

# DANISH CONSUMERS' SENSITIVITY TOWARDS THE BOAR TAIN T COMPOUNDS ANDROSTENONE AND SKATOLE

M. D. Aaslyng<sup>1</sup>, L. Kristensen<sup>1</sup>, Per B. Brockhoff<sup>2</sup>, Rune H. Christensen<sup>2</sup> and E. H. L.

Broge<sup>1</sup>

<sup>1</sup> Danish Meat Research Institute, Roskilde, Denmark

<sup>2</sup> Technical University of Denmark, Department of Applied Mathematics and Computer Science, Section for Statistics

**Abstract** – A future production of pork including meat from entire males is a realistic scenario for the major pig producing countries. To ensure that no boar tainted meat reaches the consumers, the only reliable preventive method is to detect and sort out the boar tainted carcasses at the slaughterhouse. One of the prerequisite for sorting at the slaughterhouse is reliable sorting limits based on consumer sensitivity. The aim of the work presented here was to describe the proportion of Danish consumers that are sensitive towards androstenone and the proportion highly sensitive towards skatole and further to investigate any age and gender effect on sensitivity. Consumers in the age interval of 15 - 99 years (n=1294) were tested using triangle tests with paper strips containing 20 ppm solution of androstenone and 0.15 ppm solution of skatole. The consumers were recruited in shopping malls, at schools and at companies in all major regions of Denmark. Sensitivity towards androstenone is age related. An increasing proportion of consumers are sensitive with increasing age up to 70 years, where after the sensitivity decreases. In total, between 19 and 38 % of the consumers are sensitive towards androstenone. More females than males are sensitive towards androstenone. Even though it is expected that most people can detect skatole, only 5-6% were classified as highly sensitive. This proportion was constant with age, and no difference between genders was seen.

**Key Words** – Castration, Odour identity, Smell test

## • INTRODUCTION

There is a growing international attention on the animal welfare problem of using the surgical castration of male piglets that has been used for centuries to eliminate the risk of boar tainted meat. A future production of pork including meat from entire males is therefore a realistic scenario for the major pig producing countries. Despite many attempts to reduce boar tainted meat through feeding, breeding and management, it has not been possible to eliminate the problem in the primary production [1]. Thus, to ensure that no boar tainted meat reaches the consumers, the only reliable preventive method is to detect and sort out the boar tainted carcasses at the slaughterhouse. Boar taint is known to be correlated to the concentration of the two compounds skatole and androstenone [2]. To complicate it further, while most people are expected to be able to detect skatole [3], only a part of the population can detect androstenone [4]. Furthermore, it is hypothesized that the sensitivity towards skatole differs between consumers and a proportion of consumers might therefore react to even medium or low concentrations of skatole. In general, the olfactory ability is reduced by age [5], but it is not known if this is also true for androstenone and skatole. It has previously been reported that women have a higher disliking of boar tainted meat than men; however, it has not been investigated whether this is caused by the androstenone or the skatole compounds [6].

A prerequisite for sorting out the carcasses at the slaughterhouse is i) a reliable method for detecting the compounds and ii) knowledge of the consumer response to different androstenone and skatole concentrations and iii) knowledge of the proportion of consumers who are able to

detect androstenone. The work presented in this paper is part of a project set up to generate the basis for establishing sorting limits for boar taint based on consumer response and consumer threshold for androstenone and skatole sensitivity. The aim of the work reported here was to describe the proportion of Danish consumers that are sensitive towards androstenone and the proportion highly sensitive towards skatole and to investigate any age effect and gender effect on sensitivity.

## • MATERIALS AND METHODS

Consumers in the age interval of 15 - 99 years (n=1294) were tested using a triangle test with paper strips containing 20 µl propylene glycol and 20 µl androstenon (20 ppm solution) or skatole (0.15 ppm solution); androstenone and skatole always being the odd sample. The procedure was adapted from Meier-Dinkel et al. [7]. Androstenone (5 $\alpha$ -androst-16-en-3-one, Sigma Aldrich) was dissolved in methanol prior to dissolving it in propylene glycol (1.2 propanediol, Sigma Aldrich). Skatole (3-methylindole, Sigma Aldrich) was dissolved directly in propylene glycol. Propylene glycol was used as control odour.

20 µl of the odorants were dispersed on paper sticks (250 g/m; SSP IDENT, Einbeck Germany) and stored in polystyrene test tubes, assigned with three digit randomized numbers for approx. 24 hours in a fume hood before getting sealed.

Paper strips were prepared three to four days in advance and were used for approx. ten consumers each.

Three triangle tests of androstenone and skatole were presented in mixed order. The consumers were asked to sniff the paper stick and pick the odd sample by first impression and were allowed to sniff as long as they wanted. If they were not able to detect a difference between the samples, they were forced to pick a random sample. The consumers were recruited in shopping malls, at schools and at companies in all major regions of Denmark. The effects of age were tested in logistic regression models using likelihood ratio tests, and the effects of gender were tested with chi-square tests.

## • RESULTS AND DISCUSSION

Depending on age group, between 19 and 38% of the consumers were able to detect androstenone in this concentration (Table 1). This is lower than seen in previous studies such as [4], who found that 51% of the consumers were sensitive towards androstenone (n=391, three countries) [4], and [8] who found that 45.3% were sensitive towards androstenone (n=1569, all Flemish). This might be caused by the test method as the consumers were tested on pure crystalline androstenone [4] or a saturated solution of androstenone [8], which must be expected to be more intensive, compared with our method and also more concentrated than what can be expected in the meat. Still, approx. one third of the Danish consumers were sensitive when using our method, and they should be taken into account when establishing a sorting limit.

There was a clear age effect in the consumers' ability to detect androstenone. Interestingly, the ability of detecting androstenone seems to increase with age up to 70 years when a decrease is seen. A decline in sensitivity was also seen by Bekaert et al. [8]. In comparison, the proportion of consumers being highly sensitive towards skatole was stable within age groups. This ability therefore seems to be conserved with age.

Table 1 Percentage of consumers in different age groups very sensitive towards skatole and sensitive towards androstenon

| Age group | Skatole,<br>0.15 ppm | Androstenone,<br>20 ppm | N   |
|-----------|----------------------|-------------------------|-----|
| 15-20     | 7                    | 19                      | 238 |

|                   |          |         |     |
|-------------------|----------|---------|-----|
| 21-30             | 5        | 23      | 162 |
| 31-40             | 4        | 30      | 219 |
| 41-50             | 6        | 30      | 275 |
| 51-60             | 6        | 33      | 177 |
| 61-70             | 3        | 38      | 127 |
| >71               | 3        | 24      | 96  |
| P(age difference) | P=0.4748 | P<0,001 |     |

Females are often claimed to be more sensitive towards androstenone than males [3]. This was also shown in this study in which 33% of the females were sensitive towards androstenone while this applied to only 21% of the males. As androstenone is a male pheromone this was also expected. This study only detects if the consumers are sensitive or not and not whether they like the odour or not. One fifth of the male consumers were sensitive, and as the liking of the odour might be different between genders, this high proportion must also be taken into account when setting a sorting limit.

No difference was seen between genders in their ability to detect low concentrations of skatole.

Table 2 Percentage of females and males very sensitive towards skatole and sensitive towards androstenon

| Age group            | Skatole, 0.15 ppm | Androstenone, 20 ppm | N   |
|----------------------|-------------------|----------------------|-----|
| Female               | 5                 | 33                   | 717 |
| Male                 | 6                 | 21                   | 577 |
| P(gender difference) | P=0.4303          | P<0,001              |     |

Setting up a sorting limit requires knowledge of consumer reactions towards pork with different levels of androstenone and skatole depending on the consumers' sensitivity towards the compounds.

The sensitivity towards androstenone and skatole seems to depend on age and gender differences. In this study, a significant effect was seen of age and gender on androstenone sensitivity. Sensitivity towards androstenone fluctuates during a lifetime while sensitivity to skatole appears to be stable throughout the life. It is therefore important to take both androstenone and skatole into account when analysing differences in consumer reactions towards boar taint as these two compounds have different impacts on consumer sensitivity.

## • CONCLUSION

Sensitivity towards androstenone is age related. The proportion of sensitive consumers increases with increasing age up to 70 years, and then the sensitivity decreases.

In total, between 19 and 38% of the consumers are sensitive towards androstenone. More females than males are sensitive.

Even though it is expected that most people can detect skatole, only 5-6% were classified as highly sensitive towards skatole. This proportion was constant with age, and no difference was seen between genders.

## ACKNOWLEDGEMENTS

Lisbet Falch Jakobsen and the chemical laboratory at DMRI are acknowledged for their technical assistance. The Pig Levy Fund and the Ministry of Food, Agriculture and Fisheries of Denmark are thanked for financial support.

## REFERENCES

1. Zamaratskaia, G. 2009. Cause and possible ways to eliminate boar taint in pork. *Technologija mesa*. P 43-47
2. Dijksterhuis, G.B., Engel, B., Font i Furnols, M.; Agerhem, H., Fischer, K., Oliver, M. A., Claudi-Magnussen, C., Siret, F., Béague, M. P., Homer, D. B. & Bonneau, M. (2000). An international study on the importance of androstenone and skatole for boar taint: II. Sensory evaluation by trained panels in seven European countries. *Meat Science* 54: 261-269
3. Font-i-Furnols, M. (2012). Consumer studies on sensory acceptability of boar taint: A review. *Meat Science* 92 pp 319-329
4. Blanch, M., Panella.Riera, N., Chevillon, Å., Font I Furnols, M., Gil, M. Gil, J.M, Kallas, Z. & Oliver, M.A. (2012). Impact of consumer's sensitivity to androstenone on acceptability of meat from entire male pigs in three European countries: France, Spain and United Kingdom. *Meat Science* 90: 572-578
5. Mattes, (2002). The chemical senses and nutrition in aging: Challenging old assumption. *J. American dietetic association* 102: 192-196
6. Matthews, K. R., Homer, D. B, Punter, P., Béague, M. P., Gispert, M., Kempster, A. J., Agerhem, H., Claudi-Magnussen, C., Fischer, K., Siret, F., Leask, H., Font-.i-Furnols, M. & Bonneau, M. (2000). An international study on the importance of androstenone and skatole for boar taint: III. Consumer survey in seven European countries. *Meat Science* 54: 271-283
7. Meier-Dinkel, L., Sharifi, A. R., Tholen, E., Frieden, L., Bücking, M., Wicke, M. & Mörlein, D. (2013). Sensory evaluation of boar loins: Trained assessors' olfactory acuity affects the perception of boar taint compounds. *Meat Science* 94 : 19-26.
8. Bekaert, K. M., Tuytens, F. A. M., Duchateau, L., Brabander, H. F. D., Aluwé, M., Millet, S.; Vandendriessche, F. & Vanhaecke, L. 2011. The sensitivity of Flemish citizens to androstenone: Influence of gender, age, location and smoking habits. *Meat Science* 88: 548-552.