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A SENSORY PERSPECTIVE ON TEMPORAL ASPECTS RELATED TO THE PERCEPTION OF THE MAJOR AROMA COMPOUNDS RESPONSIBLE FOR BOAR ODOUR

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Background

The contribution of skatole (3-methyl indole) and the C_{19}-Δ^{16}-steroids, particularly 5α-androst-16-en-3-one to boar odour and flavour have been well documented (Bonneau, 1998), but there is an ongoing discussion as to which one of these compounds is the most important. Compared to skatole, androstenone has a higher molecular weight and is more lipophilic in nature. Due to its chemical properties it can be expected there could be a delay in odour/flavour release between the two compounds and a difference in flavour stability. Androstenone could have a less intense but more lingering odour/flavour impact compared to skatole. It is therefore possible that there is a time delay between perceiving the skatole and the androstenone odours. This could explain the greater contribution of androstenone to flavour (perception by mouth) than to smell (perception by nose) as was found in several boar odour studies reviewed by Bonneau (1998). Sensory studies on boar odour have mostly concentrated on single or initial impression measurements.

Objectives

An objective of this study was to investigate the temporal perception of boar odour. This was done using descriptive sensory profiling (trained sensory panel) of designated boar back fat samples with varying concentrations of skatole and androstenone when served immediately after heating (warm) and after following a cooling period of five minutes (cold serving).

Methods

A total of 50 boars raised by two commercial producers and with an average slaughter weight of 72 kg was obtained from a commercial abattoir. Carcases were selected based on varying concentrations of skatole (Low <0,15 μg/g, Medium 0,15 to 0,25μg/g and High >0,25 μg/g) and androstenone (Low <0,5 μg/g, Medium 0,5 to 1,25μg/g and High >1,25 μg/g) in back fat (anterior area of the loin). The analyses was done by HPLC, using a C18-column (3,9 mm X 150 mm), isopropanol as extraction medium and a water/acetonitrile/tetrahydrofuran solvent gradient (a modification of the method of Hansen-Moller and Andersen, 1994). The back fat of each of the selected carcases was removed after 24 hours, cut into portions, individually vacuum packed and stored frozen (-20°C). Fat samples were evaluated in duplicate by the trained sensory panel using 5 descriptive terms ('skatole', 'androstenone', 'pork fat, cooked', 'pork fat grease' and 'other') and 10-point intensity rating scales marked at the extreme ends with word anchors (none, extreme). Evaluation sessions were held in a controlled sensory laboratory with individual booths. Two sessions with a 20 minute break in between session were held per day. Five blind-coded samples were presented in random order per session. The frozen pork fat portions were partially thawed for 30 minutes at 4 °C. The rind of each fat portion was removed using a sharp knife and ten cubes (10 x 10 x 10 mm) were cut. Each cube was placed into a round aluminium foil container (Hullett's 55 mm diameter, 20 mm height) and covered tightly with a 90 x 90 mm aluminium foil square. The samples were heated for 5 minutes in an AEG oven, which had been preheated to 180°C, and served to the panel. After removing the samples from the oven they were kept warm on heated sand baths that were placed on Estia solid hot plates (Setting 1). All five samples per session were evaluated warm and again after cooling for five minutes. A one-minute waiting period was observed between successive samples allowing for recovery of the olfactory system.

Results and discussions

Analysis of variance revealed significant replicate, skatole/androstenone concentration and temperature effects. The panel gave significantly lower scores during the second replicate compared to the first replicate for 'skatole', 'pork fat grease' and 'other' intensities. This suggests adaptation by the human nose to the odour of skatole on repeated exposure over a period of time. In contrast, scores for 'androstenone' remained similar over duplicate exposure.

Figures 1 and 2 indicate the way in which the trained sensory panel perceived the samples as analysed by Principle Component Analysis (PCA). The plots show distributions of the carcases on the perceived sensory profiling space, i.e. indicating the character and intensity of boar odour in the back fat of the carcases when served both warm and after cooling. Pork fat samples were separated on the first principle component into tainted (described by higher scores for the terms 'skatole' and 'androstenone' intensity) versus untainted (described by the terms 'pork fat, cooked' and 'pork fat, grease') samples. The second principle component seemed to separate tainted samples further according to skatole and androstenone-like character. On warm serving, the first dimension explained 37% of the variance in the data. For warm serving the second dimension, explained a further 22% of the variance in the data. In the case of the samples that were cold, a third significant dimension (not shown) was evident. This dimension explained a further 20% of the variation in the data and indicated the presence of odours designated by the term 'other' that had an effect on the perceived sample space.

After cooling down, the pork fat samples had significantly lower intensities for all the sensory characteristics evaluated by the panel. The results indicated that when served warm and the samples were smelled for the first time, skatole seem to have a faster rate of odourant

release and therefore are perceived to be the initial contributor to boar odour. Skatole is more volatile due to it being slightly water-soluble, of lower molecular weight and with a lower melting point compared to androstenone. This explains the lower detection threshold compared to androstenone. However, the relative contribution of androstenone to the odour profile became more evident, after most of the skatole was released together with the water vapour. This can be attributed to different odour partition (release), adaptation and retention properties for the various aroma compounds.

'Skatole', 'androstenone', 'pork fat cooked' and 'pork fat grease' intensities differed significantly ($p<0,05$) for the various skatole/androstenone concentrations. For androstenone, samples with androstenone concentrations above 0.5 µg/g were rated significantly more intense than samples below. However for skatole, samples with skatole concentrations above 0.25 µg/g were rated significantly more intense than those below, only when supported by androstenone concentrations above 0.5 µg/g. The term 'pork fat, cooked' relating to the smell of normal untainted pork fat decreased as the concentration of either skatole or androstenone increased.

Conclusions

The results of this study provide evidence that there is a time-delay between perceiving skatole and androstenone odours that can be explained by differences in partitioning rates for these odour volatiles. Skatole seems to serve as an aroma top note, released and perceived first and therefore having an initial masking effect on androstenone. This masking effect is less evident after a heated pork fat sample had cooled down. Androstenone form the body or base note for boar odour providing a possible fixative or supporting function for skatole as well as a lingering character. Individuals that are sensitive to the odour of androstenone would become more aware of its presence only when skatole volatiles decreased sufficiently e.g. when the product has cooled down sufficiently for it to be put in the mouth and eaten. Sensory studies on boar odour/flavour should take into account that the potential odour or flavour impact of the aromatic compounds is influenced by various factors. These factors could include amongst others: the concentrations of boar odour compounds in a sample, factors affecting the rate of volatilisation of the aromatic volatiles (e.g. degree of saturation of fat, melting point of fat matrix, moisture content, temperature of heating), temporal aspects as well as human factors (sensitivity, adaptation to odours, memory etc.).

Pertinent literature

Bonneau, M. 1998. Use of Entire Males for Pig Meat in the European Union. *Proceedings of the 44th ICoMST*, Barcelona, Spain. pp. 192-205.

Hansen-Moller & Andersen, 1994. Boar taint - analytical alternatives. Analysenmethoden zur Feststellung von Ebergeruch. *Fleischwirtschaft*, 79 (9) 1005-1009.

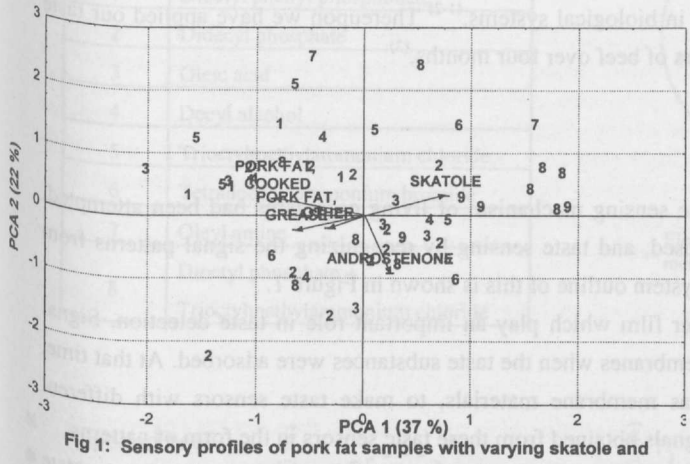

Fig 1: Sensory profiles of pork fat samples with varying skatole and androstenone concentrations (served warm)

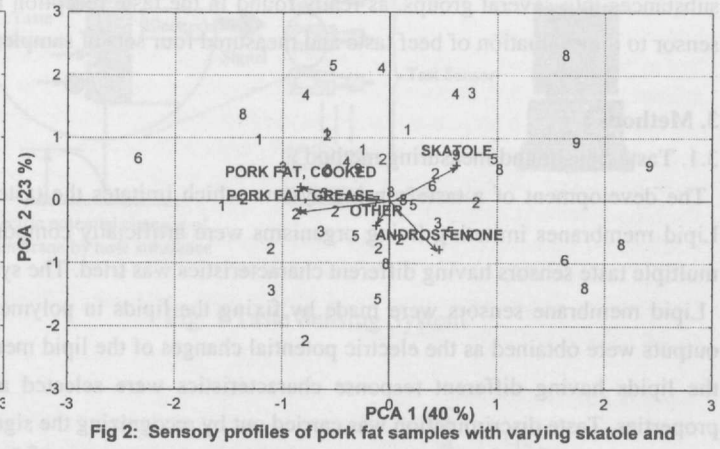

Fig 2: Sensory profiles of pork fat samples with varying skatole and androstenone concentrations (served cold)

1 Low Skatole <0,15 µg/g, Low Androstenone. <0,5 µg/g
2 Low Skatole <0,15 µg/g, Med Androstenone. 0,5 to 1,25µg/g
3 Low Skatole <0,15 µg/g, High Androstenone. 0,5 to 1,25µg/g
4 Med Skatole 0,15 to 0,25µg/g, Low Androstenone <0,5 µg/g
5 Med Skatole 0,15 to 0,25µg/g Med Androstenone 0,5 to 1,25µg/g
6 Med Skatole 0,15 to 0,25µg/g High Androstenone 0,5 to 1,25µg/g
7 High Skatole >0,25 µg/g, Low Androstenone <0,5 µg/g
8 High Skatole >0,25 µg/g, Med Androstenone 0,5 to 1,25µg/g
9 High Skatole >0,25 µg/g, High Androstenone 0,5 to 1,25µg/g