EFFECT OF HALOTHANE CARRIER AND NON-SUSCEPTIBLE GENOTYPE ON EATING QUALITY OF PIG MEAT

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SUMMARY

149 female pigs of Hal^{--} (non-susceptible) or Hal^{+-} (carrier) halothane genotype were evaluated for their eating quality by two taste panels. Traits included tenderness, juiciness, pork, abnormal and boar flavour and overall acceptablity. Intraclass correlations for the panellist effect were higher than for the animal effect for all traits (r_{animal} from 0.00 to 0.17 *vs* $r_{panellist}$ from 0.21 to 0.53) except for tenderness (r_{animal} = 0.21 *vs* $r_{panellist}$ = 0.13), indicating a higher level of subjectivity in the other traits. Significant differences between halothane genotypes for tenderness were observed from each taste panel but the genotype judged as most tender differed. There was little relationship between type of cross and eating quality.

INTRODUCTION

An understanding of the effect that an animal's genotype has on meat quality is essential if, and when, carcasses of a particular 'quality' are required for a particular sector of the market. A large number of non-genetic factors influence the trait, such as transport, handling before slaughter, processing after slaughter and nutrition. Genetic effects include a possibly large number of additive effects, the halothane genotype, and non-additive effects such as the line make-up of the product.

Meat quality is made up of organoleptic, technological, nutritional, and hygienic characteristics (see Hovenier, 1993a, for a review). The relative importance of these four groups and of their components has not yet been determined. Formal organoleptic evaluation ("eating quality") is commonly done by a panel of people trained to discriminate the subtleties of various organoleptic characteristics, such as juiciness, tenderness, etc. Taste panels are therefore used to allow quantification of some very subjective traits.

This paper presents part of the results from two larger studies that were set up to establish differences in meat quality between four commercial PIC products. We report here on the repeatabilities of several eating quality traits, and we examine the ability of taste panels to differentiate between genotypes.

MATERIALS AND METHODS

Two parent boar products (A, B) and two parent gilt products (C, D) were mated to produce the Halothane carrier (Hal^{+-}) and homozygous non-susceptible (Hal^{--}) end products for this trial. Female pigs were obtained from four farms at 30-40 kg and were grown on to end weights of 70 or 95 kg. The genotypes of these animals were to a variable degree Duroc, Pietrain, Landrace, and Large White based. Halothane genotype of all the pigs was determined using the HAL-1843™ test[a]. The distribution of animals over cross and halothane genotype is given in Table 1.
Pigs were slaughtered at one slaughterhouse and further processed by the carcass evaluations service of the Meat and Livestock Commission (MLC), Milton Keynes, UK. Loin samples of each carcass were evaluated by the MLC taste panel to provide scores regarding the meat's intensity

[a]The HAL-1843 trademark is licenced from THE INNOVATIONS FOUNDATION, Toronto, Canada, owner of the trademark.

of pork, abnormal and boar flavour, juiciness, tenderness and overall acceptability. Six readings (on a scale of 1-8) of each trait were obtained for each pig. Loin samples from 20 of these carcasses were additionally evaluated by the taste panel of Mastertaste International, Dursley, UK to provide scores regarding the meat's intensity of pork and boar flavour, sweetness, juiciness, tenderness and colour (darkness). 8-10 readings (0-10 scale) of each trait were obtained for each pig.

Table 1. Number of animals per cross and halothane genotype

Cross	Hal^{+-}	Hal^{--}	Total
A x C	3	15	18
A x D	7	12	19
B x C	55	54	109
B x D	8	12	20
Total	73	93	149

Taste panel results were analyzed using the GLM procedure of SAS with a model comprising the effects of halothane genotype, cross, panellist and animal within (Hal/cross) subclass. Animal and panellist were treated as random and tested against $MS_{residual}$; the other effects were treated as fixed and tested against a combination of MS_{animal} and $MS_{residual}$. Intraclass correlations for the animal effect, the panellist effect, and the panellist by animal interaction were estimated using the REML option of the VARCOMP procedure of SAS as: $r_{animal} = \sigma^2_{animal} / \sigma^2_{total}$; $r_{panellist} = \sigma^2_{panellist} / \sigma^2_{total}$; and $r_{pxa} = \sigma^2_{residual} / \sigma^2_{total}$ where $\sigma^2_{total} = \sigma^2_{animal} + \sigma^2_{panellist} + \sigma^2_{residual}$. The r_{pxa} statistic gives an indication of changes in ranking of animals by panellists. As there is only one observation per panellist and animal, σ^2_{pxa} equals $\sigma^2_{residual}$.
For the Mastertaste taste panel results, panellist identification was not available. Repeatabilities were estimated as for r_{animal}, omitting $\sigma^2_{panellist}$.

RESULTS

The significance levels of the tests for effects on taste panel traits, and the estimated intraclass correlations are in tables 2 and 3 for the MLC and Mastertaste taste panels, respectively.

Table 2. Statistical significance levels (P)[a] of effects and intraclass correlations for MLC taste panel traits

	effect[b]			intraclass correlation			
trait	HxC	P	A	animal	panellist	pxa	ratio[c]
Boar flavour	*	***	-	0.00	0.23	0.77	1.00
Pork flavour	-	***	**	0.02	0.53	0.45	0.96
Abnormal flavour	-	***	-	0.00	0.31	0.69	1.00
Juiciness	*	***	***	0.17	0.21	0.62	0.78
Tenderness	**	***	***	0.21	0.13	0.66	0.76
Acceptability	**	***	***	0.10	0.25	0.65	0.87

a -: $P>0.15$; *: $0.05<P\leq0.10$; **: $0.01<P\leq0.05$; ***: $P\leq0.01$
b HxC: halothane genotype by cross; P: panellist; A: animal.
c ratio: $\sigma^2_{pxa} / (\sigma^2_{animal} + \sigma^2_{pxa})$

It appears from table 2 that each of the MLC taste panel traits is strongly influenced by the panellist effect (which was to be expected, given the subjective nature of these traits). This holds especially for the flavour-related traits (boar, pork and abnormal flavour, with $r_{panellist}$ values between 0.23 and 0.53), which also show zero to very low repeatabilities (r_{animal}) and generally no effects of halothane genotype by cross. The trait juiciness has a repeatability of 0.17, but still an $r_{panellist}$ value of 0.21. Only the trait tenderness shows a repeatability that exceeds the $r_{panellist}$ value, although it is still only 0.21. Both tenderness and juiciness show significant influences of the halothane genotype by cross effect. Assuming that the variation of the panellists can be adjusted for, the ratio of σ^2_{pxa} to ($\sigma^2_{animal} + \sigma^2_{pxa}$) gives an indication of the relative extent to which animals were re-ranked by different panellists. Lower values for this statistic, indicating more agreement among panellists, were found for juiciness and tenderness which is also in line with the r_{animal} values for these traits.

Table 3. Statistical significance levels (P)[a] of effects and repeatabilities (r_{animal}) for Mastertaste taste panel traits

trait	effect[b] C	H	A	r_{animal}
Boar flavour	-	-	-	0.00
Pork flavour	*	-	-	0.11
Juiciness	-	-	-	0.01
Tenderness	-	**	-	0.13
Sweetness	+	-	-	0.00
Darkness	**	-	-	0.13

a -: P>0.15; +: 0.10<P≤0.15; *: 0.05<P≤0.10; **: 0.01<P≤0.05; ***: P≤0.01

b C: cross; H: halothane genotype; A: animal.

In view of the significance levels for the animal effect in table 3, none of the Mastertaste taste panel traits seems to have a repeatability that differs significantly from zero. Tenderness is significantly influenced by halothane genotype, whereas pork flavour, darkness (and possibly sweetness) scores differ among the crosses.

Table 4. Least square means (± standard errors) for tenderness and juiciness by taste panel and halothane genotype

Taste panel	Tenderness Hal^{--}	Tenderness Hal^{+-}	Juiciness Hal^{--}	Juiciness Hal^{+-}
MLC	4.71±0.23	3.57±0.44	4.95±0.18	4.47±0.35
Mastertaste	4.67±0.31	5.69±0.40	4.10±0.31	3.98±0.39

Least square means for tenderness and juiciness for the carcasses evaluated by both the taste panels were calculated using the same model as in table 3. Results are only presented for halothane genotype due to low number of observations per cross subclass. Meat from Hal^{+-} animals were judged as less tender by the MLC panel, but as more tender by the Mastertaste panel (Table 4). Juiciness appraisal was more in line between the panels; the overall difference between the Hal genotypes is very small.

DISCUSSION

Eating quality is a very individual experience, comprising the combined flavours, odours and textures. Taste panels are used to try and identify one or more predominating characteristics. The high intra-class correlations for the panellist effect in our trial highlight this difficulty. It is quite clear for some time now that the most important limiting factor that will be faced by prospective breeding programmes for pig meat quality is the establishment of reliable and cheap techniques to measure these traits on large numbers of animals. This holds especially for the organoleptic traits, as instrumentation of measurement is still in its infancy.
In view of the data in table 2, tenderness and juiciness appear to be traits that can be evaluated with a reasonable level of repeatability by taste panels. However, differences in mean levels of the traits between the taste panels raise questions as to the consistency of 'measurement' of eating quality traits by means of a panel.

The repeatability of the tenderness scores on our pigs was surprisingly low. Stumpe (1989) and Hovenier et al. (1993b) found values around 0.55. The variability among pigs may have been lower in our trial, or the panellists may have been unable to achieve the consistency that was clearly achieved by their panels. Hence if a taste panel is to be used for the evaluation of commercial products, or for product design support in terms of genetic line-makeup, pre-evaluation of the sensitivity and accuracy of the panellists is advisable. This should involve more than one observation per animal per panellist in order to be able to properly evaluate the interaction effect. If taste panel traits would be incorporated into breeding value estimates, adjustment for panellist effects is crucial, and the panel should be reasonably large and of stable composition.

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