Selection against Boar Taint: Slaughter Line Panel and Consumer Perception

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Introduction

Discussion to stop castration has now reached the consumer level as even the supermarkets are starting to offer meat from non-castrated animals. Changing the production system from castrates to entire males will have positive consequences for farm economy. However, there are some potential risks in terms of animal welfare like aggression and mounting, and a serious risk in terms of having pork with boar taint.

Most literature addresses boar taint as a function of androstenone and skatole, accepting the possibility of a third or even more components. At present there is no device available that can assess the risk of boar taint in the slaughter line. If and where needed the market has adopted a human test; heating a piece of fat on the carcass and assessing the absence or presence of boar taint. In this study this test is addressed as 'the slaughter line panel' (SLP). In addition a group of 155 consumers addressed as 'consumer panel' scored selected meat samples for smell and taste related traits. These data were used to study the relationship between the boar taints compounds (androstenone and skatole) and subjective evaluations by the expert slaughter line panel and the evaluations by the 'average' consumer and to evaluate the effectiveness of genetic selection against boar taint.

Material and Methods

Measurement of boar taint compounds. About 7000 entire males were tested for androstenone and skatole. The measurements started with pure line animals of one sire line (S1) and were later followed by pure line animals of other sire lines (S2 and S3) and dam lines (D1-D3). In addition, commercial crossbred finishers were tested. The fat samples from their neck were collected and frozen for lab analysis for androstenone, at first in Norway (fluoro-immunoassay) and later in the Netherlands (HPLC) and skatole (HPLC) in the Netherlands.

Slaughter line panel evaluations. Frozen and later fresh fat samples were used in a hot wire test. During this test, part of the fat was heated and smell was scored on a scale of 0 to 4. The value of 4 for this slaughter line panel score (SLP-score) was assigned to samples with a very strong unpleasant boar taint odour. Each of the samples in the dataset was evaluated by three people out of a panel of five, who regularly test boar taint samples.

Consumer panel evaluations. A total of 78 loin samples were selected on the basis of high or low breeding values for androstenone. These samples were then scored by 155 consumers. Each consumer tested two samples, one with high and another with low EBV for androstenone and there were three randomized repeats per sample. The consumer had to

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score 24 traits relating to appearance, taste, smell, saltiness and several other characteristics of the meat. Each trait in this consumer panel score (CP-score) was recorded on a scale of 1 to 9. Out of these, two traits were chosen for current analysis: general smell and general taste.

Data analysis. Genetic parameters and breeding values (EBVs) were estimated using ASReml (Gilmour, 2002). Following models were used with intent to do minimum correction.

Androstenone	= mu + line/cross + laboratory	+ animal
Skatole	= mu + line/cross + farm*slaughter date	+ animal
SLP-score	= mu + line/cross + tester +days in freezer	+ animal + permanent

Laboratory, differences in androstenone extraction protocol between Norway and the Netherlands are known to be significant, hence they were included in the models. The model for SLP-score included tester (person from the panel), days after collection of the sample (samples stayed in the freezer up to 442 days), and for observation number within slaughter day, taking into account possible smell fatigue. Finally repeated measurements were taken into account through permanent effect. Because of the nature of the selection process, line and farm of the animal were confounded, except for the finishers, which were born and raised on the same farm. Pedigree was available for all animals, including all crossbreds.

Response to selection. All observations on the samples evaluated by the consumers for CP-score were excluded from the above analysis. These scores were then used for validation of the EBVs and in evaluating the response to selection. A somewhat arbitrary index was created to classify the 78 samples evaluated by the consumer panel. The index consisted of standardised EBVs for log androstenone (ln-andro), log skatole (ln-skat) and SLP score. Each of the EBVs was given equal weight.

Results and discussion

Slaughter line panel scores

Descriptive statistics. Average levels of the boar taint compounds and slaughter line panel scores are given in Table 1. The dam lines had clearly higher values for skatole with the lowest line average higher than the highest of the sire lines. The dam lines had higher average values for androstenone. The average value for androstenone in crossbred animals was nicely in between the sire and dam lines. However, the average value for skatole and subjective score was lower than the lowest parental level. Farm management factors like feed composition and hygiene are known to influence skatole levels. However, it was impossible to disentangle line and farm effects in the current dataset. Therefore it is not possible to compare the different sire and dam lines. Nevertheless, comparison of crossbreds is possible since they were reared at the same farm.

Relationship with boar taint compounds. The estimates of genetic parameters are given in Table 2. Heritability of androstenone is in line with literature values (Sellier *et al.*, 2000; Varona *et al.*, 2005, Robic *et al.*, 2008). The heritability for skatole is higher than published elsewhere (Robic *et al*, 2008). Possible reasons for higher heritability are: (1) confounding between farm and line (2) no correction for known covariates like weight, age or fatness (3) combined analysis of different lines, adding to the within line existing genetic variation.

Limitation of the data to the original S1 sire line reduced heritability to ~0.34, a value more in line with previous findings, suggesting hypothesis (3) is relevant. Interestingly, the heritability of the subjective score was 0.23, with high genetic correlations (r_g) with both androstenone and skatole. The phenotypic correlations (r_p) with both underlying traits were somewhat lower, but clearly positive.
In this analysis, 'days in freezer', nor 'observation order' was significant for score, which helps in day to day routines. Strong differences between testers were found, the largest difference was 1.64 score points between two people on the scale of 0-4.

Table 1: Average levels of the boar taint compounds and slaughter line panel scores

	Boar taint compounds				**Slaughter panel evaluations**	
Line/cross	**#obs**	**Androstenone** (µg/g)		**Skatole** (ng/g)	**#obs**	**SLP-score** (0-4)
Sire lines		NL	Norway			
S1	3268	1.04	1.66	61.3	363	0.59
S2	712	0.97		95.1	246	0.73
S3	634	0.49		79.6	228	0.91
Average	4614	0.83		78.7	837	0.74
Dam lines						`
D1	285	1.63		182.4	288	1.41
D2	494	1.26		305.5	336	1.13
D3	215	1.90		174.5	406	1.18
Average	994	1.60		220.8	1030	1.24
Crossbreds						
S1CB	485	1.21	2.41	97.7	450	0.62
S2CB	535	0.88		112.2	597	0.47
S3CB	156	1.54		106.8	0	.
S4CB	194	1.21		86.2	0	.
Average	1370	1.21		100.7	1047	0.55

Table 2: Genetic parameters for boar taint compounds and slaughter panel scores

	#obs	**Mean**	**h^2**	**r_p (SLP-score)**	**r_g (SLP-score)**
Androstenone	6571	1.31	0.69±0.04	0.41±0.03	0.63±0.13
Skatole	6569	104.4	0.53±0.04	0.50±0.02	0.67±0.14
SLP-Score	2775	0.59	0.23±0.07		

78 lon cuts for consumer appreciation.
The 78 loin samples submitted to the consumer panel showed highly significant (P<0.001) correlations of androstenone (0.82) and skatole (0.70) with SLP-scores. These correlations were based on the average of three subjective scores while those in Table 2 were estimated

in a repeatability model. Both indicate that androstenone and skatole are strong predictors of the slaughter panel scores although a single score could be affected by error or chance.
Consumer perception. Of the total variance for general taste 39% was linked with differences between consumers and (only) 8 % with animal effects; the rest of the variance was residual error. For smell the respective numbers were 44% and 5%.
Selection on EBVs for boar taint compounds and slaughter line panel scores. The loin cuts evaluated by the consumer panel were categorized in low (20 samples), medium (40) and high (serious) (18) risk for boar taint on the basis of an index including EBVs for androstenone, skatole and SLP-score as described earlier. The results as given in Table 4 are very promising for application in breeding programs. According to these results, if sires and dams with low EBVs for boar taint compounds are used, the offspring will have lower androstenone and skatole level; considerably lower risk of boar taint in the pork according to the SLP-panel and a somewhat better taste as evaluated by the consumer panel. Loin cuts were low in fat, cooks preparing the meat samples noticed strong smells, consumer perception of boar taint was much lower than anticipated. Moreover, variation in the low group was lower than in the high group, markedly lowering the risk of extreme outliers in the population; this is due to the skewed distribution of both androstenone and skatole.

Table 3: Average levels of boar taint compounds and consumer panel scores based on genetic selection for low, medium and high (serious) risk of boar taint.

	average			Std		
	Low	medium	high	low	medium	High
Androstenone	0.75	0.81	1.57	0.73	1.18	1.69
Skatole	43	66	98	20	62	75
Average score (SLP)	0.13	0.33	0.56	0.23	0.62	0.82
Smell (consumers)	-0.05	0.02	-0.00	0.17	0.19	0.24
Taste (consumers)	0.09	0.03	-0.16	0.30	0.36	0.37

Conclusions

Results presented here show a promising heritability for a boar taint subjectively scored in samples collected at the slaughter line. Genetic correlations between this trait and androstenone and skatole are high enough to rely on genetic selection based on the latter two. A validation study, mimicking genetic selection, showed a very relevant decrease in average level of boar taint and a reduction in variance around this level. Consumer appreciation of prepared meat will most probably benefit.

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