

DLG Expert report 9/2016

Boar meat

Part 2: Sensory analysis

Sensory detection of androstenone and skatole



1. Introduction

The DLG (German Agricultural Society), as a leading organisation for sensory quality testing, is banking on the training of experts to detect the boar taint substances skatole (faecal odour) and androstenone (sexual odour) to guarantee the quality of pig meat in the long term.

An amendment to the German Animal Welfare Act will prohibit the castration of male piglets without anaesthesia and subsequent pain management with effect from 1.1.2019. Until then, castration without anaesthesia, followed by painkiller use, is still permitted in the first week of life (Jäger, 2013).

The future ban on piglet castration without anaesthesia presents meat producers and the processing industry with a challenge: until now, castration has prevented the impairment of meat quality due to boar taint.

Boar taint is caused mainly by skatole and androstenone, substances with odours described as reminiscent of faeces, urine or sweat. Androstenone is a fat-soluble sex pheromone (steroid) which is produced in the testicles of boars. In contrast, skatole is produced by the breakdown of tryptophan in the large intestine, so is not gender-specific: skatole can be detected in the fat of both male and female animals. However, androstenone inhibits the metabolism of skatole in the liver cells, leading to increased blood levels and storage in the fat of male animals. Boar meat is therefore more prone to abnormal odour and taste than meat from female animals. How strong boar meat smells and tastes depends on animal-specific factors, but also on feeding and housing conditions and on consumer sensitivity (Mörlein et al., 2013).

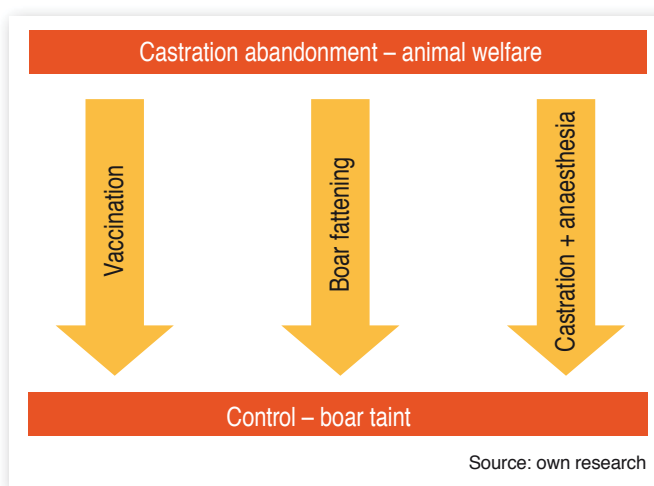


Fig. 1: Overview of alternatives to piglet castration without anaesthesia

2. Alternatives to castration without anaesthesia

In September 2008, in the “Düsseldorf Declaration”, the German Farmers’ Association (DBV), meat industry association (VDF) and retailers’ association (HDE) pronounced themselves in favour of a common approach with the goal of abandoning piglet castration without anaesthesia as soon as possible (DBV/VDF/HDE 2008). The following feasible, practical alternatives are currently available: castration with anaesthesia, immunological inhibition of androstenone production by vaccination (“immunocastration”), or boar fattening. These alternatives are presented in detail in “DLG Expert report Part 1: Boar meat – Basic knowledge”. What we know for certain is that – whichever alternative is used – quality management in each producer or processor will have the task of monitoring the resulting meat for boar taint.

3. Detecting abnormal odours

In 2013, around 10 % of farmers in Germany fattened boars (Müller, 2013); around 70,000 boars were slaughtered and processed per week at Tönnies, Vion and Westfleisch (Jäger, 2013). Since then, a rising trend has emerged. Slaughter firms now have the task of reliably detecting and rejecting carcasses with abnormal odours. According to studies by Upmann et al. (2016), the processing of meat with slightly to moderately abnormal odour appears to be possible in certain products; however, under Regulation 854/2004, Annex I, Section II, Chapter V, the official meat inspector must reject meat with a significantly abnormal odour: *“Meat is to be declared unfit for human consumption if it indicates patho-physiological changes, anomalies in consistency, insufficient bleeding (except for wild game) or organoleptic anomalies, in particular a pronounced sexual odour.”*

Despite the problems of abnormal odour and taste in boar meat, consumers and animal welfare groups are generally open to boar fattening because animals are spared a surgical procedure. For consumers, however, taste is also a crucial criterion when buying meat, so the main task facing producers now is to ensure good sensory quality of meat.

3.1. Test criterion “extraneous odour” in DLG testing

For the reasons given above, it is essential to detect abnormal odours in production and to reject the meat if necessary. This is confirmed by the numbers of international DLG quality tests for fresh meat. In 2012, DLG product tests began to make a larger number of deductions for abnormal odours (faecal/extraneous odours) in fresh meat samples. In 2012 a total of 986 samples of fresh meat (seasoned and unseasoned) were tested by DLG expert panels. Abnormal odours were detected in 55 samples (approx. 5.6 %). In 2011, by contrast, 966 samples of fresh meat (seasoned and unseasoned) were tested. Only 20 samples (around 2 %) had points deducted on the test criteria of extraneous odour and/or faecal odour. This significant increase in extraneous odour reflects the rising proportion of boar meat on the market.

The higher incidence of abnormal odours in DLG quality tests in recent years led to “faecal odour” being added to the test criterion “odour” in the DLG’s 5-Point Test Scheme®. In addition, as a leading organisation for sensory quality testing, the DLG is banking on specially trained experts who can reliably identify skatole and androstenone. After training, these experts are put to targeted use in quality testing, contributing to meaningful test results.

3.2. Assessor training

So far there is no alternative to the use of the human nose to detect abnormal odours in boar meat, as electronic detection is not likely to become available in the near future. This fact will probably require the creation of new jobs in quality assurance, using trained personnel. These slaughterhouse staff will need to be trained and tested regularly to make sure they can identify skatole and androstenone reliably and detect carcasses with an abnormal odour. One option already used in practice is to have these trained staff smell boar carcasses at the end of the slaughter line. To do this, the neck fat is heated slightly using a Bunsen burner to release the two substances in question (skatole and androstenone). However, it is vital for staff to take regular breaks. Otherwise, their ability to perceive these substances is dulled and the results can no longer be considered reliable (Schweer, 2013).

3.2. Perception sensitivity

Skatole is perceived by a large proportion of people, but there is wide variability in individual ability to perceive androstenone. Indeed, anosmia to androstenone occurs in 7 to 75 % of the population (Havlicek et al., 2010), meaning that these people are unable to perceive androstenone at all. Studies show that women are more sensitive to androstenone than men; anosmia is more common in men than in women (Müller, 2011). Other parameters, such as cultural background, experience, meat temperature and degree of processing, also affect perception. In the literature we find the following values for human ortho-nasal perception (“smell”) of the two substances:

- | | |
|------------------------|---------------------------|
| • Skatole | • Androstenone |
| – exogenous: 0.15 µg/g | – exogenous: 0.2-1.0 µg/g |
| – in fat: 0.5 µg/g | – in fat: 0.5-2.0 µg/g |
| | <i>(Mörlein 2009)</i> |

Besides their basic ability to smell the guide substances, we need to evaluate assessors’ performance on the actual task, i.e. assessing abnormal odours in boar carcasses. In medical diagnostics, the terms ‘sensitivity’ and ‘specificity’ of a test are used in this respect (Lalkhen & McCluskey, 2008). **Sensitivity** describes the percentage of all carcasses with an abnormal odour which the assessor in question correctly identifies as abnormal. **Specificity**, on the other hand, is defined as the percentage of non-abnormal carcasses which are correctly identified as such.

The occurrence of partial anosmia and differing qualitative perceptions of boar taint components are clear evidence of interindividual differences in ability to perceive odour. Qualified evaluation of olfactory performance is therefore necessary in order to objectivise the selection of assessors. Due to variation in human perception of odours, regular testing and documentation of these abilities is also essential.

4. DLG seminar “Detection of boar taint”

To give DLG’s sensory experts and other interested industry parties an opportunity to test their sensitivity to skatole and androstenone, the DLG Academy offered sensory seminars. Participants included DLG experts for fresh meat and meat products, quality management and safety officers from slaughterhouses and meat processing plants and the retail trade, as well as people from academia, laboratories and food inspection. Overall, the results for 131 people were evaluated.

In advance, the participants were given background information on the production of androstenone and skatole, as well as the causes of sensory abnormalities. The challenges of castration and boar fattening were also explained. A standardised test series comprising ten triangle tests for both androstenone and skatole introduced the participants to practical sensory analysis. In a triangle test, participants are asked to identify the ‘odd one out’ in a triad of three samples. Triangle tests are used to detect a perceptible sensory difference or similarity between two test materials. The triangle test is also particularly suitable for selecting and training assessors, and for evaluating their performance: the smaller the differences that an assessor can identify, the sharper their discriminatory ability (DIN EN ISO 4120:2007 triangle test, 2007).

In the standardised test series administered in the DLG seminars, two of the samples could contain the solvent methanol (0) and the third either skatole (S) (0.25 µg/g) or androstenone (A) (2.0 µg/g), or one sample could contain methanol and the other two androstenone or skatole (Fig. 2). Figure 3 illustrates the theory of the triangle test using the example of androstenone. Figure 4 shows the sketch plans for the DLG assessor training, in which there are two tables with ten triangles laid out on each. The sensory experts have 20 minutes per table to solve the triangles. After the first table, they move on to the second to test the next set of samples (DLG, 2012).



Fig. 2: Triangle test series: in each case, participants are required to identify the sample which differs from the other two (identical) samples.

4.1. Results

The evaluation was based on the results for a total of 131 people with a technical background. They were trained in DLG seminars in the years 2012 to 2016. The participants were 95 men and 36 women who tested their sensitivity with regard to sexual and/or faecal odour. On average, the participants correctly identified 8 of the 10 samples containing skatole, but only 5.6 of the 10 samples containing

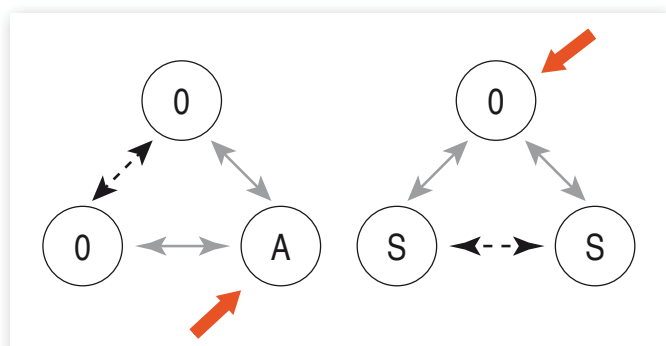


Fig. 3: Schematic layout of a triangle test

androstenone. These results are consistent with other studies which also show that androstenone is perceived less well than skatole.

The hypothesis that women perceive both substances better than men could not be confirmed with statistical significance due to the small sample size, but a tendency was observed. The average skatole detection figure for women (8.5) is higher than that for men (7.6). In the case of androstenone the averages are closer, at around 5.3 for women and 4.6 for men.

The training participants were then split into three groups (see Table 1). 26 people were assigned to the first group. These were described as “super-smellers” because they could reliably detect both androstenone and skatole. On average, this group identified 9.1 samples containing skatole and 8.1 containing androstenone. The second group was characterised by the fact that participants could reliably detect either androstenone or skatole. This group contained 75 people, described as “smellers”. The last group (“non-smellers”) consisted of people who could not identify either substance very well. Here the average sample detection figure was around 5 for skatole and 4 for androstenone.

Seminar participants who completed the test successfully were given a DLG certificate stating the number of correctly identified samples. For quality management, this provides crucial evidence of staff’s sensory capabilities and their potential uses.

In future the DLG Academy will continue to offer the sector appropriate staff training and thus contribute to quality assurance in pig meat. This is also the purpose of the “smell sticks” available from the DLG. These are samples of skatole and androstenone odours which can be used in employee screening. They allow in-house evaluation of “super-smellers” or “smellers” to be carried out at any time.

5. Outlook

Reliable detection of androstenone and skatole by human sensory analysis is not possible in every case. However, no usable practical alternatives are currently available on the market. Examples could be chemical or analytical methods, or the use of instrumental sensors. The design of testing, as carried out now by people directly on the slaughter line, can result in uncertainty in carcass evaluation (accuracy); in addition, these jobs are physically very stressful. If boar fattening and hence boar slaughtering continue to increase from 2017, it will soon be vital to step up research into detection options to replace or supplement the human senses.

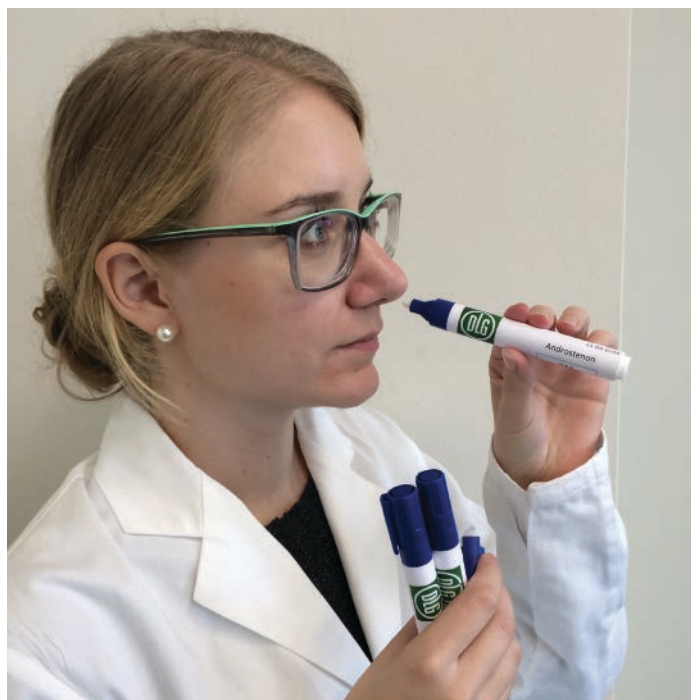


Fig. 5: Smell sticks

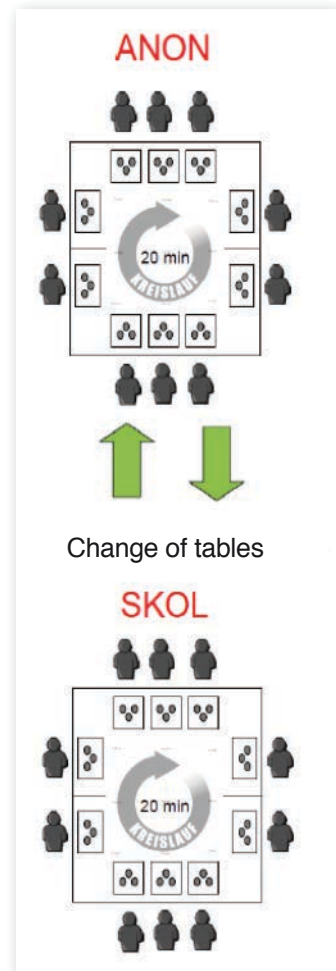


Fig. 4: Sketch plans for assessor training

Group	Number of people in group	Average number identified out of 10 samples containing skatole	Average number identified out of 10 samples containing androstenone
“Super-smellers”	11	8.7	8.18
“Smellers”	34	8.7 ¹	7 ²
“Non-smellers”	12	5	4

1 Average scored by persons who identified skatole reliably (n=33).

Source: own research

2 Only one person identified androstenone reliably but could not reliably detect skatole.

Table 1: Results of DLG assessor training as part of quality tests for fresh meat in autumn 2012 in Berlin

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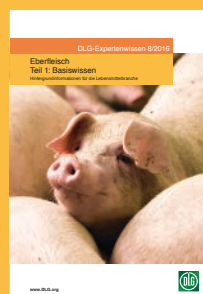
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