MASKING OF BOAR TAINT BY FERMENTATION AND SMOKING

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Introduction

Raising entire male pigs has a number of advantages including lower production costs, leaner carcass and improved welfare of the animals. However, it also has a number of drawbacks, most of them concerning meat quality, with boar taint being the most serious problem (Bonneau, 1998). Skatole, a compound with intense faecal odour, and androstenone, a steroid with intense urinary odour, are held responsible for boar taint (Bonneau, 1998). Many different flavour compounds are formed during fermentation and smoking of fermented sausage, and the hypothesis was that some of these compounds may be able to mask boar taint. In descriptive sensory profiling of a product all sensory characteristics are rated in order to provide a complete description of its sensory properties (Lawless & Heymann, 1998). Descriptive sensory profiling was performed to investigate whether it was possible from a sensory perspective to mask boar taint in a sausage model system by fermentation with different starter cultures and smoking. A model system was chosen in order to investigate nuances in a controlled context.

Materials and Methods

A model system resembling a fermented sausage was developed and the study was performed as a 3´2´2 factorial design with 3 different mixed starter cultures with lactic acid bacteria and *Staphylococcus spp* (Bactofermä T-SC-150, F-1 and F-2, kindly provided by Chr. Hansen A/S, Hørsholm, Denmark), 2 levels of androstenone/skatole (- /+) and 2 levels of smoke (- /+ liquid smoke). There were differences between the starter cultures in acidification and flavour characteristics. Model batters composed of 70% lean pork shoulder, 27% pork back fat, 2.2% curing salt (0.6% sodium nitrite), 0.75% glucose, 0.05% sodium ascorbate, 0.03% $MnSO_4 \times H_2O$ and 0.025% starter culture (appox. 10^7 CFU/g batter) were produced in batches of 2 kg. Liquid smoke 0.5 g/kg model batter was added in two of the four experiments. A pool of back fat from entire male pigs was used in boar tainted batters (HH) and back fat from female or castrated male pigs was used in control batters (LL). Meat and fat were minced (4.5 mm) and the model batters were prepared in a dough blender by mixing minced meat, fat and all dry ingredients for 1.5 min. The model batters were stored at 25°C for 5 days and final pH was measured. Androstenone and skatole were analysed according to Chen et al. (2007) with minor modifications.

A trained sensory panel, consisting of 10 female Danish students, was pre-tested for detection abilities of skatole and androstenone. The sensory profiling focused on odour using a specifically developed vocabulary of 13 sensory terms (see Figure 1). The samples were served at room temperature and sensory terms were scored on a 15 cm unstructured line scale. The raw sensory data was pre-processed using Generalised Procrustes Analysis (GPA) in Matlab 6.5 (MathWorks Inc., USA) to correct for idiosyncratic line scale usage. Afterwards each product combination was averaged over judges and sensory replicates. ANOVA- Partial Least Squares Regression (APLSR) was carried out using Unscrambler, Ver. 9.1 (CAMO ASA, Norway). The X-matrix consisted of category variables (0/1) for the experimental design variables and the Y-matrix consisted of the sensory terms plus chemical measurements of androstenone and skatole. The Y-matrix was weighted by 1/Sdev and full cross-validated. To derive significance indications for the relationships determined in the APLSR, regression coefficients were analysed by jack-knifing.

Results and Discussion

Final pH ranged between 4.5 and 4.8 in the model batters thus resembling a Nordic type of fermented sausage. The androstenone content ranged in model batters with boar tainted fat between 0.50 and 0.75 µg/g raw batter and the skatole content between 0.021 and 0.034 µg/g raw batter. This is in agreement with the normal cut-off limits for boar tainted meat (Bonneau, 1998).

Overall, the three sources of variation smoking, boar taint and starter cultures were described and discriminated across 3 Principal Components (PCs), respectively. PC1 discriminated non-smoked and smoked

samples, and PC2 clearly described difference in the level of boar taint (Figure 1). Smoking systematically changed the character of both boar tainted (HH) and control (LL) samples and smoking had a significant ($P<0.05$) masking effect on the boar tainted samples. This is seen from Figure 1, where the non-smoked HH-samples were described by the sensory terms as urinesweat-O, manure-O, piggy-O, while smoking resulted in the boar tainted samples being negatively correlated to the boar taint terms and instead described by the sensory terms salami-O, smoke-O and sweetsickly-O. Control samples were also affected by smoking. They moved from being described by the terms linseed_oil-O, whitewine-O and acidic-O to the more positive terms cooked_ham-O and aroma_intensity-O. The boar tainted samples were related to the chemically estimated content of skatole and androstenone such that the boar tainted samples were within consumer relevant limits of rejection. PC3 displayed the variation within the starter cultures and separated starter culture 1 (T-SC-150) and starter culture 2 (F-1) from starter culture 3 (F-2) (Figure not shown). The starter cultures had different sensory characteristics and the boar taint connection varied between them, but the starter cultures did not appear to be involved in the masking of boar taint. For further understanding of the effect of masking boar taint, aroma analysis could be carried out. It would also be relevant to move onto real sausage to know if the results from the model system could be confirmed in that context. Furthermore, consumer studies could confirm if this masking of boar taint also has an effect across consumer populations.

Conclusions

The design variables were clearly discriminated and described, since the sensory panel was able to distinguish between the control and boar tainted samples, non-smoked and smoked samples and the different starter cultures. Smoking had a positive influence on masking of boar taint at a normal smoking level for fermented sausages. Differences between the starter cultures were found; starter cultures 1 (T-SC-150) and 2 (F-1) were similar in linseed_oil-O and acidic-O, whereas culture 3 (F-2) was unique in aroma_intensity-O and cooked_ham-O. The sensory evaluated boar tainted samples were related to the chemically estimated contents of skatole and androstenone.

References

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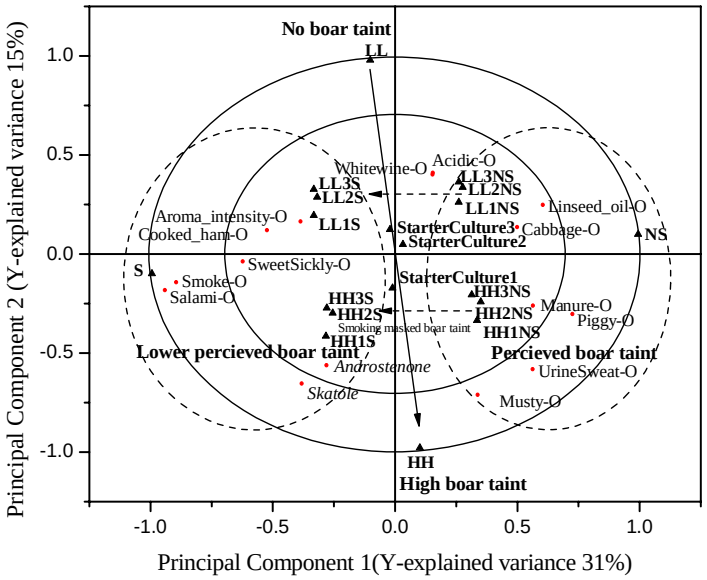

Figure 1. APLSR correlation loadings plot of the two first Principal Components (PCs) with the design variables in the X-matrix and the sensory terms in the Y-matrix. The design variables were LL = control samples, HH = boar tainted samples, starter culture 1 = T-SC-150, starter culture 2 = F-1, starter culture 3 = F-2, NS = non-smoked and S = smoked samples. The dashed circles were added to illustrate the masking effect of smoking and the dashed arrows indicate the movements caused by smoking. The vertical arrow indicates the difference between the control samples and the boar tainted samples. Comments were added to ease the interpretation of the APLSR model.