CONTROLLING BOAR TAINT: ASSESSORS' SENSITIVITY MATTERS

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Abstract – This study investigated how assessors' olfactory acuity affects the percept intensity of androstenone odor and flavor in boar loins. Olfactory acuity for androstenone was determined with triangle tests using smell strips. To discriminate sensitive (SENS) and highly sensitive ($SENS_{HIGH}$) panelists, two concentrations of androstenone, i.e. about 150 and 15 ng per strip, were used after 10 weeks training. Sensitivity was defined as the correct identification of the androstenone strip in three replicate triangles. Judges (SENS, n = 7; $SENS_{HIGH}$, n = 9) then assessed loins from boars, castrated pigs and gilts. Smell strips were also provided as references for androstenone odor intensity scale use. $SENS_{HIGH}$ assessors scored low-fat boar loins with 1.5 to 2.0 µg androstenone per g melted back fat significantly different compared to castrate and gilt loins for androstenone odor and flavor whereas SENS assessors perceived no differences. To conclude, assessors' olfactory acuity should be considered during assessor selection and training. The presented paper strip system is suggested for screening and training purposes and to be used as quantitative references in descriptive analysis. The acceptance thresholds for boar taint compounds need to be elucidated with respect to the fat content of the respective pork cuts as backfat values appear ineligible for lean cuts, e.g. loins.

Key Words – pork; androstenone; triangle test; sensory evaluation; smell strip

I. INTRODUCTION

Fattening boars is regarded as an alternative to the surgical castration of male piglets but requires the control of so-called boar taint [1, 2]. Consumer acceptance thresholds for androstenone and skatole, which are the main contributors to boar taint, were reported to be 0.5 to 1 µg/g fat and 0.20 to 0.25 µg/g fat, respectively [3]. Thresholds are usually related to backfat due to the lipophilic properties of the compounds. Results from recent studies, however, indicated that androstenone levels which exceed 1 µg/g fat are still tolerated by consumers when loins [4, 5] had been evaluated by consumers. It is, therefore, important to investigate products with varying fat contents by means of panelists trained on the detection of boar taint. Boar loins which are not perceived different from reference loins (castrate, gilt) by trained judges are considered safe in terms of consumer acceptance.

With regard to the evaluation of boar taint the selection and training of assessors appears to be crucial because androstenone perception varies among individuals in terms of detection thresholds and perceived odor quality [6]. However, only little is known how assessors' olfactory acuity affects the objective assessment of boar taint compounds.

Within this study, trained panelists' olfactory acuity for androstenone was determined. Panelists' sensitivity was then related to their sensory evaluation of boar loins with various levels of androstenone and skatole. References for scale use that are recommended for descriptive sensory analysis [7] but whose application for the evaluation of boar taint is only rarely described [8, 9] were developed during descriptive sensory analysis for androstenone odor. Thus, a model system is suggested for assessing the olfactory acuity and for the use as quantitative references in descriptive sensory analysis.

II. MATERIALS AND METHODS

Olfactory acuity of 16 assessors was determined after 22 training sessions within 10 weeks.

Androstenone sensitivity was defined as the ability to correctly identify androstenone compared to propylene glycol (PG) in triplicate triangle tests [10]. Two dilutions of androstenone were used to discriminate sensitive (SENS; 5.0 µg/g PG) and highly sensitive ($SENS_{HIGH;}$ 0.5 µg/g) assessors, respectively. Using 30 µl per strip, the absolute amount of androstenone was about 150 (SENS) and 15 ng ($SENS_{HIGH}$) per strip.

SENS (n = 7) and $SENS_{HIGH}$ (n = 9) assessors evaluated boar loins (Pietrain x [Large White x German Landrace]) with androstenone and skatole levels as given in Table 1 and reference loins (castrate, gilt) in six replicates following descriptive sensory analysis [11]. Intensity of androstenone odor and flavor were rated on a 100 mm line-marking scale with labeled endpoints (0 = "not perceivable"; 100 = "extremely perceivable") [7]. Smell strips containing about 150 ng and 300 ng androstenone were provided as references representing 50 ($A\text{-}on_{50}$) and 90 ($A\text{-}on_{90}$) on intensity scale for androstenone odor.

Table 1: Androstenone and skatole levels in backfat of evaluated animals (values are related to melted fat)

Meat type (products)	Skatole [µg/g]	Androstenone [µg/g]
Boar (LL)	< 0.11	~ 0.5
Boar (LM)	< 0.11	~ 1.0
Boar (LH)	< 0.11	1.5 - 2.0
Boar (ML)	0.15 - 0.2	< 0.5
Boar (HL)	0.25 - 0.3	< 0.5
Boar (HH)	0.25 - 0.4	1.5 - 2.0
Gilt	< 0.05	-
Castrate	< 0.06	-
Boar (NN)	< 0.1	< 0.2

First letter in parenthesis indicate the skatole and the second letter the androstenone concentration in backfat. (L = low, H = high, M = medium, N = very low). 4 to 6 animals were evaluated per meat type.

Loin samples were cooked in a convection oven (Hans Dampf Junior Professional, MKN, Germany) at 170°C (hot steam, 20 % relative humidity) for 8 minutes without any seasonings added. Samples encoded with three-digit numbers were presented in balanced order to avoid sample order effects. For detailed information concerning animals and backfat analysis of skatole and androstenone refer to Meier-Dinkel *et al*. [5]. Androstenone and skatole values are given with respect to melted back fat.

The following model (described in Lea [12]) was used within SENS and $SENS_{HIGH}$ for the analysis of variance by attribute: $y_{ijr} = \mu + P_i + a_j + P_i \times a_j + e_{ijr}$ where y_{ijr} is the observation; µ is the general mean; P_i is the fixed effect of product (levels: see Table 1); a_j is the random effect of assessor (levels 1 to 7 / 1 to 9); $P_i \times a_j$ is the random effect of the assessor×product interaction; e_{ijr} is the residual error. LS-means were compared using Tukey-test.

III. RESULTS AND DISCUSSION

SENS assessors (n = 7) did not significantly differentiate the intensity of androstenone odor in boar and reference loins (Figure 1). $SENS_{HIGH}$ assessors, however, detected a significantly higher intensity of the androstenone odor and flavor in LH and HH boar loins, i.e. from carcasses with 1.5 to 2.0 µg/g androstenone, compared to the reference loins (Figures 1 and 2). Boar loins from carcasses with low and medium androstenone levels, i.e. LL and LM were not perceived to be different with regard to the androstenone odor and flavor (Figures 1 and 2). SENS assessors perceived a significantly higher androstenone flavor in LH, HL and HH boar loins compared to gilt but not castrate loins (Figure 2).

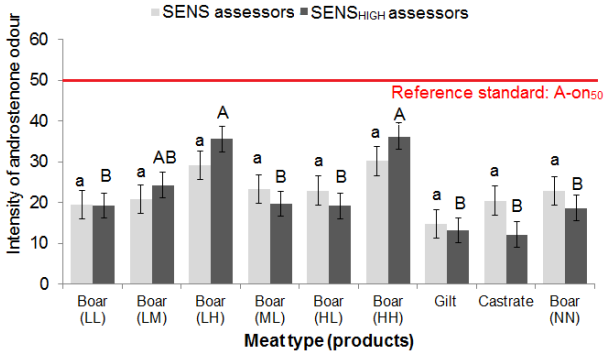

Figure 1: Percept intensity (least squares means and standard errors) of androstenone odor depending on assessors' androstenone sensitivity.

a, b /A, B Least squares means with the same letter are not significantly different (Tukey test, P < 0.05) within SENS and $SENS_{HIGH}$. Scores are defined as 0 = not perceivable to 100 = extremely perceivable.

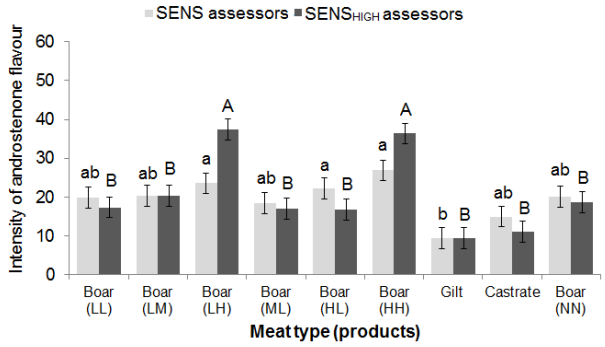

Figure 2: Percept intensity (least squares means and standard errors) of androstenone flavor depending on assessors' androstenone sensitivity.

a, b / A, B Least squares means with the same letter are not significantly different (Tukey test, P < 0.05) within SENS and $SENS_{HIGH}$. Scores are defined as 0 = not perceivable to 100 = extremely perceivable.

Compared to our study, Bañon *et al.* [13] reported cooked loins with lower androstenone and skatole levels (related to backfat) to have significantly higher boar odour than castrate loins. In contrast, Lunde *et al.* [9] referred that trained panelists perceived no higher androstenone odour and flavor intensity in minced meat with a considerably higher androstenone content (in fat). Thus, the perception of boar taint compounds varies due to the impact of fat-content, processing and temperature [14]. It is, however, important to note that androstenone and skatole contents are not comparable among studies due to varying analytical reference methods [15].

Discussed androstenone thresholds are 0.5 to 1.0 µg/g related to backfat [3]. Apparently, these backfat tresholds are not appropriate for lean loins as $SENS_{HIGH}$ assessors perceived no difference between boar loins with 1.0 µg/g and reference loins. SENS assessors did not perceive a significant difference between loins with androstenone levels up to 2.0 µg/g backfat and reference loins. Moreover, sensory defects as detected by trained panelists can still be tolerable for naive consumers [16]. In our recent consumer study [5] we have shown that androstenone levels up to 2.7 µg/g melted fat did not lower average acceptance of pork loins with 1 mm backfat. The question, however, persists how many consumers are negatively affected by lower levels of androstenone in boar meat. Interestingly, previous studies have shown that the ability to perceive androstenone is trainable [17, 18].

It has to be clarified to what extent skatole perception is affected by assessors' olfactory acuity for androstenone.

IV. CONCLUSION

Olfactory acuity of assessors influences percept intensity of androstenone odor and flavor in lean boar loins and should, therefore, be considered during assessor selection and training. Assessors with very low detection thresholds should be selected when a "worst-case scenario" for perception of taint in boar meat is needed. Assessors' detection thresholds should be reported together with their sensory evaluation of boar meat for comparative purposes. As for consumer acceptance thresholds for boar taint compounds, they need to be elucidated with respect to the fat content of pork cuts. Obviously, backfat values seem to be ineligible for lean cuts, e.g. loins.

The presented paper strip system is suggested for assessing the olfactory acuity of panelists and for use as references to illustrate intensity scales in descriptive sensory analysis. Future research could focus on developing references for sorting criteria to be used at slaughter lines to detect tainted carcasses.

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