Identification of Boar Off-Flavour with an Electronic Nose

[1]Ampuero S, [2]Amrhein M, [1]Dubois S, [1]Bee G.
[1]Agroscope Liebefeld-Posieux Research Station ALP, Posieux, Switzerland; [2]Online Control Ltd, Lausanne, Switzerland.

Introduction

Androstenone (A), skatole (S) and indole (I), compounds held responsible for boar taint, are highly lypophylic and practically non volatile. These two characteristics greatly hindered the use of systems that analyze the head space of the sample such as an electronic nose for the sorting out of boar tainted carcasses. Therefore alternative methods had to be explored. A previous preliminary study [1] on the evaluation of an electronic nose for the sorting out of boar tainted carcasses has led to a system composed of a mass spectrometer (MS) and a pyrolyser. Furthermore, from the few possible tissues available to perform an analysis (i.e. blood, salivary gland, muscle, adipose tissue) adipose tissue was identified as the most suitable for this purpose because it contains all compounds currently known in relation to boar taint and in higher concentrations. The purpose of the present study was to develop a system for optimal detection of boar tainted carcasses (minimum of false negatives) and with a sample turn over that approaches that of an industrial slaughter house.

Materials and Methods

The electronic nose system consisted of a MS electronic nose (Smart Nose 151, LDZ. Switzerland) coupled with an automatic-sampler pyrolyser (CDS pyroprobe AS2500 APLUS). The analysis was performed by introducing 0.5 µL of liquefied fat, collected from porcine backfat the day after slaughter, in a capillary tube, with 3 to 5 repetitions per sample. The gas phase produced by pyrolysis at 600°C was instantaneously transferred to the ionization chamber of the MS. The generated data was recorded during 240 s by scanning between 10 to 250 amu at 50 ms/amu. The classification models were developed by multi-class SVM (Support Vector Machine) and variable selection via genetic algorithms [2].

The chemometric classification models were established against reference classifications based on HPLC determination of the principal boar taint compounds in back fat: A, S and I and / or sensorial analysis. Two sensory analyses were performed with panels composed of 8 and 11 persons, from which about 50% were women. The boar-odour and boar-flavour as well as juiciness and tenderness of grilled loin chops were analyzed. Thus, 57 samples (55 boars and 2 barrows) were evaluated with bipolar R-Index [3, 4], and 18 samples (12 boars and 6 barrows) were tested with an intensity 9 point, non-structured scale anchored on both ends. Based on different large sensory evaluation studies performed in Switzerland the reference classes were defined as (conc. in adipose tissue): **no** boar taint: $A \leq 0.5$ µg/g and S, $I \leq 0.16$ µg/g, **mild** boar taint: $0.5 < A \leq 1.0$ µg/g and S, $I \leq 0.16$ µg/g and **strong** boar taint: $A > 1.0$ µg/g or S, $I > 0.16$ µg/g.

Over a period of 12 months, a total of 353 adipose tissue samples originating mainly from Swiss Large White and Landrace boars and barrows were analyzed. Large variations in age, body weight, rearing systems and feeding regimes were present in the set of samples. Semi-external validations were carried out with 17 to 42% of new samples.

Results and Discussion

In bipolar R-Index sensory test (Figure 1) a 99% and 95% confidence levels were adopted to delimitate the classes: strong, mild and no boar taint. Although a fairly good correspondence with HPLC boundaries is observed, the region with A between 0.5 and 1 v and S and $I \leq 0.16$ µg/g is not correctly described. Probably some necessary information is missing, like the presence of other substances. This observation has already been made in previous studies [5] but a clear answer is still lacking.

The combined utilization of the reference classifications based on HPLC and sensory analysis, with prevalence of the sensory classification, resulted in SNV models with 100% correct classification of the fitted values and up to 4 and 1.9 % (strong and no boar-taint respectively) of misclassification by cross validation (CV). After elimination of fit and CV outliers semi-external validations with sets of samples containing 17 to 42% of new samples revealed up to 98% of correct classification of strong boar-taint samples (Figure 2).

The results of this study confirm that a fast, reliable and objective detection of boar tainted carcasses is possible.
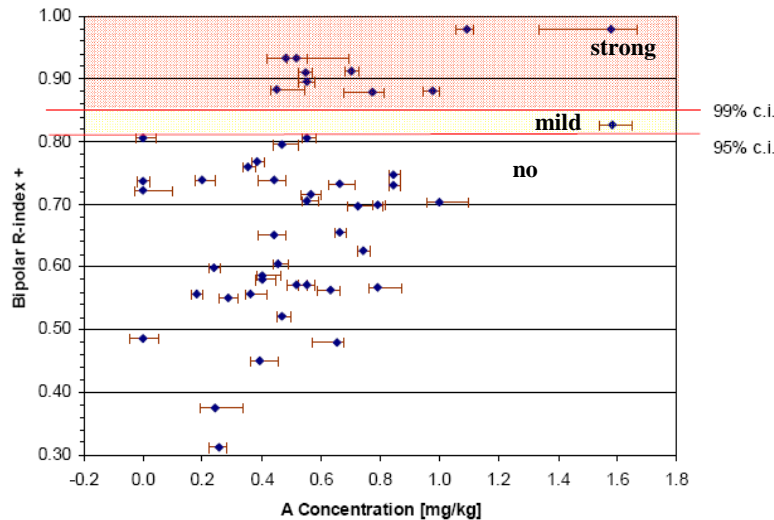
Figure 1. *Bipolar R-Index (positive) sensory test of the boar-flavour of 57 cooked loin chops (55 boars and 2 barrows) 99% and 95% confidence levels delimitate strong, mild and no boar-taint classes.*
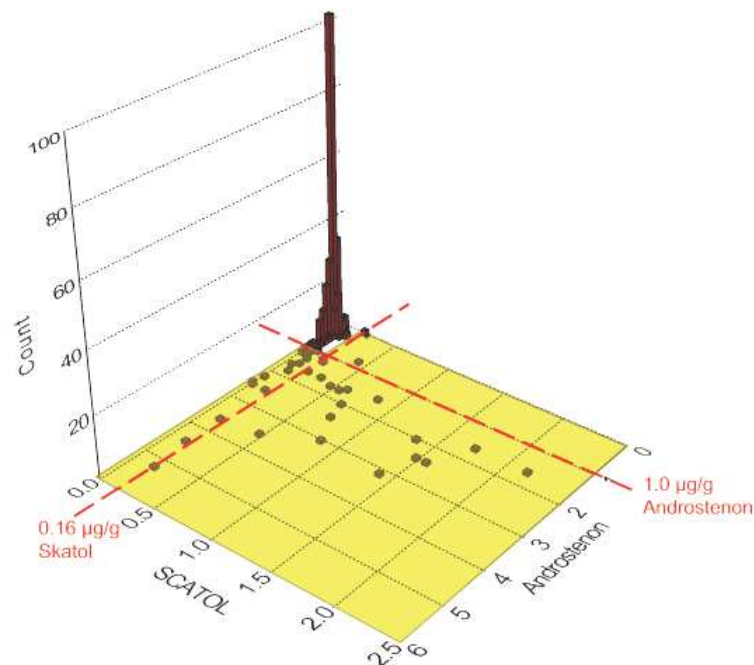

Figure 2. *Frequency distribution of 353 samples as a function of A and S contents in back fat. Red lines: HPLC boundaries for the strong class. Yellow surface: samples assigned to the strong boar-taint class by the electronic nose system.*

References

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