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Consumers' perception and acceptance of boiled and fermented sausages from strongly boar tainted meat

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ABSTRACT

Characteristic off-flavours may occur in uncastrated male pigs depending on the accumulation of androstenone and skatole. Feasible processing of strongly tainted carcasses is challenging but gains in importance due to the European ban on piglet castration in 2018. This paper investigates consumers' acceptability of two sausage types: (a) emulsion-type (BOILED) and (b) smoked raw-fermented (FERM). Liking (9 point scales) and flavour perception (check-all-that-apply with both, typical and negatively connoted sensory terms) were evaluated by 120 consumers (within-subject design). Proportion of tainted boar meat (0, 50, 100%) affected overall liking of BOILED, $F(2, 238) = 23.22$, $P < .001$, but not of FERM sausages, $F(2, 238) = 0.89$, $P = .414$. Consumers described the flavour of BOILED-100 as strong and sweaty. In conclusion, FERM products seem promising for processing of tainted carcasses whereas formulations must be optimized for BOILED in order to eliminate perceptible off-flavours. Boar taint rejection thresholds may be higher for processed than those suggested for unprocessed meat cuts.

1. Introduction

The production of un-castrated animals is considered an alternative practise to the surgical castration of male piglets which was proven painful for the animals (EFSA, 2004; Hay, Vulin, Génin, Sales, & Prunier, 2003; Llamas Moya, Boyle, Lynch, & Arkins, 2008). Besides that surgical intervention is avoided, raising boars is advantageous in terms of a superior growth rate, a more efficient feed conversion, greater carcass leanness (Lundström, Matthews, & Haugen, 2009; Pauly, Luginbühl, Ampuero, & Bee, 2012). The main disadvantage, however, is the risk that off-flavours occur, so-called boar taint, which primary originates from the accumulation of androstenone and skatole, mainly in the animals' fat (Patterson, 1968; Vold, 1970). Much effort is being put into the development and optimisation of feeding, breeding and management measures to reduce the responsible compounds in the animal. Nonetheless, a certain risk for tainted carcasses requires reliable sorting at slaughter. Yet, processing of tainted raw material will be a further challenge. This becomes even more relevant when surgical piglet castration without anaesthesia and analgesia will be banned in 2018 in the EU ("European Declaration on alternatives to surgical castration of pigs,", 2010). Especially the question what to do with highly tainted fresh meat that has been declared as 'unfit for human consumption' due to 'organoleptic anomalies, in particular a pronounced sexual odour' (cp. Section 2, Chapter V: DECISIONS CONCERNING MEAT, 1. (p)) according to EU legislation (Regulation (EC) No 854/2004, 2004) is unsolved. Disposing such carcasses appears ethically disputable. It thus needs to be shown whether tainted meat, which is not suitable for fresh consumption, can be processed in a way that consumer acceptance is not impaired.

Producing meat products from tainted raw material without impairing consumers' product appreciation is challenging: on the one hand off-flavours due to 'boar taint' should not be perceivable; on the other hand recipes must be generally palatable. Rejection thresholds for key compounds are discussed for pork fat (see Lundström et al., 2009), but cannot be transferred to processed products because they highly vary in terms of fat content; usually, the fat content in sausages is much higher compared to loins or alike. Nevertheless, sausages appear promising with regard to consumer acceptance as the amount of

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'boar taint' can be controlled by blending of raw material. Additionally, off-flavours can be masked by spices, herbs, smoke and aroma compounds developed during fermentation (Lunde et al., 2008; Stolzenbach, Lindahl, Lundström, Chen, & Byrne, 2009). Especially for small-scale producers the possibilities for blending tainted and untainted raw material are limited and precise recommendations/recipes are needed for the use of highly tainted material. Some studies have investigated consumers' acceptance of processed boar meat, for example bacon (Gullett, Partlow, Fisher, Halina, & Squires, 1993; Lunde, Skuterud, Lindahl, Hersleth, & Egelandsdal, 2013), cooked and dry-cured ham (Diestre, Oliver, Gispert, Arpa, & Arnau, 1990) and fermented sausages (Meier-Dinkel, Sharifi, Frieden, Tholen, Fischer, Wicke, & Mörlein, 2013). To the best of our knowledge, consumer acceptance data is, however, very limited for boiled sausages as are trials with systematic variation of the sausage type and the proportion of tainted raw material.

The main research questions in our study were

i) to investigate consumers' acceptability of two types of sausages (raw smoked-fermented and boiled emulsion-type sausages) made from 50% (and 50% standard material) or 100% boar-tainted raw material in comparison to a control product made solely from standard raw material;
ii) to study the consumer perception of the various sausage batches by including a CATA ballot with sensory flavour descriptors.

In the present study, the check-all-that-apply (CATA) approach is used for investigating the perceptions of consumers on products by presenting a list of terms from that all items are checked that are appropriate for the product at hand. Originally brand perception was studied with the CATA method but the ballot can also include terms related to sensory, hedonic or emotional aspects of the respective products. This method is also interesting as CATA questions may be used to obtain a rapid sensory profile from naïve consumers instead of a time-consuming quantitative descriptive profile (Meyners, Castura, & Carr, 2013; Valentin, Chollet, Lelièvre, & Abdi, 2012).

Our first hypothesis was that using 50 or 100% material from tainted carcasses reduces overall acceptability of boiled emulsion-type (BOILED) and raw smoked-fermented (FERM) sausages. The second hypothesis was that consumers will more often perceive off-flavours and therefore chose negative terms (e.g. barn, pig, sweat) to describe the flavour of sausages with boar meat compared to the control sausages.

2. Material & methods

2.1. Participants

A consumer sample (n = 120) was recruited in and around Göttingen, Germany and balanced according to gender and age groups (18 to 41 years and 41 to 65 years). Participants were required to consume boiled emulsion-type and raw smoked-fermented sausages at least once per week. Oral informed consent was taken from all participants and an incentive (15 €) was given to compensate for their participation at a sensory laboratory (Institut für Sensorikforschung und Innovationsberatung, isi GmbH & Co. KG, Rosdorf, Germany).

2.2. Selection of raw material and production of sausages

Carcasses for sausage production were selected in a commercial slaughter house. In the chilling area, back fat samples of 45 boars were collected and later assessed by 10 sensory assessors trained on the detection of boar taint in fat according to a 6 pt.-scheme described in Meier-Dinkel, Gertheiss, Müller, Wesoly, and Mörlein (2015). For the sausage production five boars with the highest fat score according to the panellists' evaluation were chosen. Standard raw material was collected from five female pigs at the same day. For sausage production shoulders, backfat (only for FERM products) and jowl (only BOILED batches) were used. Androstenone, skatole and indole contents were measured by SPE-GC–MS in all backfat samples (see Section 2.5 and supplement Fig. S1). For each sausage type (BOILED; FERM) one reference batch that contained only standard raw material (BOILED-REF; FERM-REF), one batch containing 50% tainted and 50% standard raw material (BOILED-50; FERM-50) and one batch containing only tainted raw material (BOILED-100; FERM-100) were produced. Thus, six batches were produced in total using the pooled boar and standard raw materials, respectively: For the tainted raw material meat and fat of five boars was used to prevent conclusions based on individual animals. Similarly, the standard raw material from five female pigs was mixed before further use.

BOILED batches comprised a proportion of ~80% lean meat and 20% fat. To each batch the following was added: ice (20%), sodium chloride (1.62%), curing salt (E250; 0.20%; mixture of 99.5 sodium chloride and 0.5% sodium nitrite), sodium citrates (E 331; 0.3%), smoke condensate (0.05%; Chardex H GF, Red Arrow International LLC) as well as a standard spice mixture (0.6%) containing black pepper, mustard, coriander, caraway, red pepper powder, garlic, chilli, salt, rice starch and nutmeg. Shoulders and jowl of standard and boar parts were chopped into 5 × 5 cm cubes and premixed by hand to ensure equal distribution of all animals, respectively. Batches were prepared to achieve 0, 50 or 100% of boar lean meat and fat. Then they were separately minced using a grinder (mincer FL82N, Fa. ADE) equipped with a 3 mm grinding plate. Lean meat and 1/3 of the ice were chopped for 30 s in a 5 l — bowl chopper (FGC 10–20, Fa. FEUMA). Afterwards fat, spices and the remaining ice was added and each batch was chopped to a homogenous mass without exceeding a temperature of 12 °C. The meat emulsion was filled into artificial sausage casings (calibre 60 mm; Tripan transparent 60/30, Fa. HEIFO Rüterbories GmbH & Co.KG, Osnabrück, Germany) using a vacuum-filling machine (VF 608, Fa. Handtmann). Sausages were scalded in 85 °C water for about 90 min to a core temperature of 75 °C. Finally, sausages were cooled down for 20 min in cold water, after that in a chilling room for 24 h, then vacuum-packed and kept frozen at −18 °C for 6 weeks until the consumer test.

FERM batches comprised a proportion of ~80% lean meat and 20% fat. To each batch the following ingredients were added: black pepper (0.30%), mace (0.10%), caraway (0.05%), coriander (0.05%), sugar (1.2%), sodium chloride (1.9%) and smoke condensate (0.07%; Chardex H GF, Red Arrow International LLC). Shoulder and backfat were cut into cubes (5 × 5 cm) and frozen to a temperature of around −4 °C. Then the cubes were chopped to a particle size of 2–3 mm together with other ingredients. Meat mass was filled into natural casings (calibre 20–25; sheep) with a vacuum-filler (VF 608, Fa. Handtmann). The fermentation process was done in a smoking and fermentation chamber (Maurer Atmos, Titan 2 with internal regulation) for 7 days. Air humidity and temperature were continuously decreased (starting temperature 22 °C, final temperature 20 °C; starting air humidity 94%, final air humidity 80%). After fermentation sausages were smoked for 52 min (smoking temperature 20 °C) using a friction smoking generator. Products were finally evacuated and kept frozen at −18 °C for 6 weeks until the consumer test.

2.3. Acceptance test

The consumer test was conducted on 2 days in December 2014. Consumers were informed that they would evaluate sausages of artisanal production that were made from pig fat and meat.

In total, 10 sessions with a maximum of 14 consumers were held. Sample presentation followed a within-subject design and a monadic sample presentation at room temperature. Samples were coded (three digits) and the order was randomized within the sausage types; half of the sessions started with the boiled sausages and with the smoked raw-fermented sausages, respectively. Sample amount per consumer was approximately 25 g (1.5 cm thick slice of BOILED; four 1 cm thick