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Evaluation of different heating methods for the detection of boar taint by means of the human nose

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ABSTRACT

No automated detection system for boar taint detection is currently available, thus boar taint at the slaughterline can currently only be assessed using the singeing method (olfactory scoring). This study compares several heating methods (microwave, soldering iron and pyropen) and evaluates the effect of habituation, cleaning the soldering iron, singeing the fat twice in the same place, and variations in the technical procedures. All methods seem to be suitable for detecting boar taint but the choice of heating method for sensory scoring of boar taint depends on habituation of the trained assessor and specific conditions applied. The pyropen seems to be most suitable because it does not contact the fat and is easy to handle (wireless). Finally, the intensity score may also be influenced by: contamination from not cleaning the soldering iron, singeing the fat twice in the same place, and the effect of habituation.

1. Introduction

In most EU countries, 80 to 100% of the male pigs are castrated to avoid boar taint (Fredriksen et al., 2009). Societal pressure is increasing to seek more humane alternatives for surgical castration. The production of entire male pigs is gaining more and more acceptance in several countries including the Netherlands and Belgium. Moreover, some supermarkets have adjusted their marketing strategy by selling pork from entire male pigs. Entire male pig production is perceived as a humane alternative for castration (Vanhonacker, Verbeke, & Tuyttens, 2009). When producing entire male pigs, however, the risk of selling pork with boar taint must be minimised. No method has yet been found to raise entire male pigs with a sufficiently low prevalence of boar taint (Haugen, Brunius, & Zamaratskaia, 2012). Consequently, rapid detection methods for use in slaughterhouses are needed to identify and sort out carcasses with unacceptable levels of boar taint.

At present, no harmonised method for detecting boar taint is available and a variety of detection methods for use away from the slaughter line ("off-line") and at the slaughter line ("at-line") are used. Off-line detection methods can be used in the slaughterhouse but not directly on the carcass. At-line methods can be applied directly on the carcass at the slaughter line. In a Danish pig slaughterhouse, an off-line colorimetric method for the measurement of skatole levels in backfat is used (Vahlun, 1993). A fat sample is physically removed from each carcass and analysed in a laboratory. Some of the limitations are that androstenone is not measured, and that maximum 180 samples can be tested per hour (EFSA, 2004). Various other potential electronic methods for the rapid off- and at-line detection of carcasses with boar taint have been investigated, but they need further development before they will be ready for application in commercial slaughterhouses (Lundstrom, Matthews, & Haugen, 2009).

The lack of a validated detection system requires most slaughterhouses (and researchers) to use sensory assessment by trained assessors for the rapid determination of boar taint in carcasses. These olfactory scoring systems require the heating or singeing of a sample matrix (usually fat) to release boar taint odour if present, which is then assessed by one or more trained assessors. Much variation exists in the methodological approaches of these olfactory evaluations: the selection and training of the trained assessors, the method used for heating the samples (e.g. cooking, melting, boiling, or singeing), the specifications of the method used (e.g. temperature of the apparatus, duration of heating), and the type of sample (e.g. part of the carcass, size) that is assessed (Table 1).

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Table 1
Comprehensive list of research papers on heating methods used by trained assessors for detecting boar taint (since 2008 with topic: boar taint, sensory evaluation and expert panel).

Heating method	Method specification			Sample specification		Reference
	Temperature	Time	Other	Type	Size	
Boiling	/	10 min	/	Meat	/	Skrlep et al. (2010)
	185 °C	5 min	Hot plate	Fat and composite[a]	1×1×1 cm	Whittington et al. (2011)
Cooking		3 min	1800 W — Grill plate	Meat	2,5 cm	Aluwé et al. (2009)
	180 °C	2×4 min	/	Meat	/	Byrne, Thamsborg, and Hansen (2008)
	70 °C	/	Internal temp	Meat	1.27 cm^3	Coker et al. (2009)
	150 °C	2×3 min		Meat	1 cm	Hansen et al. (2008)
	190 °C	4 min	Grill plate	Meat	1 cm	Pauly et al. (2010)
	180 °C	5 min	/	Fat	50 g	Parunovic, Petrovic, Matekalo-Sverak, Parunovic, and Radovic (2010)
	/	2×1 min	frying	Meat	25 g	Lunde et al. (2010)
Soldering iron	/	/	30 W	Fat	On the carcass	Aluwé et al. (2009)
	180 °C	/	/	Fat	4×4×4 cm	Whittington et al. (2011)
Melting	185 °C	Until melted	Hot plate	Fat	20 g	Whittington et al. (2011)
Microwave	/	50 s	700 W	Fat		Aluwé et al. (2009)
	/	2×20 s	High power	Fat	10 g	Prusa et al. (2011)
	/	2×15 s	High power	Meat	10 g	Prusa et al. (2011)
	/	90 s	750 W	Fat and composite[a]	20 g	Whittington et al. (2011)

[a] Composite sample: muscle and fat from the cheek and submaxillary glands.

Whittington et al. (2011) compared various heating methods (microwave, melting, singeing and boiling) and concluded that the microwave, singeing and boiling methods seem suitable for detecting boar taint in slaughterhouses. Because of its simplicity and speed, the microwave method, performed off-line, was suggested as the best method. The most commonly used at-line method by slaughterhouses in the Netherlands and Belgium, however, is the singeing method (Jarmoluk, Martin, & Fredeen, 1970). Some slaughterhouses use a gas burner to which a small plate is attached to singe the fat. However, gas burners create much higher temperatures (flame temperature around 1300 °C) than soldering irons (30 W Ersa® — maximum temperature of 380 °C), which increase the risk of burning the fat. The present study was the first time that the pyropen (Weller®) – with or without an attached plate – was tested as an alternative method for singeing fat. This is a small pen-like gas burner (ca. 20 cm long) filled with isobutene. The five settings make it possible to adjust the temperature to the conditions. The pyropen may be a promising heating method for boar taint detection because the temperature range is lower than that of normal gas burners and more similar to that of the soldering iron. Also, the pyropen does not require an electrical cord, unlike electric soldering irons. This feature makes it easier to use at the slaughter line. Finally, when using the pyropen without the assembled plate, no risk of contamination with boar taint compounds (in contrast to the soldering iron) exists.

Although the singeing method currently seems to be the most commonly used method in slaughterhouses, the best way to perform the singeing method has not been subjected to scientific scrutiny. The lack of methodological harmonisation (e.g. concerning temperature, wattage, selection and training of the trained assessors), the paucity by which methodological details are reported in some studies, and the lack of knowledge on the effects of these methodological differences make it difficult to compare the results of different studies. Both researchers and slaughterhouse are increasingly calling for further optimisation and harmonisation of the singeing method. Potential influencing factors need to be investigated, together with evaluation and comparison of differences in methodology.

In this study, a series of experiments on olfactory assessment of boar taint have been conducted with various objectives, i.e. to compare different off-line methods (microwave, soldering iron, pyropen and pyropen with plate) for heating the fat samples; to investigate the technical performance (maximum temperature of the singeing tool and time needed per sample assessment) of the pyropen at two settings and of three soldering irons of different wattage; to compare the odour intensity scores of a group of samples with and without cleaning the soldering iron after each sample; to test the effect of singeing the fat twice at the same place; and to evaluate the effect of habituation by scoring the same group of 30 samples three times during one day.

For this study, four people were trained in the olfactory assessment of boar taint of fat samples removed from the carcasses of entire male pigs. We present data on the effect of the various experimental treatments using the scores given by these four trained assessors. In addition, the concentrations of the main boar taint compounds (androstenone, skatole and indole) of all samples used in experiments were determined via chemical analysis. These concentrations were correlated with the sensory assessments of the four trained assessors.

2. Materials and methods

2.1. Samples

Bulk neck fat (±30×15 cm) samples of entire male pigs were collected at a slaughterhouse of the VION Food Group (Eindhoven, the Netherlands) to minimise the effect of (possible) uneven distribution of the boar taint compounds in the carcass. The neck fat was singed using a gas burner equipped with a plate and scored for the presence of boar taint by the slaughterhouse trained assessor at the slaughter line using a five-point scale (0: normal pork smell to 4: strong boar taint, as described by Mathur et al. (2012)). Depending on the experiment, samples were used from all five categories or only from categories 0 and 4 (Table 2). This categorical scale (used in the slaughterhouse) was only used during the experimental set-up to indicate to the slaughterhouse trained assessor what intensities of boar taint samples were needed. Hence, the subsequent chemical analyses of the boar taint compounds could be limited to these preselected samples only. All visible meat was trimmed from the bulk neck fat sample, which was then cut into smaller pieces of standardized format (±7×2 cm) to eliminate visual differences between samples as much as possible. These samples were stored at −20 °C until experiments were conducted.

2.2. Chemical analysis

The concentration of androstenone, skatole and indole was determined by chemical analyses on the bulk neck fat samples (±30×15 cm) (skin removed). An LC–MS based detection method was used as described by Bekaert et al. (2012). In short, sample preparation