ONTARIO PORK

Ontario Pork Research Final Report (18-007) Executive Summary

Reporting Date: January 28th, 2021

Introduction: An important phase of mammary development occurs between the age of 90 days and puberty. Previous research suggests optimum mammary development requires unrestricted feeding. Breeding companies often restrict feed to replacement gilts during this phase of growth to reduce weight gain and hopefully reduce lameness.

Objectives:

1) To determine the impact of a specialized feeding regime for replacement gilts on their lactation performances.

2) To help develop best-adapted feeding strategies for replacement gilts that will minimize leg problems (increasing longevity) while maximizing mammary development.

Materials and Methods: Gilts were assigned to 1 of 4 feeding programs: [1] commercial diet fed ad libitum (CON), [2] commercial diet fed 10%, or [3] 20% below ad libitum, and [4] a high-fiber diet fed ad libitum (with 25% more fiber than the commercial diet and energy density reduced by 5%; FIB). Gilts received the feeding program between 90 days of age and breeding at approximately 190 days of age. Body weight and feed disappearance were determined weekly. Lactation data were analyzed.

Results and Discussion: The high fibre diet controlled the body weight and backfat depth of gilts when fed during the development period of 90 to 190 days of age. By the end of gestation, body weight among treatment groups was similar. No differences in piglet growth rates pre- and post-weaning were observed.

Conclusions: The use of a high fibre feeding program fed ad libitum can be utilized to control the growth of developing gilts without impairing subsequent lactation performance.

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Introduction: Sow milk yield is a major determinant of piglet growth and is largely affected by the number of milk secretory cells present at the onset of lactation. There are two main phases of rapid mammary cell development in swine, namely, from 90 days of age until puberty and during the last third of gestation. The effects of prepubertal feeding on mammary development in gilts are not well understood. A study where mammary composition was measured, suggested that a period of ad libitum feeding before puberty is needed to maximize mammary growth. Furthermore, it has been reported that decreasing energy intake of gilts at specific periods between 9 and 25 weeks of age, reduces mammary growth. This is important because many gilt development programs use restrictive feeding during the grower-finisher stage to attempt to improve skeletal growth and prevent lameness problems in replacement breeding-stock. It is not known whether programs designed to slow growth in young replacement stock affects subsequent milk production and this needs to be investigated.

Objectives:

1. To determine the impact of a specialized feeding regime for replacement gilts on their lactation performances.
2. To help develop best-adapted feeding strategies for replacement gilts that will minimize leg problems (hence increasing longevity) while maximizing mammary development.

Materials and Methods:

Gilts (n=168) were recruited for this study. Gilts were selected at 90 days of age over 14 monthly batches and were assigned to 1 of 4 gilt development feeding programs to ensure equal distribution of body weight (BW) and genetics among feeding programs. Between 90 and 140 days of age, gilts were housed individually in partially slatted pens (163 cm × 198 cm) and between 141 and ~220 days of age, gilts were housed in gestation stalls (66 cm × 213 cm). Gilts were bred on the second observed heat using artificial insemination (~190 days of age). Of the gilts selected for breeding following the feeding trial, 94 were confirmed pregnant. Upon pregnancy confirmation, gilts were moved into group housing and at approximately day 110 of gestation, gilts were moved into farrowing crates (183 cm × 239 cm) equipped with a heat mat. Piglets received access to water via a nipple drinker but no creep feed. Litters were standardized via cross-fostering to 12 ± 1 within 48 hours of birth. Piglets were ear notched and had teeth clipped within 24 h of birth; tails were clipped, males castrated, and iron injection given at 4 days of age. Piglets were weaned at 20.5 ± 0.4 days of age.

The 4 gilt development feeding programs were as follows: [1] a control commercial diet fed *ad libitum* (CON), [2] 10% and [3] 20% daily feed restriction of the CON diet, based on *ad libitum* feed intake of CON group, and [4] a high-fibre diet fed a*d libitum* formulated to have 50% more fibre than CON (FIB). Originally, the project was designed to include only 3 treatments but the 20% restricted diet was added because it was felt that under some gilt development programs animals may experience more than 10% restriction and it would be important to determine if this more extreme restriction would impact lactation. Gilts received the feeding program from 90 days of age until approximately 190 days of age, when they were bred. The feeding program was divided into growing and finishing phases, which were fed between 90 and 125, and between 126 and 190 (breeding) days of age, respectively. Once bred, all gilts received between 1.8 and 2.3 kg per day (depending on visual assessment of body condition) of a standard gestation diet. Once moved to group housing, the gestation diet was delivered to individual gilts using an automated feeding system (Gestal, Gestal 3G station, St-Lambert-de-Lauzon, QC, Canada) and using a feeding curve based on individual pig weight at breeding (2.4 kg per day for first 86 days, and 3.1 kg per day until day 110 of gestation). Once in the farrowing room, gilts received 2 kg per day of standard lactation diet prior to farrowing; after farrowing gilts received a daily stepwise increase in lactation feed allowance until ad libitum feed intake was achieved on day 4 of lactation.

During the development period, BW and feed disappearance were determined weekly. Once bred, gilts were weighed bi-weekly until 110 days of gestation and daily feed intake was recorded via the Gestal software. Gilts were weighed within 24 hours after farrowing and at weaning (20.5 ± 0.4 days) and feed intake was determined weekly during the lactation period.

Back fat depth (BF) and loin-eye depths (LD) were assessed via a trained technician using ultrasound (Agroscan L, ECM Noveko International Inc., Angoulême, France) at the P2 position on days 90, 145 (puberty), 160, and 190 (breeding) days of age during the development period. BF and LD were also measured on days 60 and 110 of gestation, between days 5 and 11 of lactation, and at weaning. Piglets were weighed within 24 hours of birth and on days 2, 7, and 14 of lactation and at weaning.

All statistical analyses for growth performance and milk composition were completed using Proc Glimmix of SAS with gilt (or litter for the offspring) as the experimental unit. For gilt growth performance the model included fixed effects treatment (gilt development feeding program), week, and the interaction of treatment and week, the random effects of block and gilt with in block and a repeated measures statement. Initial BW, initial BF, and initial LD were used as covariates. For lactation (sows and offspring) and post-weaning performance (offspring), the interaction between treatment and week was not significant, so data were analysed at individual time points with treatment as the fixed effect.

Results and Discussion:

On day 125 of age, gilts that received the 20% restricted feeding programs tended to have lower BW than gilts that received the CON ($P = 0.08$) and lower BW than gilts that received the FIB feeding programs ($P < 0.05$); intermediate BW were observed for gilts that received the 10% restricted feeding program. On day 145 of age (puberty), gilts that received the 20% restricted feeding program had lower BW than gilts on all other feeding programs ($P < 0.05$) and gilts that received the CON and FIB feeding program ($P = 0.08$ and $P = 0.009$, respectively). On day 160 of age, gilts that received the 20% restricted feeding program had lower BW than gilts on all other feeding programs ($P < 0.02$), gilts that received the 10% restricted feeding program had lower BW than gilts that received the CON feeding program ($P < 0.05$), and gilts that received the FIB feeding program had intermediate BW versus those fed the CON and 10% programs. On day 190 of age (breeding), gilts that received the 20% restricted feeding program had lower BW than gilts on all other feeding programs ($P < 0.001$) and gilts that received the FIB and 10% feeding program had lower BW than those that received the CON program ($P < 0.001$).

The average daily gain (ADG) was less for gilts that received the 20% feeding program during the grower phase (day 90 to 125 days of age) compared to those fed the FIB program ($P < 0.05$) and tended to be less than gilts fed the CON feeding program ($P = 0.078$); intermediate ADG was observed during the growing phase for gilts that received the 10% feeding program. During the finisher phase [day 125 to 190 (breeding) days of age] ADG tended to be less for gilts fed the 20% program than those of the CON feeding program ($P = 0.08$); intermediate ADG was observed during the finisher phase for FIB and 10% gilts. Over the entire development period, the ADG was less for gilts that received the 10% and

20% feed restricted programs than those that received the CON program ($P = 0.08$ and $P < 0.05$, respectively), while intermediate values were observed for gilts that received the FIB program.

The average daily feed intake (ADFI) was less for gilts that received the 20% restricted feeding program versus all other feeding programs ($P < 0.001$), and not different between gilts that received the CON and FIB feeding programs, for either grower or finisher phases, or over the entire development period.

On day 145 of age, gilts that received the 10% and 20% restricted feeding programs had less BF than those that received the CON feeding program ($P < 0.05$), while intermediate values were observed for gilts that received the FIB feeding program. On day 160 of age, gilts that received the FIB, 10%, and 20% feeding programs had less backfat (BF) than those that received the CON feeding program ($P < 0.05$), and gilts that received the 20% restricted program tended to have less BF than those that received the FIB program ($P = 0.07$). On day 190 of age, gilts that received the 20% restricted program had less BF than those that received the CON or 10% feeding programs ($P < 0.05$) and gilts fed the FIB and 10% program had less BF than those that received the CON feeding program ($P < 0.05$).

On day 145 of age, gilts that received the 20% restricted feeding program had reduced LD versus gilts that received the CON program ($P < 0.05$), while intermediate values were observed for gilts that received the FIB and 10% programs (Table 1). No differences were detected for LD among any of the feeding programs during the remainder of the development period

There were no differences among gilt development feeding programs for BW, LD or ADFI throughout gestation or litter characteristics at birth (i.e. total born, born alive, stillborn, mummified, or litter birth weights (Table 2). On day 60 of gestation, gilts that received the 20% restricted feeding program during the development period tended to have less BF than those that received the CON feeding program ($P = 0.077$), while intermediate values were observed for gilts that received the FIB and 10% programs. No differences in BF were observed among gilt development feeding programs by day 110 of gestation.

During lactation, no differences were observed among gilt development feeding programs for BW, BW loss, BF, LD or LD loss, ADFI, or piglet BW or ADG. Only BF loss over the lactation period tended to be less for gilts that received FIB versus the 10% feeding program during development ($P = 0.07$), while intermediate losses were observed for gilts that received the CON and 20% feeding programs during development. There were no differences in the chemical composition of milk among gilts development feeding programs.

Conclusions:

In summary, the high fibre feeding program for developing gilts was successful in reducing BW and BF at breeding, without impacting piglet growth or sow performance during the first lactation. Piglet BW and growth rates during lactation or the post-weaning period were not affected by the gilt development feeding program. Since it is crucial to have gilts in ideal body condition at breeding, the inclusion of fibre in developing gilt rations could be a way for producers to control energy intake in group housing environments and where feed is provided *ad libitum.*

Knowledge Transfer:

1. Gregory N, Farmer C, Friendship RM, Huber L-A. The effect of a high-fiber feeding program for replacement gilts on body weight and composition at breeding. J. Anim. Sci 2020;98,Suppl. S:75.

2. Gregory N. The Effect of a High Fibre Gilt Development Feeding Program on Body Composition and Subsequent Lactation Performance. MSc Thesis University of Guelph (https://atrium.lib.uoguelph.ca/xmlui/handle/10214/23714)

3. Gregory N, Farmer C , Friendship RM, Huber L-A. The effect of a high-fibre gilt development feeding program on body composition and first lactation performance. (poster) Le Porc Show (Virtual Conference).

Table 1. Growth performance of gilts during the development period.

	Treatment[1]					*P*-Value[2]		
	CON	FIB	10%	20%	SEM[3]	Trmt	Week	Trmt×Week
No.	17	15	21	19				
Body weight, kg						<0.001	<0.001	<0.001
Day 90	50.84	50.59	51.08	50.93	0.82			
Day 125[4]	85.21^{a,x}	85.95^{a}	82.94^{ab}	80.43^{b,y}	0.82			
Day 145	104.07^{ab,x}	105.73^{a}	100.09^{b,y}	95.66^{c}	0.82			
Day 160	119.17^{a}	117.57^{ab}	113.94^{b}	108.99^{c}	0.82			
Day 190	150.44^{a}	46.94^{b}	145.64^{b}	139.00^{c}	0.82			
ADG, kg						0.005	0.037	0.226
Grower	0.98$^{a, x}$	1.01^{a}	0.92^{ab}	0.86$^{b, y}$	0.03			
Finisher	1.06^{x}	0.97	0.99	0.94^{y}	0.03			
Overall	1.04$^{a, x}$	0.98^{ab}	0.96$^{y, b}$	0.91^{b}	0.02	0.003	.	.
ADFI, kg							.	.
Grower	2.54^{a}	2.67^{a}	2.20^{b}	1.95^{c}	0.07	<0.001		
Finisher	3.82^{a}	3.96^{a}	3.29^{b}	3.01^{c}	0.07	<0.001		
Overall	3.42^{a}	3.49^{a}	2.96^{b}	2.64^{c}	0.05	<0.001		
Backfat, mm						<0.001	<0.001	<0.001
Day 90	6.75	6.57	6.58	6.72	0.24			
Day 145	10.88^{a}	9.97^{ab}	9.53^{b}	9.19^{b}	0.24			
Day 160	12.92^{a}	11.24$^{b, x}$	10.69^{b}	10.22$^{b, y}$	0.24			
Day 190	16.74^{a}	14.87^{bc}	14.85^{b}	13.76^{c}	0.24			
Loin depth, mm						0.031	<0.001	0.134
Day 90	50.64	49.88	49.88	51.57	0.69			
Day 145	63.77^{a}	62.39^{ab}	63.80^{ab}	59.15^{b}	0.69			
Day 160	68.23	67.38	65.39	65.18	0.69			
Day 190	72.25	70.98	68.91	68.93	0.69			

[1] Dietary Treatments: [1] control commercial diet fed ad libitum (**CON**), a [2] **10%** and [3] **20%** daily feed restriction of control diet based on ad libitum feeding, and [4] a high-fibre diet fed ad libitum formulated to have 50% more fibre than control with an approximate 15% energy reduction (**FIB**); gilts were transitioned from grower to finisher diets on day 125 of age

[2] Feeding program effect (**Trmt**), week of feeding program effect (**Week**), interaction between feeding program and week of study **(TrmtxWeek)**

[3] Maximum value for standard error of means

[4] Gilts were transitioned from grower to finisher diets on Day 125

[a b c d] Means without a common superscript in a row differ ($P < 0.05$)

[x y] Mean without a common superscript in a row tended to differ ($0.05 \leq P \leq 0.1$)

Table 2. Sow growth performance during gestation and litter characteristics at birth.

	Treatment[1]					P-Value[2]
	CON	FIB	10%	20%	SEM[3]	Trmt
No.	15	14	21	19		
Body weight, kg						
Day 60 G	176.2	176.2	170.1	168.8	4.00	0.179
Day 110 G	211.4	226.5	217.1	222.0	4.62	0.128
Backfat, mm						
Day 60 G	18.9[x]	16.7[x,y]	17.4[x,y]	16.7[y]	0.70	0.074
Day 110 G	19.7	18.1	19.3	17.9	0.79	0.266
Loineye, mm						
Day 60 G	70.2	68.8	70.5	71.5	1.26	0.402
Day 110 G	71.6	73.7	70.8	72.5	1.60	0.456
Gestation ADFI, kg	2.6	2.6	2.6	2.7	0.03	0.278
Litter Characteristics						
Total born	13.0	14.0	13.0	14.0	0.78	0.367
Born alive	12.0	12.0	12.0	14.0	0.84	0.245
Still born	2.0	2.0	1.0	1.0	0.48	0.566
Mummified	0	0	0	0	0.16	0.446
Litter birth weight, kg	16.7	18.3	17.7	19.5	1.33	0.496

[1] Dietary Treatments: [1] control commercial diet fed ad libitum (**CON**), a [2] **10%** and [3] **20%** daily feed restriction of control diet based on ad libitum feeding, and [4] a high-fibre diet fed ad libitum formulated to have 50% more fibre than control with an approximate 15% energy reduction (**FIB**)

[2] Feeding program effect (**Trmt**)

[3] Maximum value for standard error of means

[a b] Means without a common superscript in a row differ ($P < 0.05$)

[x y] Mean without a common superscript in a row tended to differ ($0.05 \leq P \leq 0.1$)