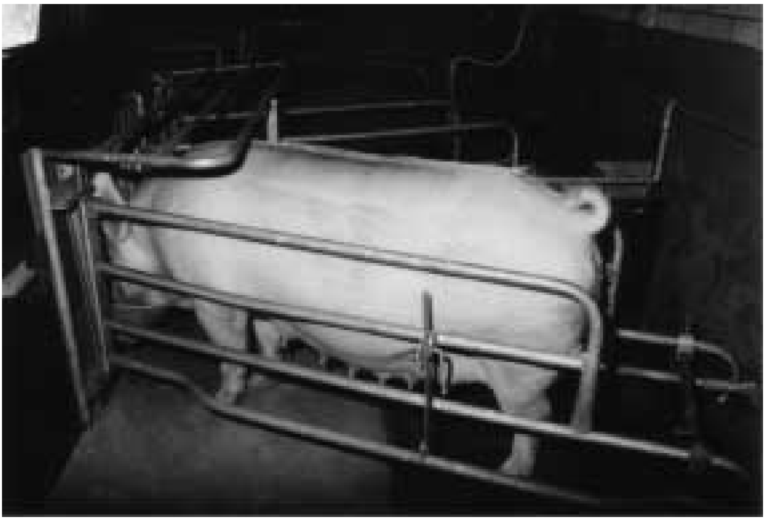
In this trial it was investigated whether the supply of glucogenic energy at the end of pregnancy is insufficient for an optimal growth of the foetuses. Therefore, sows were fed an extra daily amount of 500 g starch or an extra daily amount of 198 g fat. As a result of differences in analysed and calculated amounts of starch and fat in the diets (table 2) and as a result of slightly lower feed intakes of the sows (table 5), actual differences in starch and fat intake between experimental treatments were lower than intended. Sows that received the extra starch diet were fed an extra daily amount of 360 g starch instead of 500 g. Sows that received the extra fat diet were fed an extra daily amount of 164 g crude fat instead of 198 g.

The supply of extra dietary fat in late-pregnant sows that were fed a high NSP low starch diet did not increase litter weight at birth. This is in agreement with other studies (Sinclair et al., 2001; Averette Gatlin et al., 2002). In general, litter birth weights have not been affected by fat supplementation of sows' diets in late pregnancy (Pettigrew, 1981). The supply of extra dietary starch in late-pregnant sows that were fed a high NSP low starch diet also did not increase litter weight at birth. This suggests that the late-pregnant sows that were fed the high NSP low starch diet received sufficient glucogenic energy for foetal development. These results are in contrast with the study of Fisker and Sørensen (1999) where sows that were fed a high starch diet had heavier litters than sows that were fed a high NSP low starch diet. In the study of Fisker and Sørensen (1999) late-pregnant sows that were fed the high starch diet received 1,088 g/d starch and sugar whereas sows that were fed the high NSP low starch diet received 665 g/d starch and sugar (Fisker and Back Knudsen, 2001). In our study, sows that were fed the high NSP low starch diet received 534 g/d starch and sugar. In a study of Van der Peet-Schwering (not published) late-pregant sows that were fed a high NSP low starch diet ad libitum received about 600 g/d starch and sugar whereas late-pregnant sows that were fed a high starch diet restrictedly received about 950 g/d starch and sugar. The preliminary results of this study do not show a difference in litter weight at birth between the restricted and ad libitum fed sows. The results of our study and of the study of Van der Peet-Schwering et al. (unpublished) suggest that a daily intake of 500 to 600-g starch and sugar in late-pregnant sows is sufficient for foetal development.

Thus, a shortage of glucogenic energy does not seem the explanation for the lighter litters in sows that were fed a high NSP low starch diet in the study of Fisker and Sørensen (1999). A shortage of protein, however, might be an explanation. Everts (1994) concluded that a faecal digestible protein supply of 250 g/d in late-pregnant sows is necessary to guarantee a normal foetal development. Moreover, for a good fermentation of NSP in the large intestine nitrogen is necessary and microbes may compete with the sows for dietary protein. In the hindgut, 49 to 62 g bacterial protein may be synthesised per kg fermented NSP (Bakker et al., 1995). Therefore, a somewhat higher protein level is advised in high NSP low starch diets. In our study, all late-pregnant sows received 300 g/d faecal digestible protein whereas in the study of Fisker and Sørensen (1999) sows that were fed the high starch diet and the high NSP low starch diet received 254 and 215 g/d faecal digestible protein, respectively. Thus, a shortage of protein in sows that were fed the high NSP low starch diet seems a likely explanation for the reduced litter birth weight in the study of Fisker and Sørensen (1999).

The number of stillborn piglets was numerically higher ($p = 0.07$) in sows that received extra dietary fat at the end of pregnancy. These results are in contrast with other studies (Shurson et al., 1986; Stahly et al., 1986) where the number of stillborn piglets was not affected by extra dietary fat at the end of pregnancy. However, in a study of Averette Gatlin et al. (2002) also an increase in the number of stillborn piglets was observed when late-pregnant sows were fed a diet with 10% supplemental fat. Neither Averette Gatlin et al. (2002) nor we can explain this increase in stillborn piglets.

Sows that were fed extra dietary starch or extra dietary fat increased more in weight and backfat thickness during late pregnancy than sows that were fed the high NSP low starch diet, because of the higher daily energy intake. It has frequently been demonstrated that as energy intake increases in pregnancy, backfat thickness at farrowing increases and voluntary feed intake in lactation decreases (Dourmad, 1991; Revell et al. 1998). The results of our study agree with these results although voluntary feed intake was only slightly decreased in sows that were fed extra dietary starch or fat in late pregnancy. In the studies of Dourmad (1991) and Revell et al. (1998) voluntary feed intake of the sows was decreased in week 1, 2 and 3 of lactation whereas in our study voluntary feed intake of the sows was only decreased in week 3 of lactation. In week 1 of lactation sows were fed on an ascending scale, consequently, a difference in feed intake in week 1 was not expected. Moreover, Sinclair et al. (2001) concluded that voluntary feed intake during lactation is suppressed by increased body fat at a limited body protein mass but not when body protein mass at farrowing is also increased. Using the equations of Everts et al. (1994), it can be calculated that body protein mass in sows that were fed extra dietary starch or extra fat was 0.3 and 0.9 kg higher at farrowing, respectively, than in sows that were fed the high NSP low starch diet. The slightly higher levels of body protein mass possibly explain the just minor decreases in voluntary feed intake during lactation. As a result of the only small differences in feed intake during lactation, decreases in weight and backfat thickness of the sows during lactation were similar for the three experimental treatments.



5 Practical implications

Late -pregnant sows can be fed a high NSP low starch diet without adverse effects on litter weight at birth if faecal digestible dietary protein supply is at least 250 g/d. A daily intake of 500 to 600 g starch and sugar in late-pregnant sows seems sufficient for foetal development. A supply of extra dietary starch or extra fat in late pregnancy does not increase litter weight at birth but it does increase maternal gain.

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Appendix

Appendix 1 Ingredients and calculated chemical composition of the three experimental diets and the lactation diet (g/kg)

	High NSP low starch diet	Extra starch diet	Extra fat diet	Lactation diet
Wheat	45.00	38.00	43.00	–
Tapioca	50.00	40.00	48.00	366.85
Extracted soya bean meal	37.00	32.00	35.00	97.00
Soya hulls	48.00	41.00	45.00	–
Extracted sunflower seed	180.00	154.00	170.00	185.00
Sugar beet pulp	401.30	344.33	378.65	–
Wheat starch (Puramyl)	–	146.00	–	–
Extracted alfalfa meal	21.00	18.00	20.00	50.00
Peas	–	–	–	105.00
Wheat middlings	–	–	–	80.00
Cane molasses	51.00	44.00	48.00	40.00
Straw	110.00	94.00	104.00	–
Animal fat	42.60	36.50	40.00	37.50
Soya oil	–	–	55.00	10.00
L-Threonine	0.40	0.34	0.37	0.32
Liquid lysine 50	1.00	1.00	1.00	2.20
Limestone	–	–	–	10.10
Monocalcium phosphate	4.80	4.10	4.50	6.20
Salt	2.50	2.10	2.40	4.30
Vitamin and mineral premix	5.00	4.30	4.70	5.00
Phytase premix	0.40	0.33	0.38	0.53
Net energy (MJ/kg)	8.44	8.97	9.84	9.41
Dry matter	890	889	896	881
Crude protein	129	111	122	156
Crude fat	52	45	104	60
Crude fibre	178	152	168	94
Ash	72	62	68	77
Starch	72	187	69	325
Sugar	78	67	73	34
Non-starch polysaccharides[1]	491	420	464	219
Digestible NSP	298	256	281	99
Ileal digestible lysine	4.3	3.8	4.1	7.1
Ileal digestible methionine + cystine	3.0	2.6	2.8	3.8
Ileal digestible threonine	3.1	2.7	3.0	4.2
Ileal digestible tryptophan	1.0	0.8	0.9	1.4
Calcium	6.6	5.6	6.2	9.1
Phosphorus	4.0	3.5	3.8	5.7
Digestible phosphorus	2.3	1.9	2.1	3.1
Potassium	10.6	9.0	10.0	12.2
Sodium	1.7	1.4	1.6	2.0
Linolenic acid	6.4	5.5	34.1	

[1] Non-starch polysaccharides = dry matter – ash – crude protein – crude fat – starch - sugar