Effects of feed restriction on growth, blood chemistry and reproductive performance in replacement gilts

Debora M. Holanda[1], Sarah Stephens[1], Huaigang Lei[2], Jonatan R. Sanchez-Osorio[3], Julia L. Moroni[4], Louisa J. Zak[5], Egbert F. Knol[5], and C. Martin Nyachoti[1]

[1]Department of Animal Science, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2; [2]Topigs Norsvin Canada Inc., Oak Bluff, Manitoba, Canada R4G 0C4; [3]Topigs Norsvin Spain, Las Rozas de Madrid, Madrid, Spain, 28290; [4] Topigs Norsvin International B.V., Meerendonkweg 25, Netherlands, 5216 TZ 's-Hertogenbosch; [5] Topigs Norsvin Research Center B.V. Meerendonkweg 25, Netherlands, 5216 TZ 's-Hertogenbosch.

The practical application of embryo transfer in pigs could benefit using embryo donors for multiple cycles. Thus, raising the need to investigate feeding strategies for donors which will not be required to recover body condition lost during previous lactation. The objective was to evaluate the effects of temporary feed restriction, from d 6 to 14 of the estrous cycle, on growth, blood variables and reproductive performance in replacement gilts. Twenty replacement gilts (TN70, Topigs Norsvin, Oak Bluff, Canada) were assigned equally across 2 feeding regimens following a randomized complete block design where the block was backfat thickness. The feeding regimens were based on the first day of the estrous cycle: CON, recommended feeding levels from d 0 to 14 and a flush feeding (25% above recommended levels) from d 15 until d 21; or RES, CON but with restricted feeding (25% below recommended levels) from d 6 to 14. The CON treatment was based on the recommendations of the Feed Manual TN70 (Topigs Norsvin, 2015). On days 0, 5, 14 and 20 of the cycle, body weight and backfat thickness were measured. On d 21 (detected estrus), gilts were inseminated and on d 27 they were euthanized to collect embryos, ovaries and uterus. Uterus and ovaries were weighed whereas corpora lutea were counted and weighed. Blood serum was collected on d 14, and 20 for chemical analyses. Data were analyzed using the mixed procedure of SAS where each gilt was the experimental unit. Feeding regimens were considered as the fixed effect and backfat block as the random effect. Means were obtained with the LSMEANS statement. No differences ($P > 0.05$) were observed on growth performance among feeding regimens. However, when comparing the average daily gain (ADG) within feeding

regimens between feeding periods, no differences ($P > 0.05$) were observed among gilts fed CON whereas gilts fed RES showed a decreased ($P < 0.05$) ADG during d 6 to 14 compared to d 0 to 5 and to d 15 to 21. Regarding blood serum variables, gilts fed RES had higher ($P < 0.05$) total protein and potassium but lower ($P < 0.05$) sodium-to-potassium ratio than gilts fed CON on d 14. On d 20, Gilts fed RES had higher ($P < 0.05$) cholesterol values than gilts fed CON. No differences ($P > 0.05$) were observed on the number of corpora lutea, number of embryos collected or on collection efficiency. Similarly, no differences ($P > 0.05$) were observed on the weight of reproductive organs and on measurements of ovaries among feeding regimens. In conclusion, restricting feed intake of replacement gilts by 25% of the recommendation from d 6 to 14 of the estrous cycle reduced ADG without compromising their reproductive performance.

Keywords: blood chemistry, feed restriction, gilt, growth, reproduction.

Tables:

Table 1. Growth performance of gilts under conventional (CON) or restricted (RES) feeding regimen

Item	CON	RES	SEM	*P*-value
Body weight, kg				
d 0	139.4	139.4	2.6	1.000
d 5	143.0	143.5	2.9	0.905
d 14	147.7	144.6	2.8	0.439
d 20	152.3	152.5	2.6	0.965
ADG, kg				
d 0 to 5	0.720	0.820	0.195	0.693
d 5 to 14	0.522	0.198	0.131	0.099
d 14 to 20	0.810	1.302	0.358	0.346
Overall	0.672	0.655	0.149	0.936
ADFI, kg				
d 0 to 5	2.400	2.400	-	-
d 5 to 14	2.400	1.800	-	-
d 14 to 20	2.994	3.000	-	-
Overall	2.598	2.343	-	-
GF				
d 0 to 5	0.300	0.342	0.074	0.697
d 5 to 14	0.218	0.113	0.071	0.230
d 14 to 20	0.270	0.433	0.119	0.346
Overall	0.280	0.272	0.062	0.936
Back fat, mm				
d 0	9.8	9.5	0.6	0.437
d 5	10.3	10.0	0.6	0.689
d 14	11.1	10.2	0.6	0.158
d 20	11.4	11.2	0.9	0.772

ADG, average daily gain; ADFI, average daily feed intake; GF, gain to feed ratio.

Table 2. Comparison of average daily gain (ADG) of gilts under conventional (CON) or restricted (RES) feeding regimen between feeding periods

Item	CON	RES
ADG, kg		
d 0 to 5 (P1)	0.720	0.820
d 5 to 14 (P2)	0.522	0.198
d 14 to 20 (P3)	0.810	1.302
SEM	0.647	0.658
P-value		
P1 *vs*. P2	0.511	0.047
P2 *vs*. P3	0.354	0.001
P1 *vs*. P3	0.772	0.122

ADG, average daily gain.

Table 3. Embryos collected and collection efficiency from gilts under conventional (CON) or restricted (RES) feeding regimen

Item	CON	RES	SEM	*P*-value
Corpora lutea	17.0	17.0	0.7	1.000
Embryos collected	7.46	8.00	2.22	0.824
Blastocysts	4.47	6.50	2.64	0.253
Right embryos	4.00	4.20	1.21	0.909
Left embryos	3.45	3.80	1.34	0.740
Efficiency, %	43.01	48.18	14.53	0.716

Embryo collection was performed *ex-vivo* separately from the right and left uterine horns.

Table 4. Reproductive tract measurements of gilts under conventional (CON) or restricted (RES) feeding regimen

Item	CON	RES	SEM	*P*-value
Ovaries, g	21.61	22.09	2.02	0.815
CL, g	6.06	5.68	0.40	0.515
CL/Ovaries	0.287	0.260	0.025	0.197
Left ovary				
Width, cm	3.51	3.71	0.21	0.509
Length, cm	3.09	3.12	0.14	0.877
Weight, g	9.06	10.72	0.64	0.086
Average CL, g	0.351	0.335	0.022	0.618
Heaviest CL, g	0.486	0.473	0.056	0.873
Total CL, g	2.567	3.016	0.311	0.296
Right ovary				
Width, cm	3.600	3.830	0.210	0.442
Length, cm	3.404	3.040	0.310	0.149
Weight, g	12.54	11.37	1.76	0.499
Average CL, g	0.367	0.328	0.018	0.149
Heaviest CL, g	0.514	0.476	0.045	0.533
Total CL, g	3.485	2.661	0.299	0.066
Uterus, g	648.4	679.1	34.4	0.520
Organ weight relative to body weight (g/kg)				
Ovaries	0.142	0.146	0.013	0.819
Left ovary	0.060	0.071	0.005	0.113
Right ovary	0.083	0.075	0.011	0.514
Uterus	4.263	4.476	0.260	0.540

CL, corpus luteum.

Table 5. Blood serum chemistry profile of gilts under conventional (CON) or restricted (RES) feeding regimen at day 14 of the estrous cycle

Item	CON	RES	SEM	*P*-value
Na, mmol/L	141.8	141.5	0.5	0.659
K, mmol/L	4.29	4.71	0.09	0.006
Na:K	33.3	30.2	0.6	0.004
Cl, mmol/L	100.1	100.1	0.4	1.000
Ca, mmol/L	2.54	2.55	0.02	0.657
P, mmol/L	2.27	2.30	0.07	0.807
Mg, mmol/L	0.836	0.847	0.017	0.655
Total protein, g/L	67.4	70.0	1.4	0.033
Albumin, g/L	45.5	47.3	0.6	0.058
Globulin, g/L	21.9	22.7	1.5	0.442
Albumin:globulin	2.1	2.1	0.2	0.934
ALKP, U/L	95.2	89.2	7.6	0.582
GGT, U/L	32.7	34.6	4.4	0.673
Creatine kinase, U/L	1,013	1,102	184	0.738
Urea, mmol/L	3.53	3.62	0.42	0.779
Creatinine, µmol/L	150.9	163.8	5.2	0.095
Cholesterol, mmol/L	1.73	1.84	0.10	0.348
Triglyceride, mmol/L	0.251	0.242	0.033	0.847
Glucose, mg/dL	78.20	75.68	1.98	0.361
Osmolality[1], mmol/L	279.6	279.7	0.9	0.932

ALKP, alkaline phosphatase; GGT, gamma-glutamyl transferase. [1], calculated osmolality.

Table 6. Blood serum chemistry profile of gilts under conventional (CON) or restricted (RES) feeding regimen at day 20 of the estrous cycle

Item	CON	RES	SEM	*P*-value
Na, mmol/L	144.4	144.2	0.8	0.756
K, mmol/L	4.94	5.09	0.14	0.168
Na:K	29.3	28.5	0.9	0.270
Cl, mmol/L	101.6	102.2	1.0	0.498
Ca, mmol/L	2.55	2.58	0.02	0.208
P, mmol/L	2.33	2.29	0.10	0.781
Mg, mmol/L	0.928	0.910	0.021	0.557
Total protein, g/L	70.6	68.5	1.0	0.174
Albumin, g/L	47.0	47.1	0.8	0.923
Globulin, g/L	23.6	21.4	1.2	0.222
Albumin:globulin	2.05	2.26	0.13	0.274
ALKP, U/L	90.9	99.1	13.8	0.471
GGT, U/L	37.1	36.2	3.5	0.837
Creatine kinase, U/L	963	623	173	0.183
Urea, mmol/L	4.49	4.54	0.27	0.872
Creatinine, µmol/L	149.3	161.7	4.4	0.065
Cholesterol, mmol/L	2.24	2.58	0.15	0.014
Triglyceride, mmol/L	0.246	0.281	0.038	0.526
Glucose, mg/dL	79.0	78.7	2.3	0.917
Osmolality[1], mOsm/L	286.6	286.6	1.4	1.000

ALKP, alkaline phosphatase; GGT, gamma-glutamyl transferase. [1], calculated osmolality.