Food Research International 108 (2018) 387–395

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

The use of smoke as a strategy for masking boar taint in sausages and bacon

Margit Dall Aaslyng*, Anette Granly Koch

Danish Meat Research Institute, Technological Institute, Gregersensvej 9, Taastrup DK-2630, Denmark

ARTICLE INFO

Keywords:
Entire male pigs
Boar taint
Liquid smoke
Natural smoke
Skatole
Androstenone
Sausages
Bacon

ABSTRACT

Smoke has often been recommended as a masking agent for boar taint. However, guidelines on how much smoke is necessary have not been established. We compared different smoking parameters in bacon (smoking times) and sausages (smoking times and use of liquid smoke). In streaky bacon from entire male pigs with skatole concentrations of up to 0.6 μg/g and androstenone concentrations of up to 5.8 μg/g in the neck fat, three smoking times were compared: 10, 30 and 60 min. Boar taint was partially, but not fully, masked. The longer the smoking time, the better the masking effect. In sausages from entire male pigs with an average skatole concentration of up to 0.6 μg/g and androstenone concentration of up to 3.6 μg/g (the meat part) or 2.4 μg/g (the fat part) in the neck fat, smoking for 40 and 80 min fully masked the boar taint, whereas only a minor effect was seen after 10 and 20 min smoking. Liquid smoke (0.1%) did not mask boar taint when added to sausages from entire male pigs with an average skatole concentration of 0.36 μg/g (meat) or 0.38 μg/g (fat) and androstenone concentration of 2.3 μg/g (meat) and 2.9 μg/g (fat). To effectively mask boar taint, an intense smoked flavour is therefore necessary, and the longer the smoking time, the better. In contrast, the use of liquid smoke mixed into the product was not effective in the concentrations used in the current study.

1. Introduction

The European pork industry has agreed to introduce a voluntary ban on castration without anaesthesia from 2018. Since carcasses from entire male pigs might develop boar taint due to skatole and androstenone, it will be necessary to sort out the carcasses containing the two compounds in high concentrations in order to meet consumer demands for high quality pork. This means that the carcasses that have been sorted out must be used in such a way that the boar taint problem is of less importance than in the fresh meat. Skatole and androstenone are present in the whole carcass (Meinert, Lund, Bejerholm, & Aaslyng, 2017; Wauters, Vercruysse, Aluwé, Verplanken, & Vanhaecke, 2016), and there is an urgent need to identify different strategies that can mask the boar taint so that all parts of the carcass can be used.

The use of smoke has frequently been mentioned as a strategy for masking boar taint (Lunde et al., 2008; Lunde, Skuterud, Lindahl, Hersleth, & Egelandsdal, 2013; Martínez et al., 2016; Stolzenbach, Lindahl, Lundström, Chen, & Byrne, 2009), since it seems to be effective and is already used in several products such as bacon and sausages. In general, the studies only use one smoking approach, and a clear procedure on how intense the smoke flavour needs to be to effectively mask the taint has not yet been presented.

Smoke can be added to the product either using a traditional smoking process in a smoking chamber (natural smoke) or using liquid smoke. Smoking in a smoking chamber can be roughly divided into cold smoke (below 25 °C), warm smoke (25 °C–45 °C) and hot smoke (40 °C–60 °C) (Fellows, 2017, chap. 15; Sikorski & Sinkiewics, 2014). Smoke contains flavour compounds such as isoeugenol and phenolic compounds eg. guiacol, syringol and phenol (Fellows, 2017). The exact composition depends both on the type of wood and on the processing parameters (e.g. temperature, water and content of the wood). Industrial smoking can be regarded as an art, and the process parameters used in one plant and one smoking chamber cannot be directly transferred to another system. The exact process parameters must therefore be optimised in each individual case based on a sensory evaluation of the products.

Liquid smoke is produced from smoke from different types of wood and is produced through several cleaning steps. In this way, extracts are formed with different contents of chemical compounds (Rozum, 2014) and thereby different smoke characteristics. The liquid smoke can either be on the surface of the products as in the commercial fermented sausages in Stolzenbach et al. (2009) and in bacon in Lunde et al. (2013) or partly mixed into the product as in the model sausages in Stolzenbach et al. (2009) and in Lunde et al. (2008), where liquid smoke is added to a marinade and tumbled into pork chops. Although several types of liquid smoke exist, until now the masking effects of different kinds of liquid smoke with different sensory characteristics on boar taint have not been compared.

* Corresponding author.
E-mail address: mdag@teknologisk.dk (M.D. Aaslyng).

https://doi.org/10.1016/j.foodres.2018.03.069
Received 18 December 2017; Received in revised form 22 March 2018; Accepted 25 March 2018
Available online 28 March 2018

Consequently, even though several publications point out that smoke can be used as a potential masking agent, no guidelines on the optimal use of smoke can be given to the industry. In our study, we compared different smoking times and different types of liquid smoke to identify the most effective smoking procedure and, based on the results, establish guidelines on how to use smoke to mask boar taint. Bacon is a product with a high fat content, and it is therefore expected to be susceptible to boar taint, since both skatole and androstenone are fat-soluble compounds (Fischer et al., 2011; Rius & Garcia-Regueiro, 2001). It is of interest to investigate whether smoke can mask boar taint in bacon. In bacon, an animal-to-animal variation can exist, meaning that two animals with the same concentration of skatole and androstenone in the neck fat might have different sensory qualities due to other differences, such as fat percent, or simply due to random variation between animals. In sausages, this animal-to-animal variation are minimised, since several animals are mixed in a batch. This increases the power of the study in terms of comparing smoking times. Futhermore, sausages are a meat product which is often smoked. It is therefore also of interest to investigate the potential of smoke in masking boar taint in sausages.

The aim of the study was to compare, in three different experiments, the effectiveness of different smoking intensities gained by different smoking times and by the use of liquid smoke in masking boar taint in meat from entire males. The hypothesis is that the smoking intensity and the potential for masking boar taint are correlated and that liquid smoke mixed into a product will have a beneficial masking effect. The degrees of smoking effectiveness were compared in sensory studies using trained sensory panellists.

2. Material and methods

Three studies were performed to 1) investigate the effect of different smoke intensities in bacon using natural smoke, 2) investigate the effect of different smoke intensities in sausages using natural smoke and 3) investigate the effect of liquid smoke with or without natural smoke in sausages. In all three studies, boar taint was assessed by a trained sensory panel.

2.1. Chemical analysis

The content of skatole and androstenone was analysed in the neck fat of the entire males using the method described in Hansen-Møller (1994) and further modified as described by Aaslyng, Broge, Brockhoff, and Christensen (2015). In short, the compounds were extracted from the fat using methanol by homogenisation followed by centrifugation after chilling. The extract was then analysed by HPLC using fluorescence detection. The content was expressed as µg/g fat tissue.

2.2. Production of bacon

Streaky bacon was produced from meat from 17 entire males and five castrates. The content of androstenone and skatole in the neck fat of the selected carcasses can be seen in Fig. 1. The carcasses were collected at the slaughterhouse, with the castrates selected randomly and the entire males selected on the basis of the skatole concentration in the neck fat (Mortensen & Sørensen, 1984). Breed was not controlled, though most Danish slaughter pigs are a combination of Duroc (sire) and Landrace and Yorkshire (sow). The average carcass weight for the entire males was 85 kg and the meat percentage 60.9% while it was 81.1 kg and 59.5% for castrates. For further details, see Aaslyng, Jensen, and Karlsson (2018). The meat was vacuum-packed, frozen and kept at −40 °C until use.

The bacon was produced with 12% weight gain using a brine as described in Table 1. After injection, the bacon sides were tumbled for 6 h at 5 °C, 6 RPM, tumbling for 15 min and resting for 45 min. The bacon sides were then divided into three parts, which were dried at 45 °C, 10% relative humidity (RH) for 30 min to get a dry surface to facilitate the adherence of the smoke, and then smoked in a smoking chamber at 45 °C for 10, 30 or 60 min at 40–50% RH. After smoking, the bacon was left to rest for 5 min and chilled to below 5 °C, before being vacuum-packed and kept chilled at 4 °C until analysis. Beach wood was used to produce the natural smoke. The wood was burned on a heating plate and the smoke send through tubes into the smoking chamber.

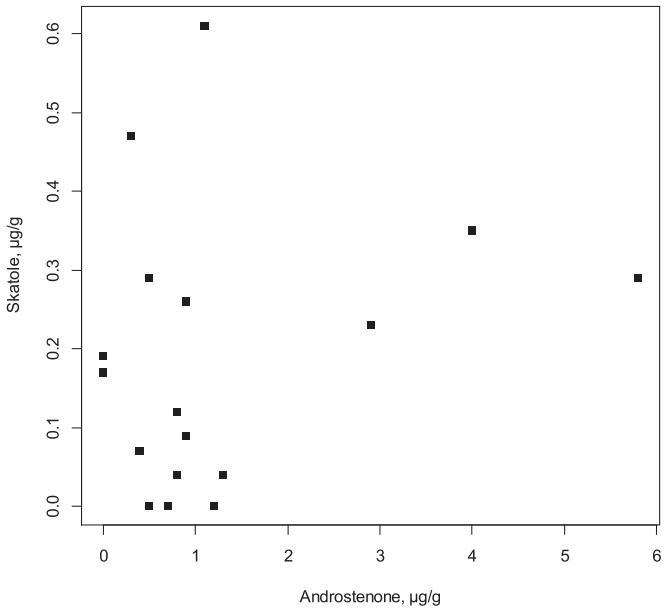

Fig. 1. Distribution of skatole (µg/g) and androstenone (µg/g) in the neck fat of entire males used for bacon production.

Table 1
Brine composition used for streaky bacon.

	Weight percent
Water	56.58
Nitrite salt, 0.6%[a]	9.34
NaCl	12.14
Na-tripolyphosphate[a]	2.80
Glucose[a]	18.67
Ascorbate E301[b]	0.47
Total	100%

[a] SFK Food A/S, Skanderborg, Denmark.
[b] Kryta, Roskilde, Denmark.

2.3. Sausages with different smoking times

The sausages were produced from a mixture of meat (fore-end, Essfood 1351) from two entire males with an average skatole concentration of 0.60 µg/g (individual values 0.80 µg/g and 0.40 µg/g) and an average androstenone concentration of 3.6 µg/g (individual values 0.9 µg/g and 6.3 µg/g) in the neck fat and fat (jowl, approx. 50% fat) from six entire males with an average skatole concentration of 0.57 µg/g (std.dev. 0.16 µg/g, minimum 0.40 µg/g,maximum 0.83) and androstenone concentration of 2.4 µg/g (std.dev. 2.2. minimum 0.9, maximum 6.3 µg/g). The animals were chosen to maximize both skatole and androstenone in the mixture and is as such not a representative sample of the population, but merely the worst case from the days of sampling. The meat (28.70% w/w) and fat (36.00% w/w) were minced using a 3 mm hole size and mixed with water/ice (27.00% w/w), potato flour (SFK Food A/S, Skanderborg, Denmark, 4.00% w/w), caseinate (Arrabawn CO-OP, Tipperary, Ireland, 2.00% w/w), NaCl (1.60% w/w), Na-phosphate (SFK Food A/S, Skanderborg, Denmark, 0.28% w/w),