The new stress negative Pietrain line developed at the Faculty of Veterinary Medicine of the University of Liege.

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Introduction

The development of a new stress negative Pietrain line was launched at the Faculty of Veterinary Medicine of the University of Liege in the 1980's.

Two main objectives of the project were defined. Firstly fundamental research was required on the Halothane locus and its impact on meat production and quality, especially in a specific genetic background like the Pietrain which is completely different from other halothane positive lines.

Secondly, there was a increasing requirement for pigs that were completely free of the stress gene, both to reduce carcass loss due to unacceptable pH levels and though PSE-PSS syndrome and to meet consumer requirements for a reduction in pre-medication before transport.

The Pietrain ReHal (resistant to halothane anaesthetic gas) was created by Hanset and co-workers by intogressing the negative stress gene (N) from the Large White into the Pietrain. The background Pietrain genome has been recovered by successive backcrossing. The first backcross generation (BC1) were 75% Pietrain, and at the present moment the seventh backcross (BC7) has been reached.

In 1998, a total of 600 pigs, stress negative animals heterozygotes (Nn) that are 99.6% Pietrain and also homozygotes (NN), born to Nn parents, constitute the foundation sire line of the research station farm at the campus of Sart Tilman (University of Liege).

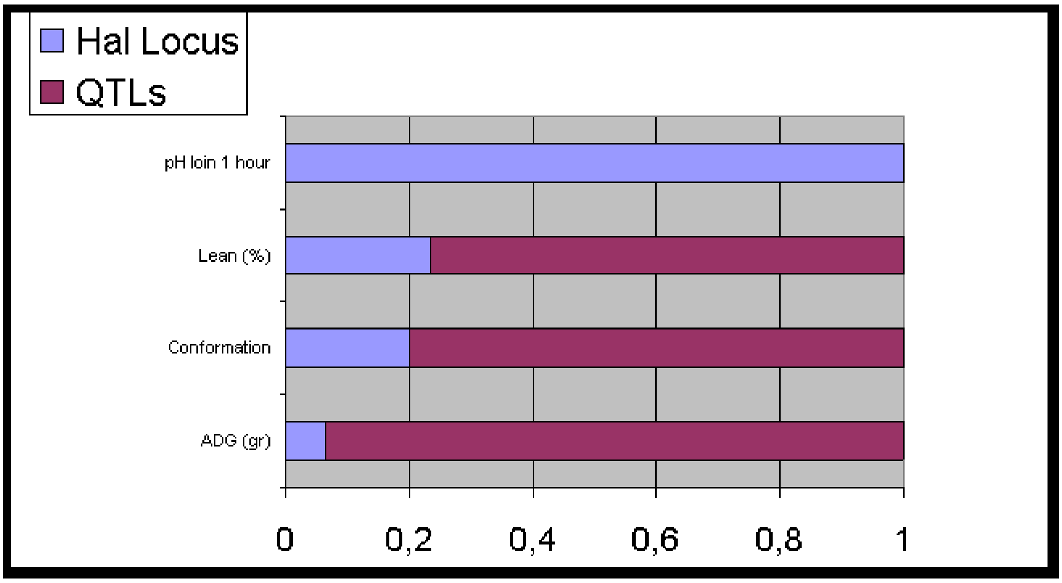
Relative importance of Halothane locus and QTLs

At the beginning of the project, Nn animals (F1) were crossed in order to obtain the F2 which gave information about the contribution of the 3 genotypes (NN, Nn, nn) of the Halothane locus to the total variation.

The main conclusions of the experiment conducted by Hanset et al. were that:

- for the different traits, Nn animals are closer to stress negative homozygote animals,
- homozygotes nn of the F2 are clearly different from pure Pietrain animals,
- the role of other genes (Quantitative Trait Loci (QTL)) and their relative importance obtained from the results of the F2 (figure 1.) indicate that the Hal locus explains nearly 100% of the variation in pH; QTL have an important effect on other traits than the pH.
- QTLs have to be identified and there is a certain selection potential.

Figure 1 . Percentage of the variation explained by the Hal locus and QTLs (F2 of the Pietrain x Large White cross - adapted from Hanset et al., Nezer and Georges).



The used of ReHal boars in station

Three commercial sow lines were obtained from a private company (Detry SA) and transferred in November 1995 to the University station as part of a project co-financed by IRSIA-IWONL.

The objective of the study was to estimate growth and carcass performance of ReHal (Nn) boars on commercial sows under station conditions.

The 3 sow lines (L, F, N) were crossed with ReHal boars. Due to the more recent introduction of the N line, growth and carcass data were available for two sow lines (F and L) only. All the animals were born in 1996 and 1997, slaughtered in 1997 and received the same feed composition with the same management conditions.

An integer value (from 11(best) to 17 (worst)), considered as a subjective ranking of the carcass, and an estimated meat percentage (obtained from a camera giving the SKG2 meat percentage estimation) were available from the system currently used by the private slaughterhouse participating in the study.

The growth and carcass performances of the total data set (83 NN, 188 Nn, 72 nn and 37 with unknown halothane genotype) indicate clearly that the reconstruction of the Pietrain breed has been almost attained (table 1).

The Europe ranking distribution shows that more than 85% of the pigs are in the S and E highest classes (table 2).

The pigs born from ReHal boars used as terminal boars are also characterised, on average, by a feed efficiency of 2.959, a daily gain during the fattening period of 649 g, a killing out percentage of 82.6 percent with an SKG2 meat percent estimation of 58.55 and a back fat thickness of 2.005 cm.

A linear fixed model including sow line (L, F), genotype (NN, Nn, nn) and sex does not explain the differences in weaning weight. The same model including weaning weight as a covariate explains 12.6%

of the variation in slaughter weight. The effect of genotype on slaughter weight corrected for weaning weight was not significant.

A third fixed linear model including sow line (L, F), genotype (NN, Nn, nn), sex fixed effects and weight at weaning and weight at slaughter as a covariable explained from 6.3 to 18.1 of the variation in carcass traits (table 3). The percentage of variation explained by each effect of the linear model on the traits is given in figure 2.

Table 1. The use of ReHal boars on station. Growth and carcass performance of pigs obtained from ReHal parents at the Research Station farm of the University of Liege (total data, 380 animals).

Variable	Mean	Std Error
BIRTH_W	1.592	0.021
WEAN_W	7.695	0.085
SLAU_W	114.485	0.737
SUBJ_RK	14.200	0.054
CARC_LG	83.299	0.174
CARC_W	95.948	0.504
KO_PERC	82.647	2.605
MEAT%	58.557	0.177
BACK_FT(cm)	2.005	0.031
PH LOIN 1H	6.289	0.015
pH LOIN 24	5.721	0.010

Birth weight (BIRTH_W), Weaning weight (WEAN_W), Slaughter weight (SLAU_W), Subjective ranking (SUBJ_RK), Carcass length (CARC_LG), Carcass weight (CARC_W), Killing out % (KO_PERC), Percentage of meat (MEAT %), Back fat thickness (BACK_FT), pH loin after 1 Hour (PH LOIN 1H), pH loin after 24 hour (PH LOIN 24).

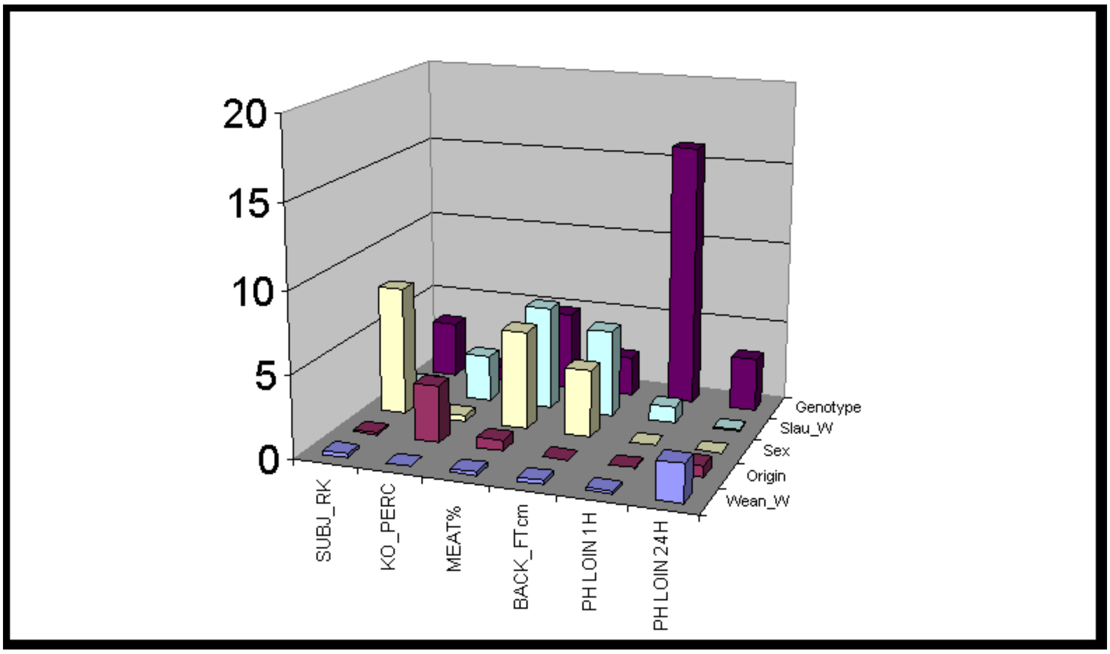
Table 2. The use of ReHal boars on station. Europe carcass ranking of pigs born from different commercial sow lines crossed with ReHal boars (station results, no O and P class).

EUROP	Frequency	Percent
S	123	35.9
E	171	49.9
U	48	14.0
R	1	0.3

Table 3 . The use of ReHal boars on station. Percentage of the variation (R^2%) of the different traits explained by the linear model including sow line, genotype, sex fixed effects and weaning weight and slaughter weights as covariate.

Subjective ranking	(SUBJ_RK)	12.3
Killing out p%	(KO_PERC)	7.5
Percentage of meat	(MEAT %)	18.1
Back fat thickness	(BACK_FT(cm))	12.1
pH loin after 1 Hour	(PH LOIN 1H)	17.3
pH loin after 24 hour	(PH LOIN 24	6.3

Figure 2. The use of ReHal boars on station. Percentage of the variation (R^2%) of subjective ranking (SUBJ_RK), carcass length (CARC_LG), killing out % (KO_PERC), percentage of meat (MEAT %), back fat thickness (BACK_FT), pH loin after 1 Hour (PH LOIN 1H), pH loin after 24 hour (PH LOIN 24) explained by the different effects included in the linear model.



The use of ReHal heterozygote (Nn) boars on commercial sow lines

In parallel with the study of the ReHal on station, where ReHal animals have been continuously produced from heterozygote ReHal sows (Nn) and new Pietrain (nn), another experiment was set up in order to test the ReHal line under commercial conditions.

5,002 piglets were obtained from sows and boars of different genetic origin; ReHal (Nn) boars were compared to Landrace and Pietrain pure bred animals. All the animals were born on two farms and fattened on 19 farms.

The data were analysed by a linear fixed model including: fattening farm effect, sow line, sex, boar within breed and breed of the boar. The distribution of the data by origin of boars is given in table 4.

The descriptive statistics concerning some growth and carcass traits are given in table 5. The overall results (table 5) are influenced by the frequency of Pietrain boars in comparison with other origins. The percentage of variation explained by the linear model ranged from 10.1% to 21.9% and the relative importance of each effect is illustrated in figure 3. Differences between breed of boars were significant and are given for subjective ranking and percentage of meat in table 6.

The results of the subjective ranking and meat percentage indicate that ReHal heterozygote boars perform quite well and that the estimated meat percentages are close to the Pietrain results. ReHal boars give better results than Landrace boars.

Table 4. The use of ReHal boars (farm conditions). Frequency distribution of boars used on commercial sow lines

Origin	Frequency	%	Cum. Freq.	%
LANDRACE-B	191	3.8	191	3.8
LANDRACE-F	120	2.4	311	6.2
PIETRAIN-F	203	4.1	514	10.3
PIÉTRAIN	3912	78.1	4426	88.4
REHAL	582	11.6	5008	100.0
-B(Belgium)-F (France)				

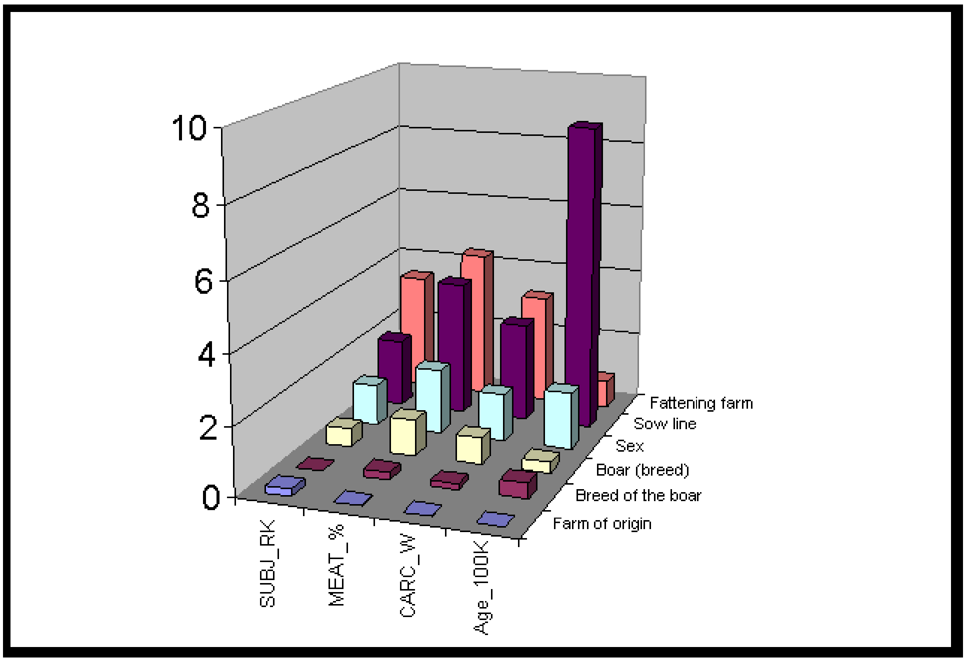
Table 5. The use of ReHal boars (farm conditions). Growth and carcass performances of pigs born from commercial sow lines and different boar types.

Variable	N	Mean	Std Dev	
AGE_WEAN	5008	27.698	3.012	
AGE_SLAU	5008	213.237	18.833	
SUBJ-RK	5008	13.900	1.115	
MEAT %	5008	59.362	3.349	
CARC_W	5008	92.514	10.434	
SLAU_W	5008	112.821	12.724	
AGE_100K	5008	209.499	18.501	

Table 6. The use of ReHal boars (farm conditions). Least square means of subjective ranking and estimated meat % least squares means of the boar origin effect.

Origin	Subjective	Estimated
	ranking	meat %
PIÉTRAIN	13.784	59.482
PIETRAI-F	13.932	58.987
REHAL	13.988	58.933
LANDRAC-B	14.085	57.998
LANDRAC-F	14.425	56.945

Figure 3. The use of ReHal boars (farm conditions). Percentage of the variation (R^2%) of subjective ranking (SUBJ_RK), percentage of meat (MEAT %), carcass weight (CARC_W) and age at 100 kilos (AGE_100K) explained by the different effects included in the linear model.



The ReHal^{CC}, the ReHal homozygote

In 1997 and 1998 BC5, BC6 and BC7 generations have been produced. For the different years, litter number per year was on average 2.06 and the number of piglets born and weaned per sow per year was respectively 19.02 and 15.45. Better results have been obtained due to improved management conditions on the farm.

More recently, it has been decided to produce the ReHal homozygote stress negatives that we call ReHal^{cc}. These homozygote stress negative pigs are, at the molecular level, CC pigs and they correspond to the NN nomenclature of the previous studies. A large number of ReHal^{cc}, with the meat and carcass performance of Pietrain pigs, is expected to be produced at the end of this year and during 1999.