CONSUMER'S SEGMENTATION BASED ON ACCEPTABILITY OF BOAR MEAT IN A STUDY CARRIED OUT IN BARCELONA (ES) AND READING (UK)

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Abstract – The aim of this work was to study consumers' acceptance of pork with different levels of boar taint, in Barcelona (ES, n=126) and Reading (UK, n=146). Samples were classified as 'Females', 'Low boar taint' (low levels of androstenone and skatole), and 'Medium boar taint' (medium levels of androstenone and skatole). In the pooled sample (ES + UK) three segments of consumers were identified on the basis of 'How delicious do you find this meat'. The first segment was labelled as 'pork lovers' (n=169), the second as 'boar meat lovers' (n=59) and the third one as 'gilt meat lovers' (n=44). Apart from the 'pork lovers', this study identified a group of consumers that scored better the meat with medium levels of boar taint than low levels or meat from gilts, suggesting that there is a niche for meat from medium levels of boar taint.

I. INTRODUCTION

Boar taint is an off-odour and off-flavour of pork from some entire male pigs characterized as urine-like, pig-like, sweat-like or faecal-like, which may result in consumer dissatisfaction [1]. The main compounds responsible for boar taint are androstenone (AND) [2] and skatole (SKA) [3] which are accumulated in the fat tissue. Many studies have reported the influence of the sex of pigs and the levels of AND or SKA on the acceptability of pork by consumers [4]. The main objective of the present study was to evaluate and update the results on sensory acceptability of meat from entire male pigs (as an alternative to the production of castrates), involving two European countries.

II. MATERIALS AND METHODS

Classification of consumers:

A total of 272 consumers participated in a study carried out in two European countries: Barcelona (BCN; Spain; N= 126) and Reading (RE; United Kingdom, N= 146). Consumers were stratified by age (according to each country profile) and gender (approximately 50:50 ratio between men and women).

Meat sampling and preparation:

The meat used for the sensory evaluation was obtained from conventional pig crossbreeds. Samples from boars and gilts were collected in commercial Spanish abattoirs. The meat used for the sensory evaluation was taken from the *Longissimus dorsi* muscle of commercial entire male pigs and females chosen according to the concentrations of AND and SKA in the subcutaneous fat. Samples were analysed at CCL Nutricontrol in the Netherlands. The determination of SKA levels was performed using HPLC-FLD and the determination of AND levels using GC-MS. Results were expressed as µg/g, on pure fat basis). Meat samples were classified in three groups depending on the sex and the levels of boar taint compounds [5]:

- Females (FE),
  AND < 0.04 ppm pure fat
  SKA = 0.04 ± 0.018 ppm pure fat [0.02-0.07]
- Low levels of boar taint (LBT):
  AND = 0.20 ±0.07 ppm pure fat [0.04-0.29]
  SKA = 0.06 ± 0.02 ppm pure fat [0.02-0.08]
- Medium levels of boar taint (MBT):
  AND = 1.07 ±0.40 ppm pure fat [0.58-2.28]
  SKA = 0.18 ± 0.07 ppm pure fat [0.11-0.39]

For the consumer tests, loins were cut into 0.5 cm thick slices with 5 mm of subcutaneous fat (when it was possible). Each slice was divided in two pieces, and cooked using a cooking plate at 180ºC (which was greased with maize oil). The meat was turned upside down regularly until a core temperature of 80ºC and the meat was salted after cooking, reproducing home preparation.

Sensory evaluation of samples:

Sessions of 10-12 consumers were organised for meat evaluation. Each consumer assessed 3

pieces of meat, one from each type of animal (FE, LBT and MBT). The order of presentation of samples was rotated using a partial Latin square design to avoid any first sample and carry-over effect [5] and the identity of the samples was not given to consumers. The attributes 'Delicious', 'Odour' and 'Taste' were rated on a scale going from 1 = 'dislike very much' to 9 = 'like very much', whereas the attributes 'Abnormal odour', and 'Abnormal taste' were scored between 1 = 'low perception' to 9 = 'strong perception'. The intermediate level (5) was not included to stimulate consumers to commit themselves and not to allow the easiest response [7].

Sensitivity to androstenone:

Consumers were checked for androstenone sensitivity after they had assessed the meat samples, by smelling crystals of pure substance following the protocol described by Weiler et al., [8] with some modifications. Consumers were asked about their capability to smell androstenone (Not able to smell it: 'Insensitive'; Able to smell it: 'Sensitive') and the odour preference (I like/Neutral/I don't like).

Statistical analysis:

Data analyses were conducted using SAS Statistical Package (SAS Inst., Inc., Cary, NC, USA, version 9.2). In order to establish different clusters of consumers a hierarchical cluster analysis was performed with the CLUSTER procedure and the Ward method. The cluster analysis was conducted on the basis of the attribute "delicious".
For each cluster, the MIXED procedure was used to analyse the acceptability of odour and flavour by consumers, the model included the type of animal and country as fixed effects, session as blocking effect and consumer as random effect. The interaction Type of animal and Country was removed of the model because it was not significant ($P<0.05$). Differences were declared at $P<0.05$.

III. RESULTS AND DISCUSSION

The description of consumers according to the gender, age and educational level is described in Table 1.
Due to the fact that the interaction between Type of meat and country in each cluster was not significant, results for each one are presented considering all consumers together. Additionally, no significant differences were found between countries for each cluster.

Table 1. Description of consumers participating in the consumer test, and distributed by clusters.

		Total	Cluster 1	Cluster 2	Cluster 3
			Pork lovers	*Boar meat lovers*	*Gilt meat lovers*
	n	272	169	59	44
	(%)		(62.1)	(21.7)	(16.2)
Country					
Barcelona (ES)	n	126	97	18	11
	(%)	(46)	(57)	(31)	(25)
Reading (UK)	n	146	72	41	33
	(%)	(54)	(43)	(69)	(75)
Gender (%)					
Male		48	53	39	43
Female		52	47	61	57
Age (%)					
18-25		15	15	14	18
26-40		24	26	25	16
41-60		42	40	41	50
>60		19	19	20	16
Educational level (%)					
Primary studies uncompleted		1	2	0	0
Primary studies		8	10	3	9
Secondary studies		58	59	56	57
University studies		32	28	41	34

How delicious do you find the meat?

A total of three clusters were identified on the basis of "how delicious do you find this meat". These clusters did not display any relevant difference on the basis of demographic variable (age, gender and educational level; Table 1). Figure 1 shows least square means and standard error of the scores that consumer gave to each attribute for each type of meat: female (FE), LBT (low boar taint) and MBT (medium boar taint).
The first cluster (n=169, 62.1 % of the sample; 57% from Barcelona and 43% from Reading) comprises respondents that gave high scores to all types of samples. These consumers were labelled as 'Pork lovers'.
The second cluster (n=59, 21.7 % of the sample; 31% from Barcelona and 69% from Reading) comprises respondents that liked the

boar taint and therefore, the higher the level of boar taint, the higher the score to the attribute 'Delicious'. These consumers were considered as 'Boar meat lovers'.
The third cluster (n=44, 16.2 % of the sample; 25% from Barcelona and 75% from Reading) comprises respondents that did not liked the boar taint and therefore, the lower the level of boar taint, the higher the score to the attribute 'Delicious'. These consumers were considered as 'Gilt meat lovers'.

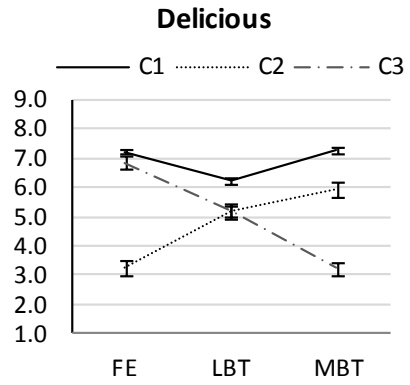

Figure 1. Least square means and standard error of the scores given to the attribute 'Delicious' for each type of meat (FE: female; LBT: low boar taint levels; MBT: medium boar taint levels).

Taste of the meat

Figure 2 shows the least square means and standard error of the score given to the Taste (from 'dislike very much' to 'like very much') and to 'Abnormal taste' (from 'low perception' to 'strong perception'). Considering the taste of the meat, the three clusters followed the same pattern as the one observed in Figure 1. As for 'Abnormal taste', the pattern was the opposite for the three consumers: Cluster 1: scored low levels of abnormal taste in the three types of meat; Cluster 2 (Boar meat lovers) gave the lowest scores to the meat with boar taint; Cluster 3 (gilt meat lovers) gave lowest scores to meat from Female.

Odour of the meat

Figure 3 shows the least square means and standard error of the score given to the Odour (from 'dislike very much' to 'like very much'). With regard to the odour of the meat, the three clusters followed a similar pattern that the one observed for the attribute 'delicious' and 'taste'. When considering the strength of the 'abnormal odour' (data not shown), scores were very small (low perception) for all of them. The very low perception of odour can be explained because the samples were prepared 0.5 cm thin and they cooled down very quickly after their preparation.

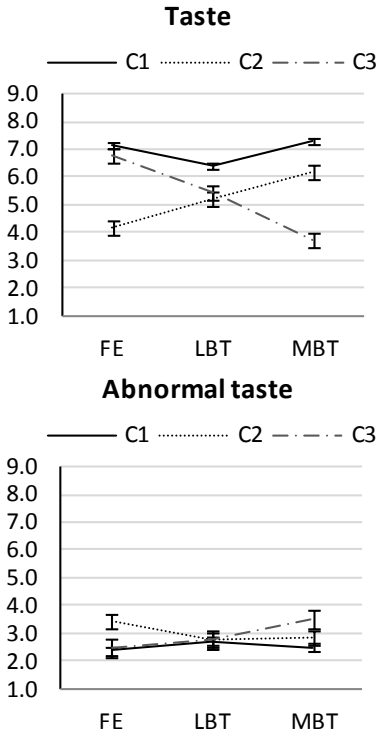

Figure 2. Least square means and standard error of the scores given to the attribute 'Taste and 'Strength of Odour' for each type of meat (FE: female; LBT: low boar taint levels; MBT: medium boar taint levels).

Sensitivity to androstenone

Table 2 shows the percentage of consumers that eat pig meat with or without the fat, and their capability to smell androstenone and the odour preference.
Results show that 57.6 % of consumers from cluster 2 (Boar meat lovers) usually eat meat with the fat, whereas 56.8 % of consumers from cluster 3 (Gilt meat lovers) usually remove fat before eating pig meat.
With regard to sensitivity to pure crystals of androstenone, similar percentages of anosmic consumers were found in Cluster 2 and Cluster 3 (about 36 %). The percentage of consumers rejecting androstenone smell ('I don't like the smell') is similar in all the three clusters. It is important to highlight that the concentration of boar taint compounds in the meat were considered medium levels [9], while the

concentration of the sensitivity test was very high (pure crystals).

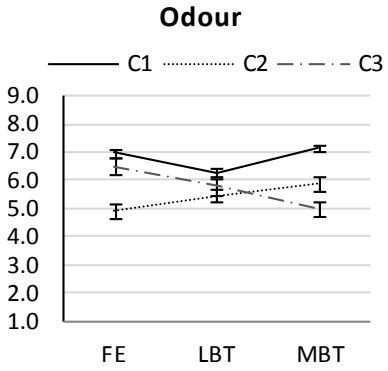

Figure 3. Least square means and standard error of the scores given to the attribute 'Odour' for each type of meat (FE: female; LBT: low boar taint levels; MBT: medium boar taint levels).

Table 2. Percentage of consumers eating pork meat with or without the fat, and their capability to smell androstenone and the odour preference, by cluster

	Cluster 1	Cluster 2	Cluster 3
	Pork lovers	*Boar meat lovers*	*Gilt meat lovers*
n	169	59	44
When you eat the pork meat, do you eat it…			
...without the fat	49.7	42.4	56.8
...with the fat	50.3	57.6	43.2
Do you like this smell?			
anosmic	45.0	35.6	36.4
no	40.2	42.4	40.9
neutral	4.1	10.2	9.1
yes	10.7	11.9	13.6

IV. CONCLUSION

This study has identified three segments of consumers that scored differently meat with different levels of boar taint, based on the deliciousness attribute. The first group was identified as 'pork lovers', the second group (Boar meat lovers) scored better the meat from entire male pigs with medium levels of boar taint, and the third one (Gilt meat lovers) scored better the meat from gilts. These results suggested that there might be a niche for meat with medium levels of boar taint compounds.

Further research is needed to elucidate if these three clusters are also identified when using higher levels of boar taint, and to elucidate if these differences are consistent in other European countries.

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