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Consumers' sensitivity to androstenone and the evaluation of different cooking methods to mask boar taint

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ABSTRACT

Boar taint is an unpleasant odour and flavour present in some entire male pigs that is due to the presence of androstenone and skatole. The aim of the study was to assess the sensitivity of 150 consumers to androstenone and to compare the acceptability and liking of meat from castrated and entire pigs, cooked with different cooking methods. Meat samples consisted of loins from castrated (CM) and entire male pigs (EM) with high levels of androstenone cooked by two cooking methods: sous-vide and fried/breaded with garlic and parsley. Consumers evaluated smell and flavour acceptability, and overall liking of CM and EM for each cooking method. The results of the study showed that dislike of androstenone odour increased significantly with sensitivity. The results of acceptability and overall liking were similar in CM and EM for both cooking methods. Therefore, the two cooking methods used in the study may be useful to mask boar taint.

1. Introduction

Boar taint is a distinctive odour and flavour that can be evident during the cooking or eating of pork and pork products from some entire male pigs. It is caused by the excessive accumulation of androstenone and skatole (Bonneau, 1982) that are accumulated in fat (Claus, Weiler, and Herzog, 1994). Numerous subsequent studies have confirmed that these two compounds are the main contributors to boar taint (Bonneau et al., 1992; Bonneau and Chevillon, 2012; Font i Furnols, 2012; Haugen, Brunius, and Zamaratskaia, 2012). In 2009, approximately 80% of male piglets were surgically castrated in Europe to avoid potential consumer dissatisfaction due to of boar taint (Fredriksen et al., 2009). Since surgical castration of piglets has become an animal welfare concern, discussions at the European level aim to ban surgical castration by 2018 (DG-SANCO, 2010). The Report from the Expert Group on ending the surgical castration of pigs (Backus, Støier, Courat, Bonneau, and Higuera, 2014) states that in the last years some countries have increased their entire male pig production. These countries are currently producing a proportion of entire male pigs: Spain (80% of entire male pigs), The Netherlands (60%), Belgium (40%), France (10%) and Germany (10%). In the case of Spain this percentage is estimated to be 85% (Borrisser-Pairó, Kallas, et al., 2016). With these entire male pig productions, consumers that dislike boar taint may have more chances to find meat with its presence.

Androstenone has been described as sweaty, dirty, and tasting of silage and parsnips. Skatole has been associated with mothball and musty odours (Annor-Frempong, Nute, Whittington, and Wood, 1997; Blanch et al., 2012; Font i Furnols, Guerrero, Serra, Rius, and Oliver, 2000). Levels of boar taint compounds over the threshold can arise in some pigs (Font i Furnols et al., 2000). Different thresholds have been suggested, but the most commonly used are 0.5 and 1.0 μg/g for androstenone in fat tissue (Claus et al., 1994; Font i Furnols, Gispert, Diestre, and Oliver, 2003; Rhodes, 1971) and 0.10 and 0.20 μg/g for skatole in fat tissue (Bonneau et al., 1992; Claus et al., 1994; Desmoulin, Bonneau, Frouin, and Bidard, 1982; Font i Furnols et al., 2003; Walstra et al., 1999). While skatole is perceived by 99% of consumers (Weiler, Fischer, Kemmer, Dobrowolski, and Claus, 1997), androstenone is perceived by approximately 40–50% of consumers (Weiler et al., 2000; Font i Furnols et al., 2003; Blanch et al., 2012; Razafindrazaka et al., 2015), meaning that consumers who are insensitive (anosmics) to this compound cannot smell it. Therefore, androstenone sensitivity affects boar taint acceptability susceptibility of consumers of different types (pork lovers, boar meat lovers and reject boar taint meat) (Panella-Riera et al., 2016). Some studies have also shown that women are more sensitive than men (Blanch et al., 2012; Bremner, Mainland, Khan, and Sobel, 2003; Lunde, Skuterud, Nilsen, and Egelandsdal, 2009; Weiler et al., 2000; Wysocki and Beauchamp, 1984). The prevalence of high levels of boar taint in Spain is 10.2%, but if high levels of androstenone are only considered, the prevalence is 5.5%. For high levels of skatole the prevalence is 6.6% (Borrisser-Pairó, Panella-Riera, et al., 2016). Prevalence of androstenone and skatole together is

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>10.2% because some pigs may have the presence of both compounds at the same time.

Because consumers are the last step of the production chain, consumer studies are necessary to assess sensory acceptability and attitudes of consumers towards pork and pork products from boars (Font i Furnols, 2012). Consumers' opinions are important when a new product is released (Amerine, Pangborn, and Roessler, 1965). Font i Furnols (2012) reviewed different consumer studies of boar taint and reported that meat from entire male pigs contained lower acceptability than meat from castrated male pigs. This study also reported that odour is the main attribute affected by the presence of boar taint.

Previous studies evaluated different cooking methods by a trained panel and found that the cooking method has an effect on boar taint perception (Agerhem and Tornberg, 1995; Font i Furnols, 2012; Prestat, Jensen, McKeith, and Brewer, 2002; Wood, Nute, Fursey, and Cuthbertson, 1995). Cooking methods can be classified depending on the use or not of a liquid medium, how heat is received (direct fire, hot plate or hot air), in addition to new technologies such as microwave or vacuum cooking (Bello, 1998). Vacuum cooking, also known as sous-vide prevents the development of some off-flavours and the loss of flavour volatiles (Armstrong and McIlveen, 2000; Schafheitle, 1990). The use of oil as a cooking medium when frying may have an effect on sensory perception due to its aromatic compounds (Prestat et al., 2002). A study from Linares et al. (submitted for publication) performed within the same project as the present study concluded that both vacuum cooking and frying reduced androstenone perception in a trained panel, with the frying method being more effective.

The use of herbs and aromatic plants for cooking is very common (Bianchi, 2015) and it might be considered for masking boar taint in fresh pig meat. Breading is a common strategy used by consumers, with breaded products being more palatable because of a crispy crust and a soft interior (Antonova, Mallikarjunan, and Duncan, 2003). Mörlein et al. (2015) found that the use of a spice mix or other ingredients mask the perception of boar taint odour. Aaslyng, De Lichtenberg Broge, Brockhoff, and Christensen (2015) assessed bacon and pork belly roll and also found that smoke and spice mix (salt, pepper, sugar, clove, marjoram, thyme, mustard, allspice and bouillon powder and gelatine) can mask boar taint. A previous study by Egea et al. (submitted for publication) within the same project as the present study evaluated different masking strategies to reduce androstenone odour and flavour in fresh pig meat in a trained panel. They concluded that breading with garlic and parsley was the best masking strategy.

If castration is prohibited, a high percentage of meat from entire male pigs with boar taint will be present in the market (Borrisser-Pairó, Panella-Riera, et al., 2016), and it will be important to find a proper use for this meat (Lunde et al., 2008). The present study had two main objectives: 1) to study consumer sensitivity to androstenone to estimate the number of consumers that are highly sensitive and may reject tainted meat; 2) to assess different cooking methods (sous-vide and fried/breaded with garlic and parsley) to mask boar taint. We compared consumers' acceptability of fresh meat from entire male pigs with high levels of androstenone to fresh meat from castrated male pigs.

2. Materials and methods

2.1. Selection and preparation of meat samples

The pigs used in the study were commercial crossbreeds (Pietrain × (Landrace × Large White)) from commercial farms that were raised from 30 kg live weight in fattening farms to the slaughtering weight (approximately 100 kg live weight) at 18 to 20 weeks. The animal density was 10 to 15 pigs/pen. The human nose methodology (Mathur et al., 2012; Borrisser-Pairó, Panella-Riera, et al., 2016) was used at the slaughterhouse to find carcasses from entire male pigs with high levels of boar taint. Forty carcasses from entire male pigs were selected by the trained panel. The subcutaneous fat from the dorsal neck region of these carcasses were analysed for androstenone by gas chromatography–mass spectrometry (Rius and García-Regueiro, 1998) and for skatole by high-performance liquid chromatography (García-Regueiro and Rius, 1998). The selected carcasses had high levels of androstenone (from 2.02 to 2.30 μg/g in fat tissue) and low/medium levels of skatole (from 0.05 to 0.14 μg/g in fat tissue). This selection was performed to collect meat samples from entire male pigs with similar levels of androstenone and skatole. Carcasses from castrated pigs were selected as control samples. Eight animals were selected in total: 4 castrated pigs and 4 entire male pigs. The loins (*Longissimus thoracis et lumborum*) from these carcasses were chosen for this study. Loins were sliced frozen in 1.5 cm loin chops and each loin chop was individually vacuum packed (vacuum bag: PA/PE 90, 160 × 250 mm, Sistemes d'Emabaltge Estudi Graf S.A., Girona, Spain; vacuum machine: EV-15, Tecnotrip S.A., Terrassa, Spain), labelled and stored at −20 °C until the time of use.

2.2. Cooking methods

Two different cooking methods were used: 1) vacuum cooking (known as sous-vide); and 2) fried/breaded with garlic and parsley.

2.2.1. Sous-vide (vacuum cooking)

Loin chop samples were thawed for 12 h at 4 °C. They were removed from their previous bags and were put in polyethylene bags (SACOLIVA S.L., Barcelona, Spain), 200 × 300 m/m, with a heat resistance from −30 °C to 120 °C, O_2 permeability of 7 cm^3/m2 per 24 h at 4 °C/80% relative humidity and water steam permeability of 0.8 g/m2/24 h. They were sealed with a vacuum-sealing machine (EGAR 8, Egarvac S.L., Barcelona, Spain) and placed in a water bath at 75 °C until the internal temperature reached 72 °C (portable T200 thermometer; Digitron Instrumentation Ltd., Hertford, United Kingdom). Samples were then stored at 4 °C until the next day's consumer study, when the meat samples were regenerated in a water bath until the internal temperature reached 65–70 °C.

2.2.2. Fried/breaded with garlic and parsley

Fifty grams of breadcrumbs (Aliada, Madrid, Spain), 8 g of fresh white garlic, 8 g of fresh parsley and 1.5 g of salt were chopped and minced in a blender (Classic, Moulinex®, Barcelona, Spain). Loin chop samples were thawed for 12 h at 4 °C. A 26 cm of diameter pan with 40 ml of extra virgin olive oil (Koipe, Andújar, Spain) was preheated for 2 min on an induction cook top until the oil temperature reached 150 °C. Each loin chop was flipped 6 times in the breading mixture before placing in the pan for frying. Loin chops were flipped after 2, 3, 4 and 5 min (until the internal temperature reached 83 °C).

2.3. Experimental design

The consumer study was carried out in Madrid (Spain) during June 2014, in a proper sensory room at Silliker Ibérica S.A. facilities. Consumers were selected by this company according to the following criteria: from both genders; following the Spanish age profile (20% from 18 to 30 years old, 40% from 31 to 45, 30% from 46 to 65, 10% > 65 years old (INE, 2014)); regular pork consumers; and have bought olive oil and cured ham in the previous two months. Oral informed consent was obtained from all participants. Socio-demographic characteristics of the 150 consumers are shown in Table 1. The gender ratio of the consumers was balanced. Two thirds of the consumers were regular pork consumers eating fresh pork at least 2 times per week. Consumers evaluated the meat samples in a sensory room equipped with 22 individual booths with individual lights. Seven sessions were carried out with 20–22 consumers each.