Sensory evaluation of boar taint – training and attributes

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Abstract— **The aim of this work was to establish a sensory panel to evaluate pork products from entire male pigs and included selection and training of assessors and selection of sensory attributes. Samples of minced pork with added amounts of androstenone and skatole were evaluated by the sensory panel before and after training. The training had a clear effect on the agreement between the assessors' scores although some disagreement persisted. Based on the average scores, the variation of sensory attributes like naphthalene odour, sweat odour, sweat flavour and perfume flavour were highly explained by the content of the boar taint compounds. The variations of other attributes included in the evaluations were not explained by the compounds at all and can be considered excluded from future sensory evaluations of pork products from entire male pigs.**

Keywords— **Boar taint, sensory panel, PLS.**

I. INTRODUCTION

The meat from a small percentage of entire male pigs develops boar taint – an unpleasant odour and flavour caused by mainly skatole and androstenone. Although the perception and sensitivity of boar taint differs from consumer to consumer, the evaluation by a trained sensory panel may serve as an easy and cheap reference for boar taint. The evaluation by a trained sensory panel represents an objective quantification of the boar taint while a consumer test represents a subjective qualitative measurement of for example preference. Ideally, the assessors in a trained sensory panel should agree in their scorings. But people are fundamentally different and although training will improve agreement there will still be differences – also in the scoring of products from entire male pigs. This is why a trained sensory panel always consists of several assessors and their combined scores are considered as the result.

At DMRI a new sensory panel for evaluation of boar taint has recently been established. In the present work the panel has been tested before and after training and the results compared. The trained panel will be used to measure boar taint in pork products from entire male pigs where the boar taint is lowered in various ways. The panel is also intended to be used as reference in development of online measuring methods for boar taint. In trials where products are processed in different ways to eliminate boar taint, it is important to obtain a *detailed* description of the sensory profile in order to estimate the effect of the different processes. Therefore, the evaluations included a large number of sensory attributes *not* including attributes like boar, unpleasant or abnormal odour/flavour. Furthermore, at DMRI it is our experience that it is very difficult to make sensory assessors agree on attributes like boar, unpleasant and abnormal.

II. METHODS AND MATERIALS

The panel assessors were pre-selected by a screening of their ability to detect androstenone and skatole. For each compound two triangle tests were conducted including two 100 ml flasks with 20 ml pure sunflower oil and one 100 ml flask with 20 ml sunflower oil with dissolved compound (androstenone 10 ppm and skatole 1 ppm respectively). Assessors that for both compounds correctly selected the flask with the compound in both triangle tests were selected to the panel. The panel was then tested twice with training in between. In the first test one assessor that did not select correctly in one of the skatole triangle tests and on assessor that did not select correctly in one of the androstenone tests were also included in the panel. The first test included 13 assessors. In the second test 10 assessors that selected correctly in all four pre-selection triangle tests were included. The tests were done using samples of minced pork with added androstenone and skatole. Table 1 shows the seven samples used in the first test. Based on the

experience of the first test nine samples were used in the second test as shown in table 2.

Table 1 Samples used in the first test

		Androstenone (ppm)		
		0	0.10	0.60
Skatole (ppm)	0	x	x	x
	0.02	x	x	
	0.10	x		x

Table 2 Samples used in the second test

		Androstenone (ppm)		
		0	0.20	0.80
Skatole (ppm)	0	x	x	x
	0.05	x	x	x
	0.20	x	x	x

Table 3 shows the sensory attributes used in the tests. An unstructured intensity scale from 0 to 15 was used.

Table 3 Sensory attributes (both odour and flavour) used in the test before and after training

Attribute	Before training	After training
Pork	x	x
Acidic (fresh)	x	x
Soap	x	x
Perfume	x	x
Sweet	x	
Spicy	x	
Piggy	x	x
Stale	x	x
Sour	x	
Pungent	x	x
Chemical	x	x
Sweat	x	x
Urine	x	x
Manure	x	x
Naphthalene	x	x
Rancid	x	x
Bitter (only taste)	x	x

The validation before training was done with four replicates and the validation after training was done with two replicates. The training was performed on the same samples using the same attributes as in the second test. The training included sensory evaluations and use of the scoring scale. The data was analysed by multivariate PLS in Unscrambler [1] and proc reg in SAS [2].

III. RESULTS

A. Agreement between assessors

Before the training the assessors fell into several groups regarding their score of the attributes (figure 1). Five assessors scored low on the scale for most attributes (group at the left of figure 1) while one assessor scored high (A202 on the figure). One assessor (A201) scored high on naphthalene odour and flavour while another assessor (A149) scored them low. The rest of the assessors were intermediate in their scores.

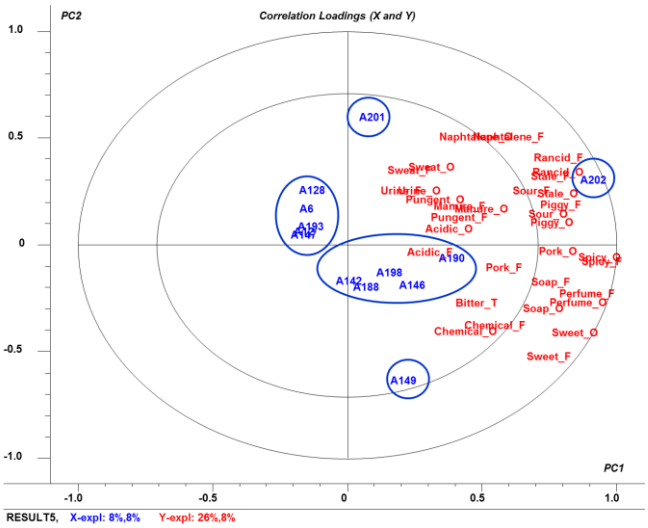

Fig. 1 PLS plot showing relationship between sensory attributes (in red) and assessors (in blue) in first test (O: odour, F: flavour, T: taste)

After the training the assessors were much more in agreement (figure 2) although two assessors (A128 and A149) did not use attributes like manure, chemical, pork, stale and soap to the same degree as the other assessors (scored low) and therefore may need further training on those attributes. In the second test 17 % of the variation in the sensory attributes was explained by the assessors compared to 34 % in the first test (based on first two PC's) – also indicating a positive effect of the training.

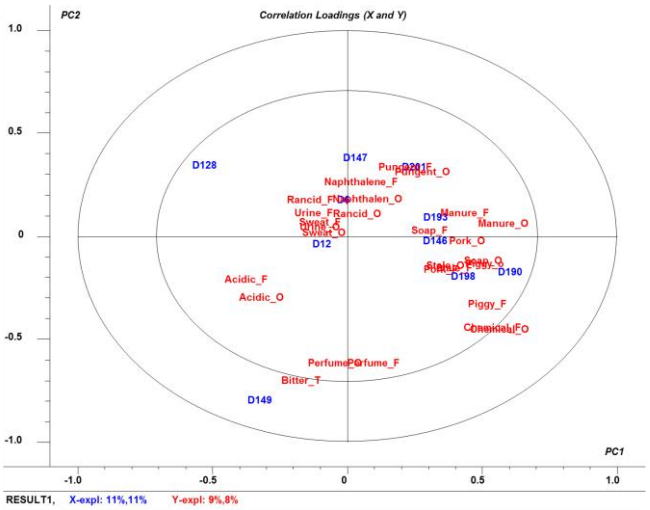

Fig. 2 PLS plot showing relationship between sensory attributes (in red) and assessors (in blue) after training (O: odour, F: flavour, T: taste)

B. Sensory attributes and odour compounds

Despite the positive effect of the training, the effects of androstenone and skatole on the intensity of all the sensory attributes still depended on the assessors (data not shown). This is not unusual. In fact this is why a sensory panel includes several assessors.

The effects of androstenone and skatole on the sensory attributes was analysed on *the average scores of the assessors* based on the data after training [2]. The analysis included quadratic effects (skatole^2 and androstenone^2) of and the interaction between androstenone and skatole (table 4).

The intensity of naphthalene, sweat, urine, pungent and chemical odour and sweat and pungent flavour increased with higher content of androstenone and skatole. The intensity of pork odour decreased with higher content of androstenone and the intensity of pork flavour decreased with higher content of both androstenone and skatole. Only soap flavour showed an interaction between the two compounds. There were no quadratic effects. Based on the R^2 naphthalene odour (R^2=0.80), sweat odour (R^2=0.74) and sweat flavour (R^2=0.82) were the attributes best described by the two compounds. Stale, piggy, rancid, acidic and soap odour and piggy and acidic flavour were not affected by the content of androstenone and skatole.

Figure 3 shows a more visual overview of the relationship between the sensory attributes and androstenone and skatole based on PLS analysis [1].

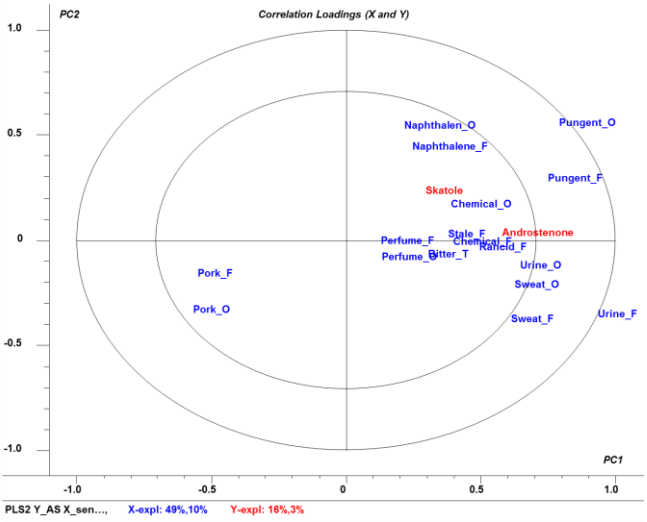

Fig. 3 PLS plot showing relationship between odour compounds (in red) and sensory attributes (in blue) after training (O: odour, F: flavour, T: taste)

IV. CONCLUSSIONS

Training clearly had an effect on the assessors' agreement on the sensory attributes although some disagreement still persisted. Based on the average scores some attributes had a high or medium dependency of the boar taint compounds and these attributes should be included in future evaluations of products from entire male pigs while attributes with no dependency can be excluded.

ACKNOWLEDGMENT

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REFERENCES

[1] The Unscrambler® v9.8. CAMO Software AS, Nedre Vollgate 8, N-0158 OSLO, Norway

[2] SAS v9.2. SAS Institute Inc., Cary, NC, USA.

Table 4 Effect of androstenone and skatole on sensory attributes (average scores)
Parameter estimates (0 when $p > 0.05$) and R^2 (Sorted by R^2)

Odour attributes

Attribute	Intercept	Androstenone	Skatole	Androstenone^2	Skatole^2	Androstenone*Skatole	R^2
Naphthalene	0,01356	1,15673	3,64038	0	0	0	0,80
Sweat	1,4084	3,98125	6,54423	0	0	0	0,74
Urine	1,90837	3,81202	7,66154	0	0	0	0,64
Pungent	2,46817	3,13269	10,62115	0	0	0	0,63
Perfume	0,24077	0,54519	0	0	0	0	0,52
Chemical	1,41561	1,36779	3,71154	0	0	0	0,50
Pork	4,67519	-2,02308	0	0	0	0	0,42
Manure	2,03442	0	11,42692	0	0	0	0,40
Stale	0,76083	0	0	0	0	0	0
Piggy	2,57167	0	0	0	0	0	0
Rancid	0,15083	0	0	0	0	0	0
Acidic	3,15833	0	0	0	0	0	0
Soap	0,44333	0	0	0	0	0	0

Flavour attributes and bitter taste

Attribute	Intercept	Androstenone	Skatole	Androstenone^2	Skatole^2	Androstenone*Skatole	R^2
Sweat	1,09362	4,11875	5,31154	0	0	0	0,82
Perfume	0,23375	0,76875	0	0	0	0	0,63
Pungent	1,75224	3,0625	6,42308	0	0	0	0,63
Urine	2,04654	4,29038	0	0	0	0	0,63
Pork	2,9733	-1,65962	-5,27115	0	0	0	0,62
Chemical	1,41519	1,51442	0	0	0	0	0,57
Soap	0,36498	0,81929	0	0	0	-4,07951	0,54
Stale	0,51962	0,68365	0	0	0	0	0,51
Naphthalene	0,26865	0,84904	0	0	0	0	0,38
Manure	1,58712	0	8,23462	0	0	0	0,31
Rancid	0,07	0,3375	0	0	0	0	0,28
Piggy	2,63417	0	0	0	0	0	0
Acidic	4,63167	0	0	0	0	0	0
Bitter taste	1,66865	0,86154	0	0	0	0	0,25