

Consumers' sensitivity to androstenone and evaluation of different cooking methods dealing with boar taint

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Highlights:

Consumer study on sensitivity to androstenone

Disliking to androstenone increases with sensitivity

Different cooking methods to improve consumer acceptability of tainted meat

Fried/breading with garlic and parsley can mask boar taint in meat

Abstract

Boar taint is an unpleasant odour and taste present in some entire male pigs, produced by the presence of androstenone and skatole. Perception of androstenone may be influenced by consumer sensitivity and the cooking method. The aim of the study is to assess the sensitivity to androstenone of 150 consumers and to compare the acceptability of meat from castrated and entire pig, cooked with different cooking methods. The sensitivity to androstenone was evaluated by smelling pure crystals of the compound. Consumers scored the intensity of androstenone (from 1=very low to 8=very high) and were classified in insensitive/low, middle and high sensitive. Meat samples consisted in loins from castrated (CM) and entire male (EM) pig ($>2\mu\text{g/g}$ of androstenone and $0.1 \pm 0.04 \mu\text{g/g}$ of skatole in fat tissue) that were cooked with vacuum cooking and fried/breading with garlic and parsley. Consumers evaluated smell, flavour preference and global liking of CM and EM for each cooking method. Results of sensitivity to androstenone were: 30.0% insensitive/low, 32.7% middle and 37.3% high; 61.5% of consumers disliked the odour. Disliking of androstenone odour increased with the sensitivity. Regarding smell preference, high sensitive consumers that dislike androstenone preferred CM in the vacuum cooking and EM in the fried/breading. Global liking was similar for CM and EM in both cooking methods. Both cooking methods used in the study may be useful to mask boar taint in tainted meat, although the fried/breading with garlic and parsley seems to be more effective for all the attributes evaluated.

Key words

Androstenone sensitivity; Boar taint; Cooking method; Consumer; Entire male pig; Masking strategies

1. Introduction

Boar taint is a distinctive odour or taste that can be evident during the cooking or eating of pork and pork products from some entire male pigs, and it is caused by excessive accumulation of androstenone and skatole (Bonneau, 1982) that are accumulated in fat (Claus, Weiler, & Herzog, 1994). Numerous subsequent studies have confirmed that these two compounds are the main contributors to boar taint (Bonneau & Chevillon, 2012; Bonneau et al., 1992; Font i Furnols, 2012; Haugen, Brunius, & Zamaratskaia, 2012). In Europe, approximately 80% of male piglets are surgically castrated to avoid potential consumer dissatisfaction because of boar taint (Fredriksen et al., 2009). Since surgical castration of piglets has become an animal welfare concern, discussions at European level are aiming to ban surgical castration by 2018 (DG-SANCO, 2010). Therefore, if piglet castration is banned, meat from entire male pigs will increase in the market and therefore, those consumers that dislike boar taint may reject this meat if this taint is perceived.

Androstenone have been described with the attributes sweaty, dirty, silage and parsnips, and skatole have been associated with mothball and musty (Annor-Frempong, Nute, Whittington, & Wood, 1997; Blanch et al., 2012; Font i Furnols, Guerrero, Serra, Rius, & Oliver, 2000). Levels over the threshold of these compounds 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 $\mu\text{g/g}$ of fat tissue for androstenone (Claus et al., 1994; Font i Furnols, Gispert, Diestre, & Oliver, 2003; Rhodes, 1971) and 0.10 and 0.20 $\mu\text{g/g}$ of fat of fat tissue for skatole (Bonneau et al., 1992; Claus et al., 1994; Desmoulin, Bonneau, Frouin, & Bidard, 1982; Font i Furnols et al., 2003; Walstra et al., 1999). While skatole is perceived by 99% of consumers (Weiler, Fischer, Kemmer, Dobrowolski, & Claus, 1997), androstenone is perceived by around 40-50% of consumers (Blanch et al., 2012; Font i Furnols et al., 2003; Razafindrazaka et al., 2015; Weiler et al., 2000) which mean that if consumers are insensitive (anosmics) to this compound and they cannot smell it. Some studies have also shown that women are more sensitive than man (Blanch et al.,

2012; Bremner, Mainland, Khan, & Sobel, 2003; Lunde, Skuterud, Nilsen, & Egelanddal, 2009; Weiler et al., 2000; Wysocki & Beauchamp, 1984). Therefore androstenone sensitivity affects boar taint acceptability of consumers and different types of consumers are described: pork loves, boar meat loves and reject boar taint meat (Panella-Riera et al., 2016). The prevalence of high levels of boar taint in Spain is 10.2%, but if only high levels of androstenone are considered, the prevalence is 5.5% and for high levels of skatole 6.6% (Borrisser-Pairó et al., 2016).

Since consumers are the last step of the chain production, consumer studies are necessary to assess sensory acceptability and attitudes of consumers towards pork and pork products from boars (Font i Furnols, 2012). Consumers' opinion is important when a new product is released (Amerine, Pangborn, & Roessler, 1965).

Previous studies evaluated different cooking methods by a trained panel and they found that the cooking method has an effect on boar taint perception (Agerhem & Tornberg, 1995; Font i Furnols, 2012; Prestat, Jensen, McKeith, & Brewer, 2002; Wood, Nute, Fursey, & Cuthbertson, 1995). Cooking methods can be classified depending on the use or not of a liquid medium, how heat is received (direct fire, hit plate or hot air) and there are also some new technologies such as microwave or vacuum cooking (Bello, 1998). 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). Vacuum cooking prevents the development of some off-flavours, the loss of flavour volatiles and improves texture of the meat (Armstrong & McIlveen, 2000; Schafheitle, 1990). 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, but frying is more effective.

The use of some herbs and aromatic plants for cooking is very common (Bianchi, 2015) and it might be considered for masking boar taint in pig fresh meat. Breaded is a common used strategy by consumers, and breaded products are more palatable because of a crispy crust and a soft interior (Antonova, Mallikarjunan, & Duncan, 2003). A previous study by Egea, Linares, Gil,

López, and Garrido (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 breeding 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 et al., 2016) and it will be important to find a proper use for these meat (Lunde et al., 2008). The aim of this study was to compare consumers' acceptability of fresh meat from entire male pigs with high levels of androstenone and from castrated male pigs prepared with different cooking methods (vacuum cooking and frying in oil) and masking strategies (breaded with garlic and parsley), and to see if the proposed strategies are useful to mask boar taint in boar meat.

2. Material and methods

2.1. Selection and preparation of meat samples

Four loins (*Longissimus thoracis et lumborum*) from castrated pigs were selected for the test to be compared with loins from entire male pigs with boar taint. The human nose methodology (Borrisser-Pairó et al., 2016; Mathur et al., 2012) was used at slaughterhouse to find carcasses with high levels of boar taint. These loins were analysed for androstenone and skatole. Androstenone analysis was performed by gas chromatography-mass spectrometry (Rius & García-Regueiro, 1998) and skatole analysis by high-performance liquid chromatography (García-Regueiro & Rius, 1998). Finally four loins from boars with 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) were used for this study.

After collection, samples were kept in the freezer at -20°C. Loins were sliced frozen in 1.5 cm loin chops and each loin chop was individually packed, labelled and stored at -20°C until the time of use.

2.2. *Cooking methods*

Two different cooking methods were used: 1) vacuum cooking and 2) fried/breading with garlic and parsley. These methods come from previous experiments from the same project as the present study, where a sensory panel evaluated the effect of different cooking methods (Egea et al., submitted for publication; Linares et al., submitted for publication).

2.2.1 *Vacuum cooking*

The meat samples were cooked in the facilities of Universidad de Murcia 3-4 days before the consumers' study. The meat samples were vacuum-packaged in polyethylene bags (R-RE; Industrias RAELMA, S.L., Madrid, Spain) and were placed in a water bath at 75°C until the internal temperature reached 72°C. Samples were then stored at 4°C till the day of the study. The meat samples were regenerated in a water bath until the internal temperature reached 65-70°C for the consumers' study.

2.2.2 *Fried/breading with garlic and parsley*

Fifty grams of bread crumbs (Aliada, Madrid, Spain), 8 g of fresh white garlic, 8 g of parsley and 1.5 g of salt were chopped and minced in a blinder (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 olive oil virgin extra (Koipe, Andújar, Spain) was preheated for 2 minutes on an induction cook top until oil temperature reached 150°C. Each loin chop was flipped 6 times in the mixture to fix the covering before putting it in the pan for frying. Loin chops were turned upside-down after 2, 3, 4 and 5 min (internal temperature 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. One hundred and fifty consumers were selected following the Spanish population profile over 18 years of age (INE, 2016). Seven sessions were carried out with 20-22 consumers each.

2.3.1 *Evaluation of consumer sensitivity to androstenone*

A test for androstenone sensitivity was performed to consumers after meat sample evaluation. Following the protocol described by Weiler et al. (2000) and (Blanch et al., 2012), a flask with pure crystals of androstenone was presented to each consumer. Consumers had to answer 3 questions: i) Do you smell anything? (No: 'Insensitive'; Yes: 'Sensitive'); ii) In an 8-point scale, can you score the intensity of this smell? (from 1='extremely weak' to 8='extremely strong'); iii) Do you like the smell? (I like/Neutral or I don't like). Considering the intensity score given, consumers were classified using the classification described by Blanch et al. (2012): 'Insensitive', 'Low sensitive' (1–3), 'Middle sensitive' (4–6) or 'High sensitive' (7–8).

2.3.2 *Evaluation of meat samples*

After cooking, each loin chop was cut in 8 pieces discarding the edge pieces, so 6 pieces per loin were obtained. Each sample was placed inside a disposable aluminium baking cup to keep it warm for the consumers. Each consumer had to evaluate a sample from castrated male pig and a sample from entire male pig for each cooking method. Consumers always had to evaluate samples starting for the sample from the left side which was changed randomly for each consumer to avoid the first sample effect (Macfie, Bratchell, Greenhoff, & Vallis, 1989), so the position of the castrated and the entire male sample were changing. Consumers were asked to evaluate their preference (smell and flavour preference): first, they had to smell both samples

(boar and castrated) and decide which sample they preferred according to smell; secondly, they were asked to eat both samples and decide which sample they preferred according to flavour. After that, consumers were asked to score each sample individually on a nine step liking scale where no middle point was given (global liking: from 1=dislike extremely to 9=like extremely). They had to do it for both cooking methods' comparisons. At the end, consumers were also asked to fill in a questionnaire, with socio-demographic questions.

2.4. Statistical analyses

Data analyses was done using SAS 9.2 software (SAS Institute Inc., Cary, NC, USA). Descriptive analyses of the parameters was performed using the MEANS and the FREQ procedures. The GENMOD procedure was used for analysing differences in discrete variables. The GLIMMIX procedure was used to analyse consumer preferences with type of meat, cooking method and position of the sample as fixed effects. Significance level was set at $P < 0.05$ for differences and $P < 0.10$ for tendencies.

3. Results

3.1. Consumer profile

Socio-demographic characteristics of the 150 consumers are shown in Table 1. The age profile was representative of the Spanish population (INE, 2016). 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.

3.2. Consumer sensitivity to androstenone

Results of sensitivity to androstenone are shown in Figure 1. Considering all the consumers, 30.0% of them were insensitive (anosmic) or low sensitive to androstenone, 32.7% middle

sensitive and 37.3% high sensitive. No differences between genders were observed when classifying consumers by these 3 sensitivity groups ('insensitive/low sensitive', 'middle sensitive' and 'high sensitive'). However, when consumers were classified in 2 groups ('insensitive/low/middle sensitive' and 'high sensitive') women sensitivity to androstenone tended to be higher than men ($P=0.054$). Regarding the liking of those consumers that are sensitive to androstenone, 61.5% of consumers disliked the odour and the rest (38.5%) found it neutral or liked it. Results of liking according to the sensitivity to androstenone are presented in Figure 2. The percentage of consumers that disliked androstenone increased with the sensitivity ($P=0.016$), the highest the sensitivity to androstenone the highest the percentage of consumers that disliked it.

Figure 3 shows the percentage of consumers that may reject tainted meat. Two thresholds of rejection were established: high sensitive consumers that dislike androstenone (Figure 3A); or middle/high sensitive consumers that dislike androstenone (Figure 3B). Depending on the threshold this percentage was between 28.0% and 44.8% for all consumers, 35.6% and 48.0% for women, and 20.8% and 41.6% for men, for high sensitive and middle/high sensitive respectively. In Figure 3A the percentage of women that may reject tainted meat was higher than men ($P=0.024$). In Figure 3B no differences were observed.

3.3. Preference of smell and flavour of the meat

Results of percentages of consumers that prefer meat from castrated and meat from entire male pigs for each cooking method are shown in Table 2. Regarding preference of smell and flavour, similar results for castrated and entire male pig meat were observed and no significant effect was found for type of meat and cooking method ($P>0.05$). Table 3 shows the results of smell and flavour preference according to consumer sensitivity to androstenone. Regarding smell preferences for vacuum cooking, the group 'high sensitive consumers to androstenone' showed a lower percentage of preference (33.3%) for meat from entire male pigs ($P=0.001$). Regarding

smell preferences for the fried/breading with garlic method, the group 'high sensitive consumers to androstenone' showed a higher percentage of preference (64.3%) for the meat from entire male pig ($P=0.009$). No significant differences were found in the flavour preference with consumer sensitivity ($P>0.05$).

3.4. Global liking of meat

Results of liking score means and standard deviation for each individual sample are shown in Table 2. No significant differences were observed in the liking score between samples and methods ($P>0.05$). Regarding consumers' approval for each sample, results were analysed defining two groups of consumers: those that scored below 5, and those that scored 5 or more in the nine step liking scale. Therefore the percentage of consumers that approve each sample (giving a score of 5 or more) could be calculated: for vacuum cooking, 73.3% approved castrated pig meat and 76.0% entire male pig meat; for fried/breading with garlic and parsley, 92.0% and 95.3% respectively (Figure 4). No differences were observed between type of meat ($P>0.05$). Global liking was also analysed according to gender and according to consumer sensitivity to androstenone but no significant differences were found ($P>0.05$).

4. Discussion

A lot of consumer studies regarding boar tainted meat have been done, but it is complex to compare between studies because the use of different methodologies (Font i Furnols, 2012). It is difficult to harmonise the methodologies and depending on the aim of the study a specific methodology may be more convenient (Aaslyng et al., 2007). Regarding sensitivity to pure crystals to androstenone, the percentage of insensitive consumers found in the present study (30.0%) was lower than previous studies that found between 41.1% and 69.7% (Aluwé et al., 2015; Blanch et al., 2012; Font i Furnols et al., 2003; Lunde et al., 2009; Razafindrazaka et al.,

2015; Weiler et al., 2000). Bremner et al. (2003) reviewed previous studies on sensitivity to androstenone and found that the percentage of insensitive consumers varied from 7.6 to 75.0%. It is important to notice that only Blanch et al. (2012) used the same methodology than the present study to classify consumer sensitivity to androstenone (insensitive/low sensitive [score 1-3], middle sensitive [score 4-6] and high sensitive [score 7-8]). Mörlein, Meier-Dinkel, Moritz, Sharifi, and Knorr (2013) and Aluwé et al. (2015) used a methodology to evaluate sensitivity to androstenone based on smell strips with a known concentration of androstenone, while the other studies used pure crystals or dissolutions in different medias (Blanch et al., 2012; Font i Furnols et al., 2003; Lunde et al., 2009; Razafindrazaka et al., 2015; Weiler et al., 2000). The presentation of the meat sample is also important. Since boar taint is caused by volatiles compounds, the perception of boar taint may be influenced by the type of recipient used for the study and the serving temperature (Taylor, 1998), so the use of a disposable aluminium baking cup seems to be a good option to keep heat, odours and flavours. All the methods have some limitations but it would be important to harmonize the methodologies to assess consumer sensitivity to androstenone to be able to compare the results of different consumer studies (Font i Furnols, 2012).

Furthermore, when consumers were classified according to gender, previous studies found that women were significantly more sensitive than men (Lunde et al., 2009; Mörlein et al., 2013; Weiler et al., 2000; Wysocki & Gilbert, 1989), though in the study by Blanch et al. (2012) these differences were not found. The present study found no significant differences, although when two groups of sensitivity were done there was a tendency ($P=0.054$) that women had more sensitivity than men. The percentage of consumers that dislike androstenone odour was similar to the one found in the study by Blanch et al. (2012) but higher than other studies (Font i Furnols et al., 2003; Razafindrazaka et al., 2015). The present study found that high sensitive consumers show higher dislike for androstenone than insensitive consumers ($P=0.016$). Previous studies have also seen this correlation (Blanch et al., 2012; Font i Furnols et al., 2003; Razafindrazaka et

al., 2015; Weiler et al., 2000). Consumers may reject tainted meat depending on their sensitivity and their liking of androstenone (Blanch et al., 2012; Font i Furnols, 2012; Panella-Riera et al., 2016). Therefore, high sensitive consumers that dislike androstenone are more likely to reject tainted meat than low sensitive consumers. Blanch et al. (2012) found that between 19.8 and 40.6% of Spanish consumers may reject boar taint. These results do not differ too much from the ones found in the present study (between 28.0 and 44.8%) performed with the same methodology. Therefore efforts to improve the acceptability of tainted meat should focus on those consumers that are more sensitive to androstenone and dislike the smell. Different studies have shown that boar taint odours are more present in meat from entire male pigs, reducing the acceptance of this type of meat (Font i Furnols, 2012).

Bañón, Andreu, Laencina, and Garrido (2004) studied meat from castrated and meat from entire male pig by a trained panel, and also by consumers and they found that meat from entire male pig was less preferred. In previous experiments from the same project as the present study (Egea et al., submitted for publication; Linares et al., submitted for publication), a trained panel compared samples from entire and castrated male pigs with no masking strategy and they found that meat from entire males had higher scores in boar taint intensity of odour and flavour. When a masking strategy was used, the panellists in these studies found no differences between castrated and entire male pig meat. In the present study, a sample of consumers was used instead of a panel test. The results showed that consumers found no differences between the two types of meat cooked with different cooking methods. Regarding smell preference, results showed that high sensitive consumers that dislike androstenone preferred castrated meat in the vacuum cooking although in the fried/breading with garlic and parsley the result was the opposite, they preferred the smell of entire male pig meat. Androstenone is a volatile compound so its concentration may be reduced when a cooking method with heat is applied (Denhard, Claus, Herbert, & Hillenbrand, 1995). One explanation of why vacuum cooking entire male pig meat is less preferred may be because the vacuum bag keep the androstenone odour inside the

bag and high sensitive consumers that dislike this smell may perceive it reject this meat. In the case of the fried/breading with garlic and parsley entire male pig meat, the fact that meat is cooked and heated in a pan may reduce the concentration of androstenone that in combination with the other aromatic ingredients (olive oil, garlic and parsley) may produce better acceptability. Another hypothesis of why fried/breading with garlic and parsley produces less rejection may be because a chemical reaction between a component of the masking strategy (garlic and/or parsley) and androstenone such as Diels-Alder reaction (Kagan & Riant, 1992; Martínez et al., 2016) or Maillard reaction (Martins, Jongen, & van Boekel, 2000), that may change androstenone structure and consequently reduce androstenone perception.

5. Conclusions

High sensitive consumers that dislike androstenone odour are more likely to reject tainted meat, consequently a special emphasis on these consumers is needed. The cooking methods used (vacuum cooking and fried/breading with garlic and parsley) resulted useful to mask and counteract the negative effect that the presence of boar taint may have in the sensory quality in fresh pork, although the fried/breading with garlic and parsley seems to be more effective for all the attributes evaluated. Therefore if the industry is able to classify tainted meat at slaughterhouse level, they could use this meat to specific products to be cooked with these cooking methods.

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Tables caption

Table 1. Description of the consumers that participate in the study (n=150)

	n	%		n	%
<i>Age</i>			<i>Education</i>		
18-30 years	33	22.0	Primary not finished	1	0.7
30-45 years	59	39.3	Primary	17	11.3
45-65 years	50	33.3	Secondary	60	40.0
>65 years	8	5.3	Higher/University	72	48.0
<i>Gender</i>			<i>Lived in a rural environment</i>		
Women	73	48.7	Yes	38	25.5
Men	77	51.3	No	111	74.5
<i>Education</i>			<i>Monthly income at your home</i>		
Primary not finished	1	0.7	< 1500 €	62	42.5
Primary	17	11.3	1500 € - 3000 €	66	46.6
Secondary	60	40.0	> 3000 €	16	11.0
Higher/University	72	48.0			
<i>People at home</i>			<i>Frequency of eating fresh pork</i>		
1 person/home	5	3.3	0 times/week	2	1.4
2 people/home	25	16.7	1 time/week	47	31.3
3 people/home	61	40.7	2 times/week	54	36.0
4 people/home	38	25.3	3 times/week	33	22.0
5 people/home	17	11.3	4 times/week	11	7.3
6 people/home	4	2.7	5 times/week	3	2.0

Table 2. Description of the results from the different cooking methods and type of meat evaluated

Cooking method	Type of meat	Smell preference ¹	Flavour preference ¹	Liking score ²			
				mean	SD	minimum	maximum
Vacuum cooking	Castrated	51	52	5.19	1.3	0	8
	Entire male	49	48	5.31	1.2	2	8
Fried/breading with garlic and parsley	Castrated	49	49	6.03	1.2	2	8
	Entire male	51	51	6.07	1.0	2	8

¹Percentage of consumers preferring castrated or entire male pig meat within the same cooking method for smell and for flavour. No significant effects were found for type of meat and cooking method ($P>0.05$).

²Liking score was based on a 1-9 scale (1=dislike extremely to 9=like extremely; the middle point was not given).

SD: standard deviation.

Table 3. Percentage of consumers (%) preferring castrated or entire male pig meat within the same cooking method for smell and for flavour according to their sensitivity to pure crystals of androstenone

	Cooking method	Sensitivity to androstenone	castrated male	entire male	Sig*
Smell Preference	Vacuum cooking	Insensitive and Low and Middle sensitive	45.7	54.3	a
		High sensitive + I like/neutral	35.7	64.3	b
		High sensitive + I don't like	66.7	33.3	b
	Fried/breading with garlic and parsley	Insensitive and Low and Middle sensitive	55.3	44.7	b
		High sensitive + I like/neutral	42.9	57.1	ab
		High sensitive + I don't like	35.7	64.3	a
Flavour Preference	Vacuum cooking	Insensitive and Low and Middle sensitive	50.5	49.5	-
		High sensitive + I like/neutral	50.0	50.0	-
		High sensitive + I don't like	54.8	45.2	-
	Fried/breading with garlic and parsley	Insensitive and Low and Middle sensitive	47.9	52.1	-
		High sensitive + I like/neutral	42.9	57.1	-
		High sensitive + I don't like	54.8	45.2	-

*Different superscripts show significant differences within the same cooking method (P<0.05).

Figures caption

Figure 1. Classification of consumers (%) according to their sensitivity to pure crystals of androstenone and gender (low sensitive: score 0-3; middle sensitive: score 4-6; high sensitive: score 7-8)

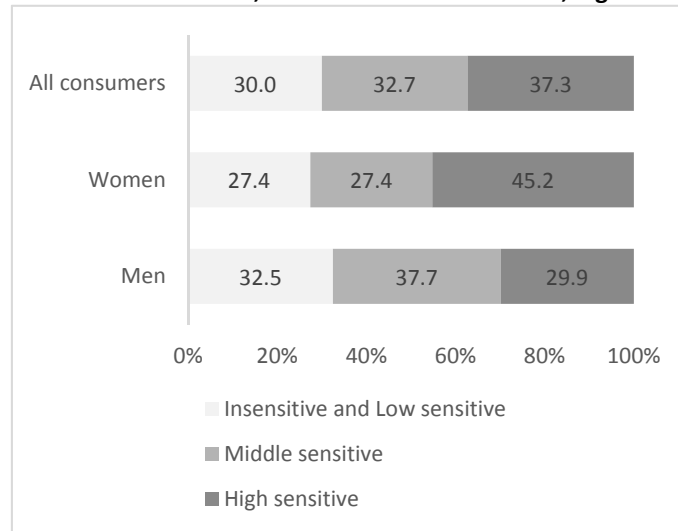
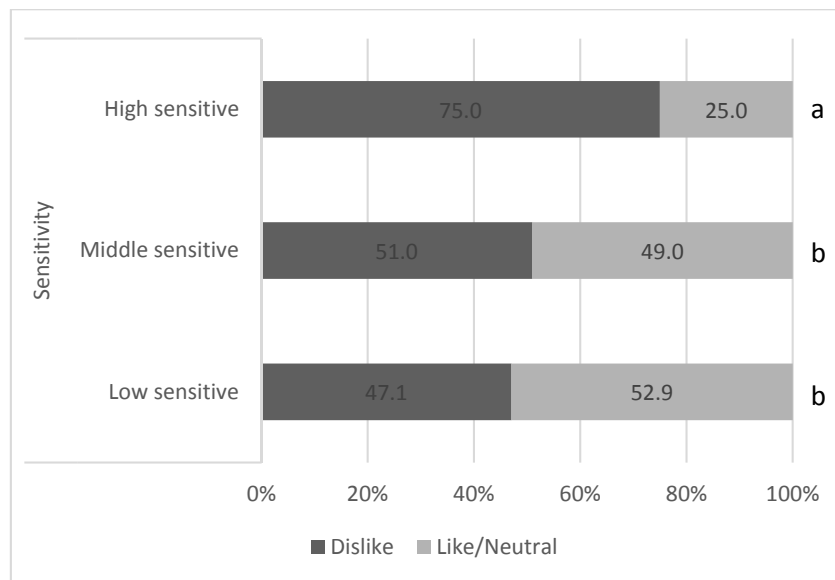
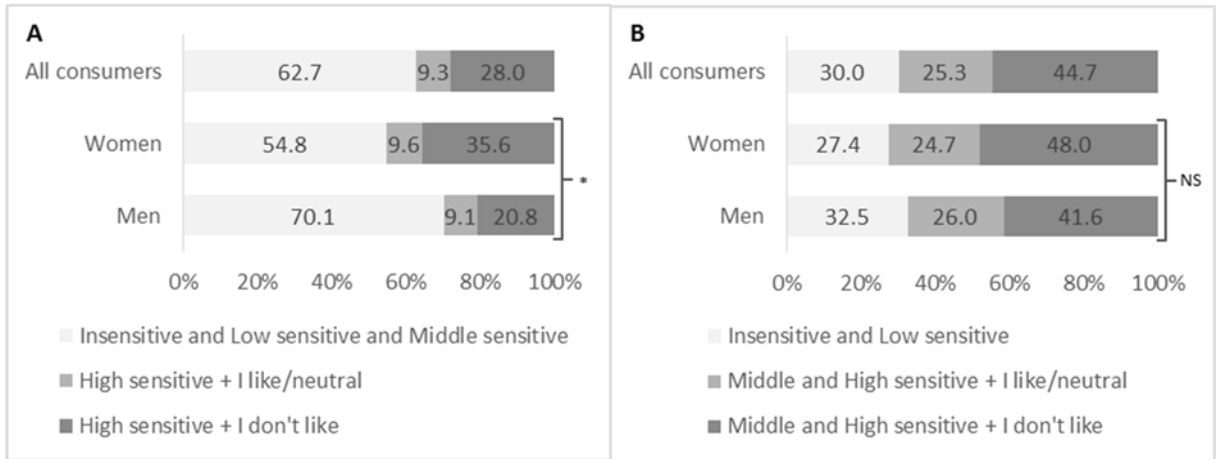


Figure 2. Consumer percentage of liking to androstenone by sensitivity to pure crystals of androstenone (low sensitive: score 0-3; middle sensitive: score 4-6; high sensitive: score 7-8)



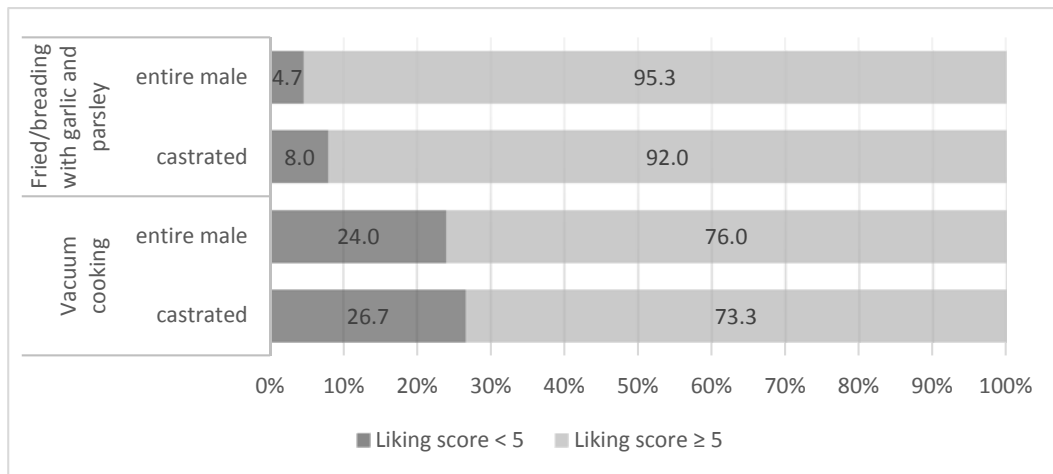
Different letters show significant differences between groups (P<0.05).

Figure 3. Classification (%) of consumers depending on the sensitivity and liking of pure crystals of androstenone, considering that consumers that may reject tainted meat were high sensitive (A) or middle/high sensitive (B)



*Significance: P<0.05; NS: no significance differences.

Figure 4. Percentage of consumers that scored 5 or more in a liking scale for entire male and castrated male pig for each cooking method



Liking score was a value in a 9 step scale (1=dislike extremely to 9=like extremely).