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Consumers dislike boar taint related off-flavours in pork chops regardless of a meal context

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ABSTRACT

This study investigated the acceptance of pork with varying levels boar-taint related off-flavours both, within a meat-alone (pure) and a meal context. In total, backfat samples of n = 24 animals were evaluated by a trained panel. The fat score was then related to the consumer liking of the pork chops. Repeated ANOVA of chop liking with consumer as a random factor (n = 37) and fat score as an interval predictor shows neither a main effect of context (d_{within} = 0.015) nor the interactions of context with linear and quadratic coefficient of the fat score. The linear ($b = -0.20$) and quadratic ($b = -0.24$) coefficients of the fat score main effect demonstrate the necessity and effectiveness of sensory quality control at slaughter. The quadratic coefficient showed a distinct penalty for higher fat scores. Sensory defects detected by trained panellists may not be noticed by usually less sensitive consumers.

1. Introduction

The surgical castration of male piglets has a long tradition in European pig production; although there are differences between countries. Nevertheless, this practice has been discussed quite controversially and there are intentions to finally ban it in Europe in 2018 as it interferes with animal welfare issues ("European Declaration on alternatives to surgical castration of pigs," 2010).

Raising non-castrated male pigs is regarded as an alternative method to avoiding surgical intervention. As a consequence, a current topic in meat research concerns the consumer acceptance of boar meat with possible off-flavours due to the accumulation of androstenone and skatole in the animals adipose tissue (Lundström, Matthews, & Haugen, 2009). That is the first part of the boar taint problem where sensory science is of great value: estimating acceptability or rejection thresholds. For a review of recent consumer studies the reader is referred to Font I Furnols, 2012. Most of these studies presented meat samples, and also processed meat products without any additional meal components. However, only a few studies were conducted within a real meal context. For example, it was studied the acceptance of minced boar meat in a 'spaghetti Bolognese' dish in an in-home situation (Mörlein et al., 2015). In that study consumers were provided with all ingredients and detailed instructions how to prepare the dish such as to ensure a certain level of standardization. Similarly, meat patties (Lunde, Skuterud, Hersleth, & Egelandsdal, 2010) and pork chops (Godt, Kristensen, Poulsen, Juhl, & Bech, 1996) were tested in-home.

The context in which a food is tasted and evaluated seems to affect its acceptability. Context effects can refer to the other meal components, the social interaction during consumption, the physical environment or the food choice freedom (King, Weber, Meiselman, & Lv, 2004). The acceptance of main parts of a meal can, for example, be influenced by the acceptability of the accompanying sides (Jimenez et al., 2015). Deliza and MacFie (1995) suggested that expectations during food consumption are crucial as they may improve or degrade product perception even before the actual tasting. Expectations can be evoked by external cues, such as information, and also by visual cues, such as the meal presentation.

The question remains whether the acceptance of boar meat is underestimated when it is presented in a pure form. In turn, one could expect (slight) off-flavours to be less of an issue when the meat is presented together with other meal components, i.e., in a meal context. It is assumed that a presentation as part of a meal would be more realistic and improve the external validity of the results (Zellner et al., 2011).

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If piglet castration is abandoned, a second issue where analytical sensory methods have become relevant regards quality assurance within meat production ("European Declaration on alternatives to surgical castration of pigs," 2010). To date, the sorting of boar carcasses is based on the olfactory assessment of the animals' backfat, (Mathur et al., 2012) as no technical method copes with the time constraints of the slaughter process (Haugen, Brunius, & Zamaratskaia, 2012). Often, carcass neck fat is heated with a hot iron at the slaughter line and trained assessors evaluate the odour of the fat in order to detect boar taint. In large slaughterhouses the number of tested carcasses can be up to several hundred per hour. In an optimal case, the sensory evaluation of the backfat allows the prediction of consumer liking or rejection. A recent investigation, however, reported weak to moderate correlations between boar taint detection methods with trained panellists (hot-iron method, microwave heating of fat samples) and consumer acceptability of meat samples in a central location test and in-home (Aluwé et al., 2012). Validation of the olfactory assessment of backfat samples against consumer liking of the respective meat is urgently needed.

The main research questions were thus

i) whether or not consumer liking of pork chops with potential off-flavours caused by boar taint is moderated by a meal presentation context, and
ii) whether or not consumer liking of boar meat is linearly related to trained experts' evaluation of backfat odour as usually carried out during sensory quality control at slaughter.

We hypothesize that tainted loins are better liked in a menu compared to single presentation, i.e., that boar taint is masked by a menu compared to a pure presentation. Masking of boar taint by the meal context was especially expected for chops with at least a medium fat score. Low fat scores were expected to correspond with no impaired consumer liking at all.

2. Material and methods

2.1. Animals, selection of loins and fat assessment by trained panellists

Boars (n = 24, crossbreed of Piétrain × (German Large White × German Landrace)) and Danish Duroc × (Large White × German Landrace) were raised at the Thünen Institute of Organic Farming and slaughtered at an average hot carcass weight of 90.0 kg (*SD*, 4.1 kg); detailed information concerning animals and meat quality parameters are given in Table 1. Boar loins (*M. Longissimus thoracis et lumborum (LTL), 12th to 6th rib*) were removed about 24 h after slaughter, vacuumed-packed (WEBOMATIC E15 basic, pump performance: 21 m3/h, vacuum: −1,0 bar; R-Vac Vacuum Sealer Bags (textured), la.va vacuum packaging) and kept frozen at −18 °C.

For the experiment, boar chops were chosen according to the olfactory 'fat score' of the respective animals, i.e. the extent to which the backfat deviates from a standard fat sample in terms of boar taint. The evaluation was done by a group of 10 assessors trained on the detection of off-odours caused by skatole and androstenone in backfat as described previously (Meier-Dinkel, Gertheiss, Müller, Wesoly, & Mörlein, 2015; Mörlein et al., 2016). For each assessor, individual subsamples about 3 g of backfat were heated for 80 s at 450 W in a microwave and immediately served for olfactory assessment. Samples were scored on a scale from 0 (no deviation from standard) to 5 (very strong deviation from standard). Assessors were highly-sensitive to the odour of skatole and androstenone (repeated discrimination of the odourants in triangle tests; 10 ng androstenone or 5 ng skatole diluted in 20 µl propylene glycol vs. odourless propylene glycol).

To indicate the reliability of the sensory results, intraclass correlation coefficients (ICC) (Shrout & Fleiss, 1979) based on the original 0 to 5 ratings were computed using R package psych (Revelle, 2015): ICC2 (single random raters) was 0.21 (95% CI: 0.11; 0.37) and the ICC2k (average random rater) was 0.77 (CI: 0.61; 0.89).

Table 1
Meat quality parameters.

Factor level (fat score)	LOW (≤1.5)		MEDIUM (>1.5–<2.5)		HIGH (≥2.5)	
	Mean	SD	Mean	SD	Mean	SD
Number of animals	8		8		8	
Fat score[a]	0.9	0.4	1.8	0.2	3.3	0.6
(Range)	(0.2–1.4)		(1.6–2.1)		(2.5–4.2)	
Androstenone[b]	0.62	0.34	1.18	0.70	1.78	1.05
Skatole[b]	0.06	0.02	0.09	0.05	0.35	0.24
Carcass weight, hot [kg]	88.1	4.1	90.7	4.6	91.2	2.7
Age at slaughter [days]	181	13	183	7	188	18
Lean Meat Yield [%][c]	56.1	1.9	55.7	1.3	56.4	0.7
Electrical conductivity[d]	3.6	1.0	2.9	0.3	3.2	0.3
pH_{24}[e]	5.5	0.1	5.6	0.05	5.6	0.05

[a] Olfactory deviation score: 0 = no deviation from standard fat sample to 5 = very strong deviation from standard fat sample. Evaluated by a sensory panel of 10 assessors trained on boar taint detection.
[b] µg/g melted backfat; measured by GC–MS (see chapter 2.2). Mean indole values <0.05 µg for all products.
[c] Estimated by Fat-O-Meter (FOM); Carometec A/S; Denmark.
[d] In [mS/cm], 24 h post mortem, *M. longissimus*, 13th/14th rib; LF-Star, Matthäus Comp.; Germany.
[e] 24 h post mortem, *M. longissimus*, 13th rib; Portamess 911, Knick Comp.; Germany.

To ensure their equal distribution across consumers, boar samples were classified as LOW (<1.5), MEDIUM (1.5 to 2.5) or HIGH (>2.5) according to the mean assessed fat score (cp. Fig. 1). The contents of the key compounds androstenone and skatole were measured by GC–MS per g melted backfat as described in Mörlein, Grave, Sharifi, Bücking, & Wicke (2012) and Mörlein et al. (2015) (cp. Table 1). Thus, eight loins were available for each of the three fat score level groups.

2.2. Participants for consumer acceptance test

In order to match the available meat samples, 40 consumers were recruited in and around Göttingen (Germany) via telephone by an agency (isi GmbH, Rosdorf, Germany). Data from 3 participants had to be excluded due to incompleteness, thus the sample comprises n = 37. It was balanced according to gender (female: 51%, male: 49%) and age groups (49% were 18 to 41 years: $M = 26.2$, $SD = 5.6$; 51% were 41 to 65 years: $M = 52.6$, $SD = 6.0$). Participants were required to consume pork chops or cutlets at least once per week. Oral informed consent was taken from all participants and an incentive (30 €) was given to compensate for their participation in two tasting sessions at a sensory laboratory (isi GmbH, Rosdorf, Germany).

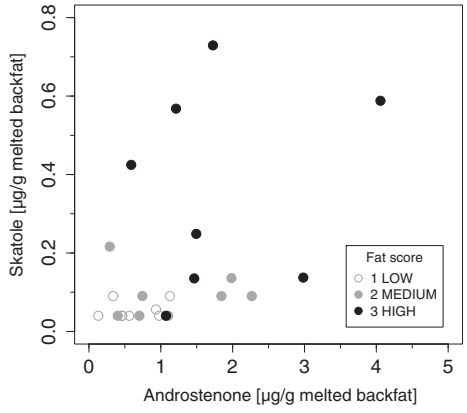

Fig. 1. Fat score (microwave heating; evaluated by 10 trained panelists) and androstenone and skatole contents in melted backfat (GC-MS) of animals (n = 24) used for chops.