Olfactory Evaluation of Boar Taint

Subjects: Zoology

Contributor: Evert Heyrman

Development of olfactory training and scoring protocol for boar taint detection and three experiments to help optimize olfactory detection.

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1. Introduction

Boar taint is an unpleasant odor/taste caused by androstenone (AND), skatole (SKA), and to some extent indole (IND) present in the fat tissue of uncastrated male pigs [1][2][3]. Traditionally male pigs are castrated to prevent this boar taint, but growing welfare concerns are pushing the pig industry towards raising uncastrated or entire male pigs. Preventing tainted meat from reaching the consumer is a primary concern for the pig chain.

Olfactory boar taint evaluation can be used as a boar taint detection system, in experimental settings as well as for an online detection system at a slaughterhouse. Although different training protocols have been described [4], they are all similar in their underlying principles. Anosmia for AND, i.e., the inability to smell AND, is well documented in humans and is a critical criterion for exclusion of a panelist in an olfactory boar taint panel [5]. It has been found that the incidence of anosmia for AND is higher among men than women, and higher among older people. No difference was found between smokers and non-smokers. It is generally advised though to abstain from smoking, as well as eating and drinking half an hour prior to evaluating boar taint [6]. For Belgium 54.7% of subjects have been found to be anosmic for AND [6]. No such anosmia was found for SKA [7]. Testing for AND sensitivity is thus a necessary first step in selecting suitable panelists. This is generally done by offering a discriminatory test with AND on smell strips or dissolved in water. After this selection procedure, retained candidates are acquainted with the odors from heated pork fat and trained with smell strips containing boar taint compounds. They are taught the scoring system and given feedback about their scoring during training until they perform the tests with a minimum of mistakes [8][9][10][11].

When used in experimental settings, olfactory evaluation is mainly performed by a panel of experts to optimize the reliability of the sensory method.

Although olfactory evaluation of boar taint is becoming a routine practice in some (European) slaughterhouses, literature on the repeatability, the detection limits and the effect of training and priming is scarce. It has been found that repeated exposure to AND increases a person's acuity to that compound. This was tested over a period of six weeks [12]. Intra-rater reproducibility has been evaluated previously and has been found to be ranging from 0.19 to 0.32 which is considered low [9]. Concerning detection limits, for AND and SKA in sunflower oil they have been reported to be 0.21 µg/g and 0.10 µg/g respectively [13]. Variability in sensory thresholds over time has been found in earlier studies on smell strips on subsequent days (ranging seven dilution levels) [14].

2. Experiment 1: Familiarity and Effect of Preceding Sample

The average score given by participants for all sample types increases progressively for participant groups with decreasing familiarity with boar taint, with groups with lesser familiarity (G2–G3) giving progressively higher scores (p = 0.002). For all groups of participants, the average score was lower if the preceding sample was tainted ($p < 0.001$, Figure 1).

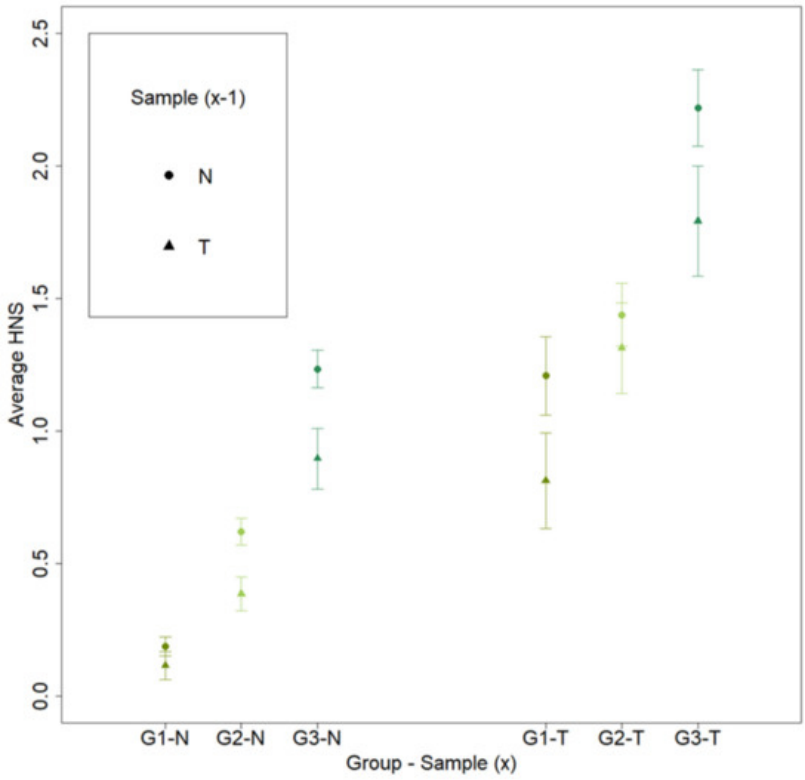

Figure 1. Average score (HNS) for each sample type (x) and previous sample type (x-1) per participant group, consisting of (1) “G1—trained” (6 trained panelists), (2) “G2—familiar” (6 people had some notion of AND and/or SKA, and/or boar tainted samples in general but who were not trained), and (3) “G3—unfamiliar” (6 people who had no notion of boar taint). The average score given by participants for all sample types increases progressively for participant groups with decreasing familiarity with boar taint. For all groups of participants, average score was lower if the preceding sample was tainted.

The interaction effect between type of participant group and the order of the presented series was significant (p = 0.005), reflecting that G3 and G2 gave a higher average score to samples from the first and second series compared to the following series they received (Table 1). Inter (consistency between raters) and intra (consistency within raters) rater reliability increased with increasing training and familiarity from 0.16 to 0.45 and from 0.18 to 0.53, respectively (Table 1). With lowering familiarity, sensitivity increased, and specificity decreased. Sensitivity and specificity also depended on the cutoff score chosen (CO1, CO2, or CO3). With increasing cutoff score, specificity increased mainly for G2 and G3, while sensitivity decreased in all three groups.

Table 1. Inter and intra rater reliability, and sensitivity and specificity for each participant group (G1: trained, G2: familiar, G3: unfamiliar) for cutoff score 1, 2 and 3.

G1	G2	G3	All	
Inter rater reliability	**0.45**	**0.29**	**0.16**	**0.25**
Intra rater reliability	**0.53**	**0.42**	**0.18**	**0.30**
Cut-off score 1				
Sensitivity	**0.45**	**0.72**	**0.82**	**0.66**
Specificity	**0.91**	**0.59**	**0.40**	**0.63**
Cut-off score 2				
Sensitivity	**0.34**	**0.44**	**0.62**	**0.46**
Specificity	**0.94**	**0.90**	**0.66**	**0.83**
Cut-off score 3				
Sensitivity	**0.21**	**0.21**	**0.40**	**0.27**
Specificity	**0.98**	**0.95**	**0.84**	**0.92**

3. Experiment 2: Detection Threshold AND, SKA, and IND

The estimated threshold for the respective compound is shown in Table 2. Thresholds per panelist and per day were plotted to illustrate the variation between and within panelists on smell strips (Figure 2) and in fat samples (Figure 3). For all compounds, the thresholds varied considerably within and between panelists.

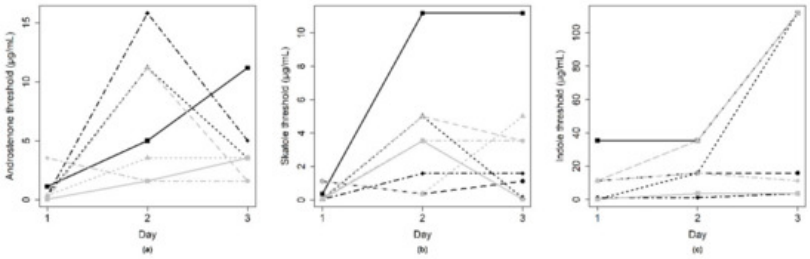

Figure 2. Sensory threshold on smell strips, with each line representing the individual thresholds (*y*-axis) of a panelist for replicate tests on three different days (*x*-axis). For all compounds, (**a**) androstenone, (**b**) skatole, (**c**) indole, the thresholds varied considerably within and between panelists.

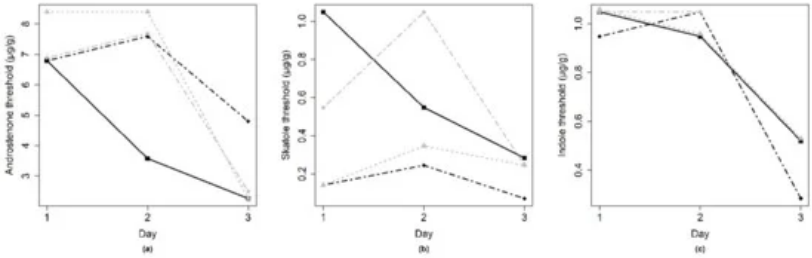

Figure 3. Sensory threshold in fat samples, each line represents the individual thresholds (*y*-axis) of a panelist for replicate tests on three different days (*x*-axis). For all compounds, (**a**) androstenone, (**b**) skatole, (**c**) indole, the thresholds varied considerably within and between panelists.

Table 2. Olfactory detection thresholds for AND, SKA, and IND. Determined for 6 trained panelists using smell strips and spiked pig fat.

Compound	Threshold Smell Strips (µg/mL)	Threshold Pig Fat (µg/g)
AND	**0.24**	**6.92**
SKA	**0.18**	**0.35**
IND	**3.71**	**0.90**

4. Experiment 3: Priming with Smell Strips

There was no significant effect of before- or after-noon (p = 0.123), or with or without priming with smell strips (p = 0.735) on the average score given for boar taint positive fat samples. The average scores without strips were 1.18 before and 0.97 after noon. The average scores with strips were 1.13 before and 0.93 after noon.

There was also no significant effect of before- or after-noon (p = 0.700), or with or without priming with smell strips (p = 0.248) on average score given for boar taint negative fat samples. The average scores without strips were 0.025 before and 0.015 after noon. The average scores with strips were 0.055 before and 0.045 after noon.

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