Deschambault Swine Test Station

27th and 28th station trials

Final Report

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Purebred Swine Performance Testing

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Table of contents

List of tables

List of figures

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Introduction

Of all animal proteins, pork is the most consumed worldwide and its consumption is projected to rise. In the market, Canada is well positioned because it is a major pork exporter reputed for its product quality and know-how. Canadian swine genetics is one of the underlying factors behind this good reputation. For many years now, swine selection is carried out based on performance testing of purebred swine for production traits and sow productivity. The performance records are used along with pedigree information to estimate the genetic potential of animals using advanced statistical methods.

These classical quantitative genetics methods have been proven to be efficient and have allowed for significant improvements on economically important traits such as litter size, growth and carcass lean yield. No specific improvement, however, has been observed on meat quality traits. There is a growing need to produce high quality pork for many domestic and international markets such as the United States and Japan. Current knowledge shows that genetics partly determines meat quality and that some quality traits are correlated, sometimes unfavourably, with traits currently included in selection schemes. In consequence, meat quality traits should be included in breeding programs in order to monitor and improve them.

In parallel, there is a revolution taking place in the swine genetic improvement sector. New tools have been made available which would allow for the identification of DNA sequences at numerous points on all chromosomes in the swine genome. These SNP (single nucleotide polymorphisms) chips contain thousands of tests on the diversity of DNA sequences of each pig. These chips are already available and have been applied in major selection programs in other species such as poultry and cattle. In pigs, the first SNP chips have been available to the industry since January 2009.

This study was designed to evaluate, in the context of the Canadian swine industry, the practical application of genomic selection for genetic improvement of different sire line traits including, more specifically, meat quality traits.

The main objectives of this project are:

- To use new genomic technologies available (SNP chips, 'Single Nucleotide Polymorphism') for genotyping station-tested pigs;
- To estimate the effects of SNPs in relation to pig performance in different breeds and lines;
- To develop methodologies to include genomics in swine genetic evaluations;
- To develop methodologies which would allow to estimate pilot genomic breeding values for several sire line traits recorded in test stations;
- Develop a DNA repository in relation with performance recorded in test stations;
- Provide guidelines regarding the use of SNP chips in swine selection for the Canadian and Quebec swine breeding sectors.

Canadian swine breeders, with the support of the Canadian Centre for Swine Improvement Inc. and regional centres as well as the collaboration of DNA LandMarks, the Food Research and Development Centre (FRDC) in Saint-Hyacinthe, the Dairy and Swine Research and Development Centre in Lennoxville, Laval University and the University of Guelph, have joined forces, their resources and means to evaluate these new tools and to confirm their position as leaders and pioneers in swine breeding. This document reports on the methodology used as well as performance information, carcass and meat quality results of station-tested pigs for these two trials. Other reports on data analysis and interpretation of results will follow.

Description of trials

This report summarizes the performance records of purebred pigs from Canadian breeders. Three breeds were evaluated: Duroc, Yorkshire and Landrace. Only barrows were introduced into the test station. Two consecutive trials were conducted at the Deschambault swine test station, with the second trial (Trial 28) being a repetition of the first (Trial 27). Trials 27 and 28 took place from November 2009 to November 2010. The acclimatization period, which takes place mainly in the nursery, corresponds to the growth period from 5.3 to 30.7 kg live weight on average. The trial, which corresponds to the testing phase, consists of the growth period for which pigs' weights increase from 30.7kg to a targeted slaughter weight of 120kg. Growth, carcass and meat quality traits were measured. During each trial, individual feed intake was measured using a computerized feeding system (Insentec^{TM}). The exact times, duration of all visits to the feeder and the quantity of feed consumed were also recorded. These data, taken continuously, allow to assess the actual consumption of pigs, but also to study their feeding behaviour.

The station-tested pigs originated from purebred swine breeding herds. In total, 19 farms provided piglets for Trial 27, 16 farms for Trial 28. Nine farms participated in both trials.

If you would like more information and obtain a complete description of the experimental protocol that was followed, the document "Trial 27-28 Protocol" is available online at the following address:

http://www.cdpqinc.qc.ca/Transfert_fichier_web/cafr/page_telechargement.awp?P1=2.

Presentation of results

1. Acclimatization period

The data gathered during the acclimatization period (in the nursery), contained in this report relate to the performance of all piglets in the test station. Raw values (breeds confounded) are presented.

1.1 Feeding program

The feeding program used during the acclimatization period was proposed by the feed supplier, La Coop Seigneurie, who won a bid to provide feed for both trials. In terms of feeding program, four cube-textured medicated feed (four phases) were used. The feeding program, nutritional constraints and the composition of the fourth feed are described in the experimental protocol of Trials 27-28.

The quantity of feed distributed per day was noted for each of the pens. Consumption calculations were made for all piglets and not on an individual basis. Feed refusals were evaluated and dead animals were considered in consumption calculations. The piglets were fed *via* a feeding-trough during the first twelve days and using a dry feeder for the remainder of the acclimatization period.

1.2 Health information

All piglets from trials 27 and 28 received a combination of medications in feed, in water and by injection to prevent health problems (Table 1 and Table 2). Additionally, piglets that showed clinical signs of disease were treated with injectable medications (Table 3). When the situation arose where numerous subjects needed to be treated, medications were administered in water for all animals requiring treatment (Table 3).

The main causes for treatment are presented in Table 5. The medication used is presented as three indicators which are defined below (Table 6):

1. The intensity of use (IU) which represents the ratio between the number of administered therapeutic doses (DT) and the number of animal-days (AD);
2. The quantity of medication used per pig;
3. The cost of medication per pig.

The main causes of mortality or euthanasia are shown in Table 7.

At the beginning of the acclimatization phase of Trial 27, the piglets were affected by an *influenza* virus, which explains why twice as many treatments were administered to piglets from Trial 27 compared to Trial 28. During Trial 27, the main reasons for treatment were overall poor condition and respiratory problems, whereas in Trial 28, digestive problems were more important followed by overall poor condition and respiratory problems (Table 5).

Furthermore, in Trial 27, 20 out of 365 piglets died, which represents a mortality rate of 5.48%. In Trial 28, only 10 piglets out of 336 died, representing a mortality rate of 2.98% (Table 7). In both trials, the majority of these deaths occurred in the nursery within the first three weeks. In Trial 27, these were mainly sudden deaths or deaths related to respiratory problems whereas in Trial 28, they were sudden deaths (Table 7).

During Trial 27, when transferring to the finishing barn, azaperone (Strenil) was used at a dose of 1.4 mg/kg in with the aim of reducing fights between pigs. The medication did not appear to reduce fights, so piglets from Trial 28 were not administered azaperone upon transfer to the fattener-finisher phase.

1.3 Performance

Table 4 shows the growth and consumption of piglets during the acclimatization phase. The average acclimatization phase was 51 days, with piglets weighing 5.3 kg on entry and 30.7 kg at the end of the phase. For this period, an ADG of 489 grams/day and a feed conversion on live weight gain of 1.48 was obtained. Feed conversion was calculated using overall feed consumption and gains and not with individual measures.

2. Testing phase

The data collected during the testing phase are shown in Tables 11 to 14, including averages, standard deviation, minimum, maximum and number of animals. The presented averages are raw averages, which mean that the breeds are confounded and no adjustments were made to account for weight or any other factor.

2.1 Sampling

For the breeds under study, a total of 671 animals began the trials, including 345 for Trial 27 and 326 for Trial 28. From this number, data records from 635 animals were included in analyses, 328 for Trial 27 and 307 for Trial 28.

Table 9 shows the distribution of pigs kept for analyses. Approximately 30% were Duroc pigs, 31% Landrace pigs and 39% Yorkshire pigs. The number of sires used varies from 69 to 97 sires per breed.

2.2 Data editing

Of the 36 pigs which began the trial but weren't retained for analyses, 23 died during the trials (10 in Trial 27 and 13 in Trial 28), 7 were excluded for health reasons and 6 animals were excluded because they were not properly castrated.

2.3 Health information

A group treatment consisting of penicillin V in water was administered in the first weeks of the fattening period in both trials because many pigs showed symptoms of lameness. However, no growth factors were used. Only pigs showing clinical signs of disease were treated with injectable drugs (Table 3).

In both trials, there were several cases of lameness which more or less responded well to treatment with penicillin in water and given *via* injection as well as injections of trimethoprim sulfa. During Trial 28, an autopsy was performed on two animals to determine a diagnosis. Following the diagnosis, the treatment by injection for lameness was modified. Instead of using penicillin or trimethoprim sulfa, lincomycin was used to treat lame pigs. A better response to treatment was then observed. In retrospect, it is strongly suspected that the cases of lameness observed in Trial 27 were caused by the same pathogens as in Trial 28.

It is found that the number and proportion of treated animals during the evaluation period of Trial 27 (124 of 336 animals; 1710 TD (water), 490 TD (injectable)) is slightly lower than for Trial 28 (140 animals of 316; 3260 TD (water), 545 TD (injectable)) (Tables 7 and 8). The Penicillin V Potassium treatment in water was administered for a period about two times longer in Trial 28 than for Trial 27, which explains why the TD for water is approximately two-fold higher for this trial.

During the testing phase, the mortality rate during Trial 27 was 2.9%, and deaths were mainly due to sudden death (6 cases), followed by wasting (2 cases), locomotion problems (1 case) and other conditions (1 case). During Trial 28, the mortality rate during the testing period was 3.99%. These deaths were related to cases of sudden death (7 cases) or to other causes (Table 7).

The results of serological tests carried out at the end of the trials are presented in Table 8. These controls allow establishing the health status of the batches of pigs with regards to PRRS, pleuropneumonia (*Actinobacillus pleuropneumoniae*) and *Mycoplasma hyopneumoniae*. The health status of both batches of pigs entered was negative for PRRS and positive for *Mycoplasma hyopneumoniae*. The Trial 27 batch was negative for pleuropneumonia whereas it was positive for Trial 28.

2.4 Feeding behaviour

The computerized equipment used in the trials for the distribution of feed collects data which allows studying the feeding behaviour of pigs. Our results were analyzed by confounding all pig breeds (all barrows) for the testing periods. We did not study the feeding behaviour in the acclimatization phase. Table 10 presents the feeding behaviour parameters that were studied. Only the descriptive statistics are shown, and the differences between testing periods have not been statistically analyzed. Every pig spends an average of 62 minutes per day at the feeder, which accounts for an overall occupation rate of about 52%. This rate varied very little during the growth of pigs. It then seems that the availability of the feeder in the pen is sufficient, on average, considering the number of pigs in each pen. This is also confirmed by the fact that 83% of the occupation period at the feeder takes place during the day (from 4:45 am to 9 pm), which still leaves plenty of time for feeding during the night.

In Figures 1 and 2, the evolution of the average daily feed intake for trials 27 and 28, respectively, are shown. A curve showing the evolution of the average temperature inside the building was added to the graphs. The graphs show that feed intake by pigs recovered very quickly after weigh-ins or when feed was changed during phases.

2.5 Performance

The average performance data are shown in Tables 11 and 12 (breeds confounded). The average initial weight was 30.8 kg whereas the final weight was 120.4 kg. The average daily gain was 1015 g/day and the feed conversion was 2.53. The performance data are considered excellent for purebred barrows originating from various herds, especially since no growth factor was offered as a preventive measure during the testing phase. The conditions in the test station therefore allowed pigs to adequately express their genetic potential.

2.6 Carcass and meat quality

The results pertaining to carcass quality are presented in Table 13. The cutting up of carcasses is standardized and respects the primal pork cuts presented in the Canadian Pork Buyers Manual. The carcasses were cut into four primal cuts: ham, loin, shoulder and belly. The average weights for each of the cuts as well as the average weight ratio of each cut with respect to the reconstituted half carcass weight are presented (all breeds confounded).

The meat quality results are presented for the loin and the ham in Table 14. The different measures are described in CDPQ's manual on the methods to evaluate meat quality.

Conclusion

Trials 27 and 28 had mortality rates comparable to previous purebred trials, that is to say slightly higher mortality rates than during commercial tests. During the testing phase, the mortality rates were low (<5%) in both tests, with the mortality rate in Trial 27 being slightly lower than the one from Trial 28.

During both trials, the pigs had excellent growth performance, which indicates that the conditions in the station allowed animals to correctly express their genetic potential. The performance observed for numerous traits (i.e. growth rate, meat quality, etc.) were comparable to those observed during other previous trials. Throughout these trials, a few abnormally high or low performance data (i.e. feed conversion, marbling, etc.) can be partly explained because only barrows were evaluated in trials 27 and 28 compared to previous tests which also included females and intact males.

These two trials have allowed us to collect the performance information as well as the DNA samples necessary to carry out the analyses in line with the pursued objectives of this genomic study. These data will be analyzed by the Canadian Centre for Swine Improvement, Inc. (CCSI) and other partners as part of this research project.

Table 1 Program of preventive medication in the feed during the acclimatization period (trials 27 and 28)

Feed	Medication	Antibiotic content	Duration (d)	Medication (g/pig)	Costs ($/pig[5])
Phase 1	Chlortetracycline[1] Tiamulin[2]	110 mg/kg 31 mg/kg	8	0.16	$0.001405
Phase 2	Non medicated	---	7	---	---
Phase 3	Trimethoprim-sulfas[3]	450 mg/kg	10	3.51	$0.22
Phase 4	Trimethoprim-sulfas[3] Tylosin[4]	450 mg/kg 44 mg/kg	6	3.62	$0.22
Phase 5	Tylosin[4]	44 mg/kg	11	0.63	$0.01
	Total for Trial 27		**42**	**7.92**	**$0.45**
Phase 1	Chlortetracycline[1] Tiamulin[2]	110 mg/kg 31 mg/kg	7	0.17	$0.001505
Phase 2	Non medicated	---	6	---	---
Phase 3	Trimethoprim-sulfas[3]	450 mg/kg	9	4.09	$0.26
Phase 4	Tylosin[4]	44 mg/kg	25	0.76	$0.02
	Total for Trial 28		**47**	**5.02**	**$0.28**

[1] Aureomycin 220® by Alpharma

[2] Denagard® by Novartis

[3] Uniprim® by Bio-Agri-Mix

[4] Tylan 40® by Elanco

[5] CDMV price excluding taxes

Table 2 Program of preventive medication in the water (H_2O) and by injection (Inj.) during the acclimatization period (trials 27 and 28)

Path	Medication	Antibiotic content	Weight (kg)	Dosage (mg/kg)	Duration (d)	Medication (g/pig)	Costs ($/pig[7])
H_2O	Tiamulin[1]	100 mg/L	6	31.5	5	0.95	0.79
Inj.	Circovirus vaccine[2]	1 dose	10.65	---	1	1.00	1.70
Inj.	Doramectin[3]	10 mg/ml	15.5	0.5	1	0.01	0.45
Inj.	Mycoplasma vaccine[4]	1 dose	19.6	---	1	2.00	0.36
Inj.	Azaperone[5]	40 mg/ml	29.2	1.4	1	0.04	0.68
H_2O	Proliferative enteropathy vaccine[6]	1 dose	34.70	---	1	1.00	2.12
Total for Trial 27					**10**	**5.00**	**6.10**
H_2O	Tiamulin[1]	100 mg/L	6	31.5	5	0.95	0.79
Inj.	Circovirus vaccine[2]	1 dose	12.8	---	1	1.00	1.70
Inj.	Doramectin[3]	10 mg/ml	14.61	0.5	1	0.01	0.49
Inj.	Mycoplasma vaccine[4]	1 dose	17.5	---	1	2.00	0.36
H_2O	Proliferative enteropathy vaccine[6]	1 dose	34.70	---	1	1.00	2.12
Total for Trial 28					**9**	**4.96**	**5.46**

[1] Denagard® by Novartis

[2] Circoflex® by Boehringer

[3] Dectomax® by Pfizer

[4] M+Pac® by Boehringer

[5] Stresnil® by Merial

[6] Enterisol Ileitis by Boehringer

[7] CDMV price excluding taxes

Table 3 Curative medication used in pigs from Trials 27 and 28

Path	Medication	Dosage	Weight (kg)	Dosage (mg/kg)	Duration (d)	Medications (g/10 kg)	Costs ($/10 kg[12])
Inj.	Ketoprofen (100)[1]	100 mg/ml	10	3	3	0.09	1.17
Inj.	Ceftiofur (RTU) [2]	50 mg/ml	10	75	3	0.225	3.83
Inj.	Tylosin[3]	200 mg/ml	10	8	3	0.24	0.42
Inj.	Penicillin[4]	300 mg/ml	10	45	4	1.8	0.47
Inj.	Trimethoprim-sulfa[5]	240 mg/ml	10	16	4	0.64	0.41
Inj.	Dexamethasone[6]	2 mg/ml	10	0,133	5	0.007	0.36
Inj.	Tulathromycin[7]	100 mg/ml	10	25	1	0.025	0.43
Inj.	Ceftiofur[8]	100 mg/ml	10	5	1	0.05	0.43
Inj.	Lincomycin Hydrochloride[9]	100 mg/ml	10	10	3	0.3	1.07
H_2O	Penicillin V potassium[10]	098 g/g	52.6	20	5	1.00	0.11
H_2O	Penicillin V potassium [11]	098 g/g	29.05	20	10	2.00	0.22

[1] Anafen® by Merial

[2] Excenel RTU® by Pfizer

[3] Tylan 200® by Elanco

[4] Depocillin® by Intervet

[5] Borgal® by Hoechst

[6] Dexamethasone 2® by Vétoquinol

[7] Draxxin® by Pfizer

[8] Excede 100® by Pfizer

[9] Lincomix 100® by Pfizer

[10] Penicillin V potassium in soluble powder by Bond and Beaulac for Trial 27

[11] Penicillin V potassium in soluble powder by Bond and Beaulac for Trial 28

[12] CDMV price excluding taxes

Table 4 Performance of piglets during the acclimatization period of Trials 27-28

Number of piglets		701
Initial age (days)		17.9
Final age (days)		69.2
Duration (days)		51.1
Initial weight (kg)		5.3
Final weight (kg)		30.7
ADG (g/day)		489
Feed (kg)[1]		25 314
Consumption (kg)	/day	0.724
	/piglet	36.1
Feed conversion		1.48

[1] Includes 20 782 kg of feed – nursery and 4 532kg of starting feed

Table 5 Individual treatment reasons during the acclimatization and test periods

	Trial 27		Trial 28	
Treatment reasons[1]	**Acclimatization**	**Test**	**Acclimatization**	**Test**
Overall poor condition	36	9	8	28
Locomotor problems[2]	7	94	2	100
Digestive problems	3	1	11	4
Respiratory problems	9	20	7	3
Nervous system problems	1	0	5	0
Other conditions	2	0	1	5
Total number of pigs treated	**58**	**124**	**34**	**140**

[1] A subject may have been treated several times for various causes.

[2] Since a large proportion of fattening pigs exhibited lameness and required treatment, and this, in both trials, it was decided to initiate treatment of penicillin V potassium in drinking water for all pigs in both batches. These treatments are not included in this table, but part of Table 3.

Table 6 Treatments administered to pigs from Trials 27 (n = 365) and 28 (n = 336) during the acclimatization period (A) and the test period (T)

Local	Administration (justification)	AD[1] (n)	TD[2] (n)	IU[3] (%)	Medications[4] (g/pig)	Costs[5] ($/pig)
A	Feed (preventative)	21 864	12 425	56.83	7.91	0.46
A	Water (preventative)	21 864	1 785	8.16	1.50	1.26
A	Injectable (preventative)	21 864	1 390	6.36	3.05	3.19
A	Injectable (curative)	21 864	108	0.49	0.35	1.11
T	Water (preventative)	29 169	344	1.18	1.00	2.12
T	Water (curative)	29 169	1 710	5.86	5.00	0.55
T	Injectable (curative)	29 169	490	1.68	6.70	3.27
A – T	**Total for Trial 27**	**51 033**	18 252	80.56	**25.51**	**11.96**
A	Feed (preventative)	16 055	13 987	87.12	5.02	0.28
A	Water (preventative)	16 055	1 680	1.05	1.50	1.26
A	Injectable (preventative)	16 055	993	6.18	3.01	2.55
A	Injectable (curative)	16 055	109	0.68	1.33	1.21
T	Water (preventative)	29 829	326	1.09	1.00	2.12
T	Water (curative)	29 829	3 260	10.93	5.81	0.64
T	Injectable (curative)	29 829	545	1.83	5.12	4.20
A - T	**Total for Trial 28**	**45 884**	20 900	108.88	**22.79**	**12.26**

[1] Animal-days (AD). This indicator represents the cumulative number of animals present every day in the nursery and in the grow-finish phase (Eg. D1 = 50 animals, D2 = 50 animals, D3 = 49 animals, Total AD = 149 animals).

[2] Number of therapeutic doses administered (TD). This indicator is equivalent to the number of "AD in treatment."

[3] Intensity of use (IU). This indicator represents the ratio between TD and AD.

[4] Sum of medication consumed in the premise / average number of pigs in the premise (for the acclimatization phase or the testing period before the first batch of pigs is slaughtered).

[5] Sum of the costs of each treatment in the premise / Final number of pigs in the premise (for the acclimatization phase or the test period before the first batch of pigs is slaughtered).

Table 7 Causes of death

	Trial 27		Trial 28	
	Acclimatization	**Test period**	**Acclimatization**	**Test period**
Poor condition[1]	0	0	0	0
Wasting	0	2	0	0
Locomotor problems	0	1	0	0
Nervous syst. problems	0	0	0	0
Respiratory problems	9	0	0	0
Sudden death	9	6	10	7
Meningitis	0	0	0	0
Other conditions	2	1	0	6
Total number (%)	**20/365 (5.48)**	**10/345 (2.9)**	**10/336 (2.98)**	**13/326 (3.99)**

[1] Piglets in poor conditions at the arrival to the test station (0-3 day(s))

Table 8 Serological controls at the end of the test period

	Trial 27		Trial 28	
	Number of pigs tested	**Number of positives**	**Number of pigs tested**	**Number of positives**
PRRS virus[1]	20	0	20	0
Pleuropneumonia (multi)[2]	20	0	20	3
Mycoplasma hyopneumoniae[3]	20	5	20 ELISA 1 PCR	3/20 (2 positives et 1 suspect) 0/1

[1] ELISA IDEXX Test (Laboratoire FMV)

[2] ELISA App multi Test (*Actinobacillus pleuropneumoniae*, all serotypes) (Laboratoire FMV)

[3] ELISA IDEXX Test (Laboratoire FMV)

Table 9 Distribution of sires, litters, herds and barrows per breed[1]

	Duroc	**Landrace**	**Yorkshire**
Number of sires used	69	72	97
Number of litters	132	151	172
Number of herds	15	19	22
Number of barrows	191	196	248

[1] For the number of piglets entered into the station and for which their data were used for analyses

Table 10 Feeding behaviour data

	Total length of visits/ pig/ day (min)	Number of visits/ pig/ day	Average meal size (g) of pigs	Rate of ingestion (g/min)	Average duration of visits (min)	% of time the feeder was busy prior to the first slaughter	% of total visit time occurring when light is on	% of total visit time occurring from 4h45 to 21h
All								
Overall	61.8	18.8	202.8	51.5	4.9	51.8	51.9	82.5
30-50 kg	61.8	20.3	124.9	36.8	4.6	50.9	47.3	78.9
50-75 kg	64.9	20.2	185.0	46.7	5.0	52.8	48.9	81.2
75-120 kg	59.8	17.0	261.4	63.4	5.1	51.7	55.5	84.9

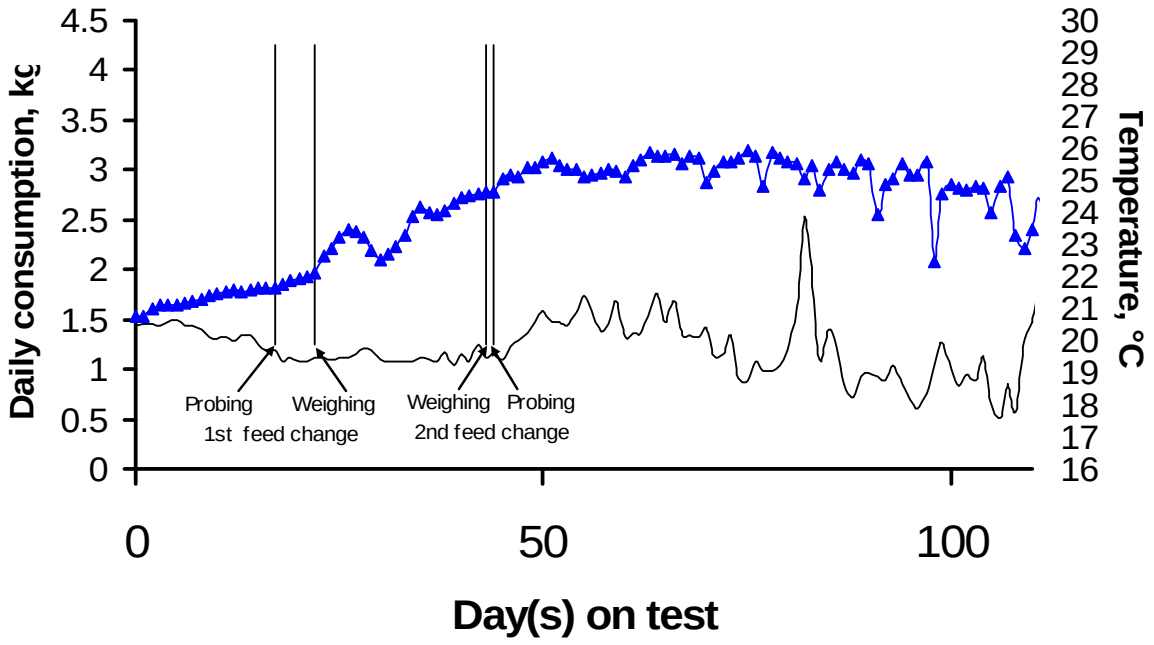

Figure 1 Evolution of the average daily consumption (▲) and temperature during Trial 27

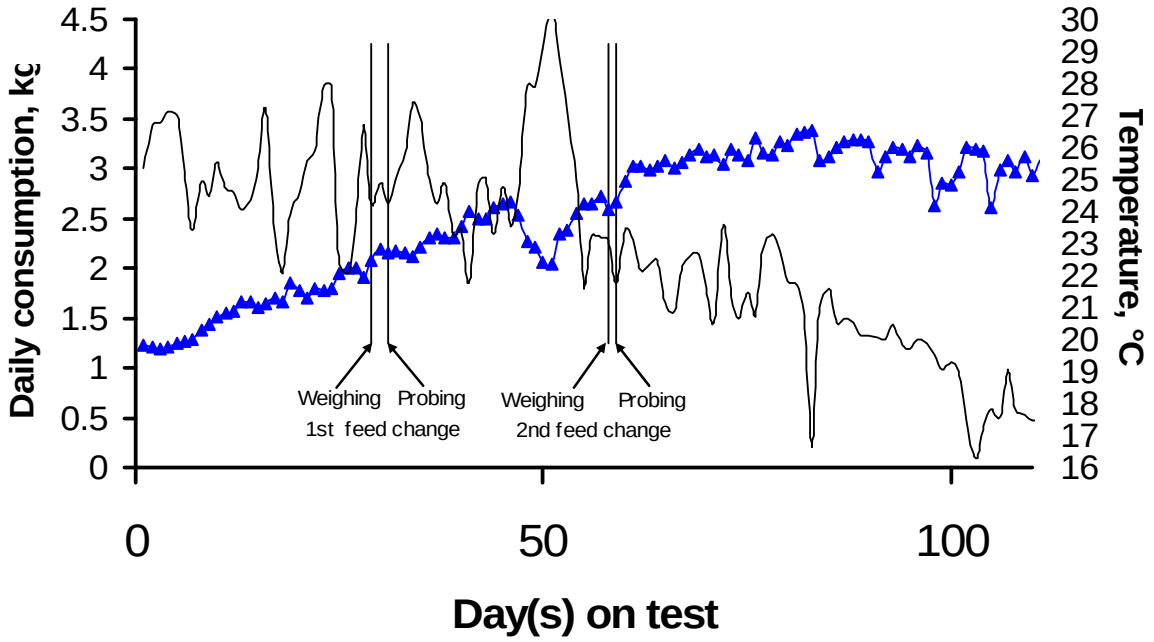

Figure 2 Evolution of the average daily consumption (▲) and temperature during Trial 28

[1] Average temperature calculated = the averages of minimum and maximum temperatures

Table 11 Performance (all breeds confounded)

Parameters	N	Mean	Std dev	Min	Max
Growth performance					
Off-test age (days)	635	158.41	10.10	137.00	189.00
Duration (days)	635	89.13	12.41	69.00	118.00
On-test weight (kg)	635	30.80	7.98	12.00	51.50
Off-test weight (kg)	635	120.38	4.47	94.50	133.50
Average daily gain (g/day)	635	1014.53	97.58	675.26	1304.35
Pre-slaughter backfat (Ultrasound) (mm)	632	16.63	3.83	9.20	32.00
Pre-slaughter lean depth (Ultrasound) (mm)	632	60.24	4.77	42.56	76.90
Feed intake performance					
Total feed intake (kg)	635	226.19	22.77	165.08	306.47
Daily feed intake (kg/day)	635	2.53	0.25	1.75	3.40
Feed conversion	635	2.53	0.19	1.97	3.18
Carcass yield					
Hot carcass weight (kg)	634	95.81	3.80	76.30	107.90
Carcass yield (%)	634	79.60	1.47	74.82	85.74
Backfat (Destron) (mm)	610	19.21	4.36	10.00	63.50
Lean depth (Destron) (mm)	610	64.11	5.43	39.00	81.50
Lean yield (%)	608	60.58	1.75	54.76	65.13
Index (Quebec slaughter grid)	576	112.43	3.32	95.00	115.00

Table 12 Performance by phase

Parameters	N	Mean	Std dev	Min	Max
Measurements at weighing					
On-test weight (kg)	635	30.80	7.98	12.00	51.50
Weight at first feed change (kg)	635	52.26	8.79	25.00	75.00
Weight at second feed change (kg)	635	77.66	10.85	41.00	106.50
Off-test weight (kg)	635	120.38	4.47	94.50	133.50
Backfat 50 kg (mm)	634	8.24	1.72	4.10	15.90
Backfat 75 kg (mm)	635	11.12	2.46	4.90	21.60
Pre-slaughter backfat (mm)	632	16.63	3.83	9.20	32.00
Lean depth 50 kg (mm)	635	44.30	5.69	24.50	73.40
Lean depth 75 kg (mm)	635	53.30	5.21	36.60	70.00
Pre-slaughter lean depth (mm)	632	60.24	4.77	42.56	76.90
Performance per period					
Daily feed intake 30-50 kg (kg/day)	635	1.69	0.33	0.74	2.92
Daily feed intake 50-75 kg (kg/day)	635	2.41	0.36	1.01	3.55
Daily feed intake 75 kg to the end (kg/day)	635	3.13	0.34	1.88	4.26
Average daily gain 30-50 kg (g/day)	635	876.57	148.98	285.71	1309.52
Average daily gain 50-75 kg (g/day)	635	1023.29	149.29	214.29	1428.57
Average daily gain 75 kg to the end (g/day)	635	1097.84	144.54	509.09	1526.32
Feed conversion 30-50 kg	635	1.95	0.31	1.40	3.72
Feed conversion 50-75 kg	635	2.37	0.30	1.54	4.71
Feed conversion 75 kg to the end	635	2.95	0.27	2.23	3.94

Table 13 Carcass Quality

Parameters	N	Mean	Std dev	Min	Max
Primal cuts					
Reconstituted half carc. (kg)	610	41.31	1.78	32.46	47.83
Loin eye area (cm^2)	603	46.64	5.24	30.73	64.00
Half carcass length (cm)	626	83.49	2.32	72.64	90.17
Leg weight (kg)	611	10.74	0.59	8.63	12.36
Loin weight (kg)	613	11.15	0.90	8.20	14.23
Shoulder weight (kg)	611	11.64	0.70	9.01	14.44
Belly weight (kg)	613	7.78	0.63	5.59	9.72
Leg yield (%)	610	26.00	1.10	22.85	29.76
Loin yield (%)	610	26.97	1.66	21.74	31.98
Shoulder yield (%)	610	28.19	1.30	24.18	33.08
Belly yield (%)	610	18.85	1.27	15.15	23.83

Table 14 Meat quality

Parameters	N	Mean	Std dev	Min	Max
Loin					
Ultimate pH	621	5.62	0.13	5.33	6.54
Luminosity	622	51.63	2.99	40.39	60.09
Color	626	3.47	0.51	2.25	5.50
Marbling (NPPC)	626	2.77	0.81	1.00	5.25
Drip loss (%)	626	3.50	2.30	0.10	11.05
Ham					
Ultimate pH	622	5.61	0.12	5.35	6.70
Luminosity	622	51.77	3.06	41.50	61.13
Color	622	3.80	0.57	2.50	5.50

APPENDIX 1 – Definition of parameters

Parameters	Abbreviations (units)	Description
Nursery-Growth Performance		
Age	Age (d)	Age at the beginning and at the end of the period For the overall period and for each of the feeding phases
Duration	Duration (d)	End date – Start date of the period For the overall period and for each of the feeding phases
Weight	Weight (kg)	Weight at beginning and at the end of the period For the overall period and for each of the feeding phases
Average Daily Gain	ADG (g/d)	(Final weight – initial weight) / number of days For the overall period and for each of the feeding phases
Total feed consumption	Feed (kg)	Total quantity to feed consumed for all piglets during the period For the overall period and for each of the feeding phases
Consumption per day*	Consumption/day (kg/d)	Consumption per piglet per day For the overall period and for each of the feeding phases
Consumption per piglet*	Consumption/piglet (kg/piglet)	Total consumption per piglet For the overall period and for each of the feeding phases
Feed conversion on live weight gain*	F.C. live weight gain	Overall consumption for all pens/live weight gain for all piglets. For the overall period and for each of the feeding phases

*Feed consumption in the nursery will be measured for all piglets and not on an individual basis.

Test-Growth Performance		
Age at the beginning of the trial	Initial age (d)	Age at the beginning of the trial
Age at the end of the test	Final Age (d)	Age at the day of shipment to the slaughterhouse prior to fasting
Duration of test	Test Duration (d)	Date at the end of the test – Date of the beginning of test
Weight at the beginning of test	Initial Weight (kg)	Weight at the beginning of test
Weight at the end of the test	Final weight (kg)	Weight on the day of shipment prior to fasting
Average Daily Gain	ADG (g/d)	Final weight – Initial weight / number of days of presence For the overall period and for each of the feeding phases
Repeated measures		
Backfat thickness	Backfat (mm)	Backfat thickness measurement between the 3rd and 4th last ribs on the live animal (at 50, 75 and 120kg) with an ultrasound machine (mode B)
Lean Depth	Lean depth (mm)	Loin lean depth measurement between the 3rd and 4th last ribs on the live animal (at 50, 75 and 120kg) with an ultrasound machine (mode B)

Feed Efficiency Performance		
Total consumption per pig	Total consumption per pig	Total consumption per pig
Daily feed consumption per pig	Daily feed consumption per pig	Daily feed consumption per pig
Feed conversion on live weight gain	Feed conversion on live weight gain	Feed conversion on live weight gain

Parameters	Abbreviations (units)	Description
Carcass Yield		
Hot carcass weight	Hot weight (kg)	Hot carcass weight after bleeding and evisceration with head, tongue, leaf fat, kidneys, jowl, feet and no trimmings
Carcass yield	Carcass Yield (%)	(Hot carcass weight / Final live weight at the end of the test) x 100
Classification index (good stratum)	Average Index	Average Index of carcasses that are in the good stratum of defined weight according to the grading grid in effect
Lean yield	Lean Yield (%)	Carcass lean yield calculated from the prediction equation established by Agriculture and Agri-Food Canada
Half-carcass length	Length (cm)	Measure on the head side of the first rib to the anterior part of the pubic bone (Foster rule)

Parameters	Abbreviations (units)	Description
Primal cut		
Half-carcass weight	½ carcass weight recons. (kg)	Half carcass weight reconstituted from the 4 primal cuts (ham, loin, shoulder and belly)
Loin eye area	Loin eye area (cm^2)	Area obtained from a picture using a digital camera and the image J software.
Ham weight	Ham weight (kg)	Cut perpendicular to the inferior part of the leg. Cut line at 4.5 cm (1 ¾ inch) from the anterior part of the pubic bone. Without the hind feet and tail.
Loin weight	Loin weight (kg)	The loin is separated from the belly by a cut which being at the extremity of the shoulder, starts at 4.5 cm (1 ¾ inch) from the base of the ribs, extends to 10cm (4 in) at the center of the loin and ends at the thigh extremity by running alongside the tenderloin at 2 cm (3/4 inch).
Shoulder weight	Shoulder weight (kg)	The shoulder is separated from the loin and the belly by a saw cut perpendicular to the back passing through the centre of the 3rd rib.
Belly weight	Belly weight (kg)	See description of the loin
Ham and ½ carcass ratio	Ham yield (%)	(Ham weight / Half carcass weight) x 100
Loin and ½ carcass ratio	Loin Yield (%)	(Loin weight / Half carcass weight) x 100
Shoulder and ½ carcass ratio	Shoulder Yield (%)	(Shoulder weight / Half carcass weight) x 100
Belly and ½ carcass ratio	Belly yield (%)	(Belly weight / Half carcass weight) x 100

Parameters	Abbreviations (units)	Description
Meat quality		
Loin: Measurement on the Longissimus dorsi muscle between the 3rd and the 4th last ribs, 24 hours after slaughter *Ham : Measures recorded on the Gluteus medius muscle, 24 hours after slaughter*		
pH 24h (loin and ham)	Ultimate pH	pH measurement at two (2) locations in the loin muscle using a pH meter. The pH of the ham is measured in the *gluteus medius* muscle.
Minolta (L*a*b) (loin and ham)	Luminosity	Reflectance measurement taken at two locations in the loin muscle with a Minolta CR300. A reflectance measure of the ham is also taken in the *gluteus superficialis* muscle.
Visual Colour Score (loin and ham)	Colour	Scores determined by comparison to Meat Colour Samples from the Japanese Colour Scale (1 to 6). In the ham, the colour score is determined on the *gluteus superficialis* muscle
Visual Marbling Score measured on the loin	Marbling NPPC	Measure of marbling level according to the NPPC Scale (1 to 10).
Loin drip loss	Drip loss (%)	Measure performed on a muscle tissue sample collected from the anterior portion of the loin and drip dried for 48 hours. (Water loss of muscle / fresh muscle weight) x 100