CONSUMER ACCEPTANCE OF PORK PATTIES FROM ENTIRE MALE PIGS IN FOUR EUROPEAN COUNTRIES

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Abstract – This study provides the results of consumer tests performed in four EU countries (Italy, France, Denmark and Poland) evaluating consumer acceptance of boar meat. One hundred and twenty eight female consumers were recruited in each country to evaluate eight different types of boar meat patties with concentrations (analysed in backfat) varying from 0.10 to 0.40 ppm for skatole (SKA), and from 0.47 to 2.00 ppm for androstenone (AND). Boar samples were presented in pair-wise comparison with patties from castrates. Each consumer evaluated 4 paired boar samples following a balanced design of serving order. Meat patties were evaluated based on their general liking score and on their preference compared to the castrate sample for odour and for flavour. Moreover, consumers' sensitivity towards SKA and AND was tested using the paper strip method. Depending on the country, between 21 and 29% were sensitive to AND, and between 6 and 17% were very sensitive to AND. A higher percentage of the consumers, between 51 and 67%, were sensitive to SKA. Liking scores of the boar meat patties depended on the sensitivity of the consumers to AND and SKA and mainly decreased with increasing SKA level. Similar results were found for consumers' preference regarding odour and flavour for boar meat patties over castrate meat patties. The results of this study did not allow to identify clear threshold levels for impaired consumer acceptance. However, preference maps (for boar compared to castrate patties) were developed for odour and flavour considering the levels of AND and SKA of the patties and AND sensitivity.

Key Words – androstenone, skatole, pork quality

I. INTRODUCTION

Surgical castration of piglets is still performed in many countries to eliminate boar taint. However, societal pressure to ban this practice is increasing and several representatives of the pork chain in all EU countries signed a declaration of intention to ban surgical castration by 2018. One prerequisite, however, is that consumer acceptance of meat from entire male pigs is ensured. Boar taint has been studied for several decades now, but the discussion on reliable cut-off levels of boar taint and on an operational definition of boar taint still persists. Two compounds are responsible, SKA and AND. In literature, cut-off levels vary between 0.15 and 0.25 ppm for SKA, and between 1.5 and 3.0 ppm for AND [1-3]. Several issues are further fueling this lack of clarity: The poor comparability of the chemical analysis of AND and SKA between laboratories, the impact of AND sensitivity, the type of product served (percentage of fat, dry, cooked or smoked products served cold or warm), the type of consumer panel used (standardized versus home) and the experimental set-up of the consumer panel [4, 5]. This study aims to further clarify the acceptability of meat from boars, presented as meat patties (a standardized meat product with high fat content), taking into account AND sensitivity of the consumers in four EU countries: Denmark, France, Italy and Poland. By offering the samples in a pair-wised design, the consumers evaluate their preference for boar compared to castrate meat

patties, thereby allowing to correct for the general acceptance of the served meat product.

II. MATERIALS AND METHODS

Minced meat patties - Eight different batches of boar minced meat were prepared at DMRI as a mixture of meat from 3 to 4 animals to achieve eight different levels of AND and SKA (analysed in fat using HPLC). Moreover, a batch of minced meat from castrates was also included as reference sample for the paired comparison. The selection of the eight levels (shown in Fig. 1) of AND and SKA was based on the results obtained in the pilot trial performed in Germany and from 0.10 to 0.40 ppm for SKA, and from 0.47 to 2.00 ppm for AND (Fig. 1). Final mean fat content was 17.2 ±1.4% for the boar samples versus 20.1% for the castrate sample. Packages of 500 g minced meat (3 mm) were vacuum packed and frozen at -20 °C. At the day of the consumer test, meat was thawed for 48 hours at 5°C and meat patties of 110 g were prepared with a patty press to ensure that all patties had the same thickness. Samples were fried for 10 minutes, until core temperature reached 80°C and served at 70° C. Paired samples were served at the same time. Before and between each serving, consumers were advised to eat a small amount of bread and drink some water.

Consumer panels - tests were performed in four EU countries: at DMRI in Denmark, at the ACTALIA sensory Lab in France, at CRPA in Italy and at CGGW in Poland. In order to have a high prevalence of AND-sensitive consumers, only women were recruited for the consumer panel. A total of 476 consumers participated in four EU countries, Denmark (n=109), France (n=128), Italy (n=121) and Poland (n=118). All consumers evaluated five paired samples of meat patties. The first pair consisted of two castrate samples (originating from two different patties). This pair was considered as warm-up sample to avoid first sample effects and that consumers get used to the meat patties. The following four pairs consisted of four out of eight boar samples each served together with one castrate sample. Paired samples were served according to a balanced design, considering in each session, the type of boar, the position of both patties and the sequence. First, consumers were asked to indicate their preference regarding odour and flavour. Second, consumers indicated their overall liking for each patty on a 9-point scale, from 'dislike' (1) to 'like' (9) with a description on each point but without the intermediate level 'neither like nor dislike' (5). Finally, consumers performed smell tests to evaluate their sensitivity to SKA and AND by using sniffing strips in a triangle triplicate with either 20 µl odorant solution (low AND: 0.5 ppm, high AND: 5.0 ppm, high SKA: 1.0 ppm) or solvent (propylene glycol). Consumers first received one triangular with L-carvone (minth) to familiarize them with the concept of triangular tests. Consumers were then identified as very sensitive, sensitive or insensitive to AND, and sensitive or insensitive to SKA [6].

Statistical analysis – Overall liking scores were evaluated by ANOVA with PROC GLIMMIX procedure of SAS, including type of boar (B1 to B8), position (1 or 2), country, AND sensitivity, SKA sensitivity, and their two-way interactions as fixed effects. Interactions were removed from the model if P>0.10. Consumer was included as random effect. Relationship of AND and SKA levels on consumers' preference was analysed using the PROC GLIMMIX procedure of SAS for odour and flavour separately, using the naeperian logarithm of AND (LnA) and SKA levels (LnS) to account for the non-normal distribution of the concentrations of the boar taint compounds. Two regression models were performed for odour and flavour: For sensitive consumers, LnS, LnA and the interaction between LnS and LnA was included. For non-sensitive consumers, the last two factors were removed from the model because these were not relevant. The final model was obtained by considering both, AND sensitive and insensitive consumers, weighted by their proportion in the population studied.

III. RESULTS AND DISCUSSION

Overall, 66% of the consumers were AND insensitive, 25% were sensitive and 9% were very sensitive. The percentage of very AND sensitive consumers was highest in Italy (17%), in line with the higher sensitivity towards L-carvone (minth). In general, the percentage of sensitive consumers was lower than those

obtained in the pilot study in Germany (29% sensitive and 18% very sensitive) and the percentages found in previous studies. Also for SKA, percentage of sensitivity was low, with 60% on average. In the pilot test, the percentage of SKA sensitivity was 72%. Fourty-two percent of the consumers identified the first training triangular with minth correctly, with 34, 34 and 36 % in Denmark, France and Poland respectively. This percentage was much higher in Italy (61%). These low percentages were unexpected and may indicate that odour solutions degraded quicker than expected.

Overall liking scores for the boar patties varied from 4.9 to 6.2 depending on boar type (Fig. 1). The liking score of the castrate sample varied between 6.6 and 6.9 (depending on the boar type presented in the paired test).

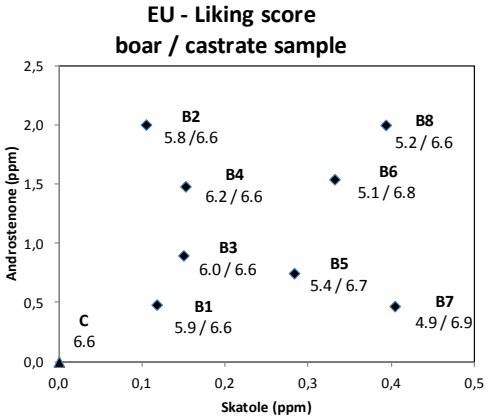

Fig. 1: Mean liking score (1: dislike to 9: like) for the eight boar meat patties according to their levels of androstenone and skatole (B1 to B8 (left)) and the paired castrate sample presented (right). Average liking score of the warm-up pair (meat from castrates) (C) is indicated at the triangle.

The average liking score of the boar samples depended on the type of boar ($P<0.001$), the position within the sample pair ($P<0.001$), country ($P<0.001$), AND sensitivity ($P<0.001$) and SKA level ($P=0.001$). Besides, type of boar interacted with country ($P=0.043$) and tended to interact with AND sensitivity ($P<0.10$) (Table 1). In all countries, the lowest scores were given to patties with high SKA levels (type B5 to B8). Consumers sensitive to SKA and AND less appreciated the boar patties compared to the insensitive consumers (Table 1). Liking scores also depended on country. In general, Italian and French consumers gave higher liking scores compared with Danish and Polish consumers. In patties with higher SKA level (type B6 to B8), consumers from Denmark gave the lowest liking scores.

Table 1: Liking scores (Least square means) of the different effects

Effect		
Position		
1	5.4	a
2	5.1	b
SKA sensitivity		
No	5.5	a
Yes	5.0	b
AND sensitivity		
No	5.8	a
Yes	5.4	b
Very	4.5	c

	Country			
Type of Boar	*Denmark*	*France*	*Italy*	*Poland*
B1	5.6	5.9 ^{ab}	6.1 ^{a}	5.8 ^{a}
B2	5.2	6.0 ^{ab}	5.5 ^{ab}	5.1 ^{ab}
B3	5.1	6.3 $_{a}$	5.8 ^{ab}	5.3 ^{a}
B4	5.3	6.2 ^{ab}	6.1 ^{a}	5.4 ^{a}
B5	5.0	5.8 ^{ab}	5.5 ^{ab}	5.1 ^{ab}
B6	4.1	4.9 ^{b}	4.9 ^{b}	4.9 ^{ab}
B7	3.6	5.3 ^{ab}	5.1 ^{ab}	4.0 ^{b}
B8	3.8	5.3 ^{ab}	5.4 ^{ab}	4.8 ^{ab}

Liking score (1: dislike to 9: like, without the intermediate level 'neither like nor dislike')

^{abc} Different letters indicate significant differences per factor or interaction ($P<0.05$).

Similar results were found when consumer preferences for odour or flavour of boar over castrate meat patties were evaluated. Odour and flavour preference clearly decreased with increasing SKA content. Moreover for AND-sensitive consumers, preference decreased with increasing AND content when SKA levels were low (Odour: insensitive: $-1.17 - 0.475 \cdot LnS$; sensitive: $-1.60 + 0.45 \cdot LnA - 0.49 \cdot LnS + 0.41 \cdot LnA \times LnS$); Flavour: insensitive: $-1.24 - 0.49 \cdot LnS$; sensitive: $-1.87 + 0.76 \cdot LnA - 0.55 \cdot LnS + 0.52 \cdot LnA \times LnS$). The preference maps were created based on the weighted proportion of sensitive and insensitive consumers, and are valid within the tested population and the tested levels of SKA (0.10 to 0.40 ppm) and AND (0.47 to 2.07 ppm) (average values in the fat of which the boar patties in each group originated). Based on the distribution of sensitive and insensitive consumers, global odour preference

varied from 48% for low AND - low SKA, 42% for high AND - low SKA, 29% for low AND - high SKA and 30% for high AND - high SKA (Fig. 2a). For flavour, preference varied from 46% for low AND - low SKA, to 41% for high AND - low SKA, to 26% for high AND - low SKA and 29% for high AND – high SKA for boar samples compared to castrate samples (Fig 2b). The study design proved to be useful to evaluate the consumer acceptance of boar meat for other meat products. For meat products with high fat levels, further research on consumer acceptance should focus on effect of SKA levels in the range between 0.00 and 0.20 ppm.

Table 2: Map of the preferences (%) for odour (a) and flavour (b) of boar meat patties over castrate meat patties depending on the levels of androstenone (AND) and skatole (SKA) and considering AND sensitivity (34%)

Odour (a)

AND(ppm)	SKA (ppm) 0.10	0.18	0.26	0.34	0.42
0.47	48	39	34	31	29
0.87	45	38	34	31	29
1.27	44	37	34	31	29
1.67	43	37	33	31	30
2.07	42	36	33	31	30

Flavour (b)

AND(ppm)	SKA (ppm) 0.10	0.18	0.26	0.34	0.42
0.47	46	37	31	28	26
0.87	44	36	32	29	27
1.27	42	36	32	29	28
1.67	41	35	32	30	28
2.07	40	35	32	30	29

IV. CONCLUSION

The study design allowed for an evaluation of consumer preference and liking of boar meat patties compared with castrate meat patties with boar taint concentrations varying from 0.10 to 0.40 ppm for SKA, and from 0.47 to 2.00 ppm for AND. The preference for the castrate over the boar patties increased with increasing SKA content of the paired boar patty. At low SKA content, the preference for the castrate patties also slightly increased with increasing AND level. It was not possible to establish a single threshold for AND and SKA as the decrease in liking or preference was gradual. The final sorting limit therefore depends on the risk the stakeholders are willing to take. For this reason, a map of preferences depending on the level of AND and SKA of the fat of the meat patties can be created to allow stakeholders to choose the threshold for both compounds according to their necessities. These maps are provided for taking into account consumers' sensitivity of the population and the type of meat product included in this test.

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REFERENCES

1. Bonneau, M., & Chevillon, P. (2012). Acceptability of entire male pork with various levels of androstenone and skatole by consumers according to their sensitivity to androstenone. Meat Science: 90, 330–337.
2. Lunde, K., Skuterud, E., Hersleth, M., & Egelandsdal, B. (2010). Norwegian consumers' acceptability of boar tainted meat with different levels of androstenone or skatole as related to their androstenone sensitivity. Meat Science, 86, 706–711.
3. Meier-Dinkel, L., Trautmann, J., Frieden, L., Tholen, E., Knorr, C., Sharifi, A. R., Bücking, M.,Wicke, M., & Mörlein, D. (2013). Consumer perception of boar meat as affected by labelling information, malodorous compounds and sensitivity to androstenone. Meat Science: 94, 19–26.
4. Ampuero Kragten, S., Verkuylen, B., Dahlmans,H., Hortos,M., Garcia-Regueiro, J. A.,Dahl, E., Andresen, O., Feitsma, H., Mathur, P. K., & Harlizius, B. (2011). Inter-laboratory comparison of methods to measure androstenone in pork fat. Animal: 5, 1634–1642
5. Lundström K, Matthews KR & Haugen JE (2009). Pig meat quality from entire males. Animal 3: 1497-1507.
6. Mörlein, D., Schiermann, C., Meier-Dinkel, L., Trautmann, J., Wigger, R., Buttinger, G., & Wicke, M. (2015). Effects of context and repeated exposure on food liking: The case of boar taint. Food Research International, 67, 390–399. doi:10.1016/j.foodres.2014.11.037