Abstract - Boars Heading for 2018

Boar taint compounds measured using PTR-TOFMS

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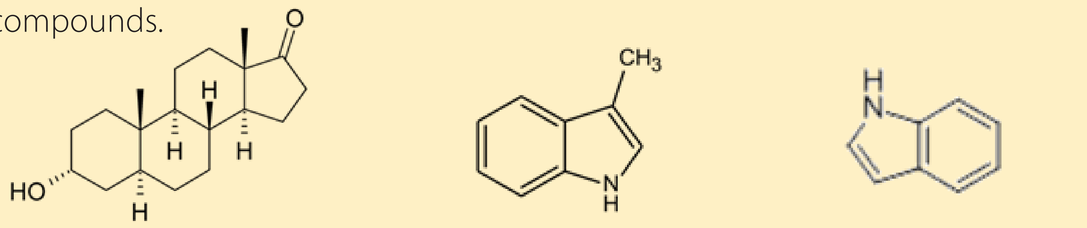
Introduction

The consumers' attention to animal welfare is increasing and so is the concern for pigs being castrated. In the future it is therefore likely that castration of pigs will cease. An affordable system for rapid measurement of the boar taint compounds: skatole, indole and androstenone (see Figure 1) should be developed for the slaughter industry to sort carcasses according to their content of these compounds.



Androstenone. M = 272.4 amu, mp = 182 °C

Indole. M = 117.2 amu, mp = 54 °C

Skatole. M = 131.2 amu, mp = 95 °C

Figure 1

In collaboration with Ionicon Analytik Gesellschaft, Austria, the Danish Meat Research Institute has tested the ability of the Ionicon PTR-TOF-MS (Proton Transfer Reaction - Time of Flight - Mass Spectrometer) for measuring the presence of the three boar taint compounds in the headspace above a fat sample in a closed vial. The PTR-TOF 8000 from Ionicon was designed especially for quantifying sub-ppbv amounts of volatile organic compounds (VOC).

Time of flight mass spectroscopy:

In Figure 2 a typical mass spectrum is shown of headspace air over a fat sample kept at room temperature. It can be seen that already at low temperatures the headspace contains a very complex mixture of substances. In Figure 2, the units on the axes' are counts per second vs. compound mass in amu (atomic mass units).

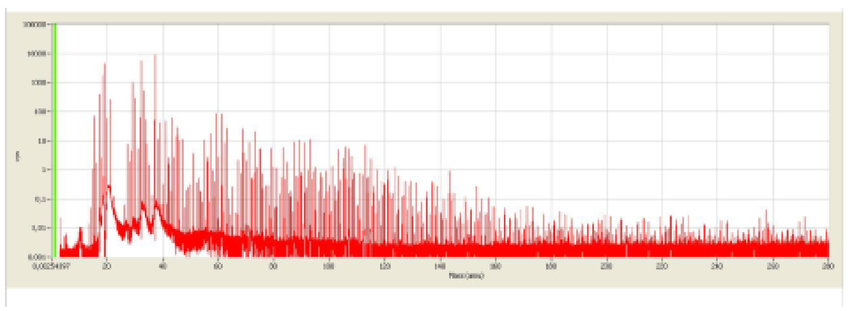


Figure 2

In a time of flight mass spectrometer, the ionized compounds are accelerated in an electric field. The achieved velocity depends on the mass of the ion and its electric charge. Thus, the time required for the accelerated ion to travel a certain distance will in many cases uniquely identify the ion.

The greatest advantage of the PTR-TOF-MS is that the headspace sample does not have to pass a membrane in order to be measured. This is a great advantage when working with very sticky compounds such as androstenone for which a membrane inlet is an impenetrable barrier.

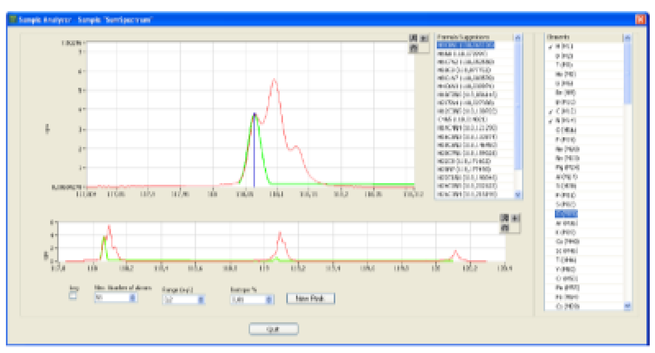


Figure 3 presents a time segment from a time of flight measurement where the signal is shown from three compounds with almost the same mass. Even in cases where peeks are overlapping it is possible to separate them mathematically for peek heights and areas to be calculated.

Figure 3

Samples

Fat samples from 14 entire male pig carcasses were analysed. The 14 pigs were selected at a Danish slaughterhouse where the Danish on-line colourimetric method for measuring skatole and indole has been in operation for the past 21 years. In order to confirm the skatole/indole readings obtained by this colourimetric method, the samples were also tested using the HPLC based ASI method which is DMRI's basic reference measurement for skatole, indole and androstenone.

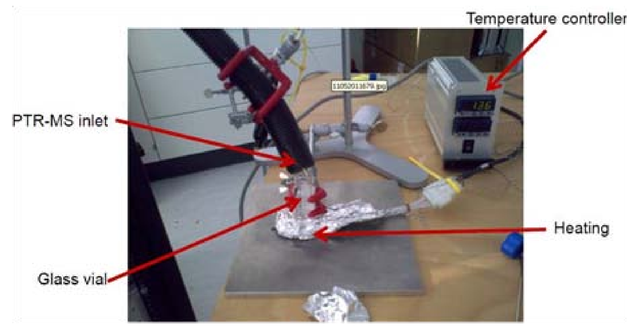


Figure 4

During measurement with the PTR-TOF-MS, air from the headspace is drawn from the vial containing the fat sample. The vial, replacement air tube and inlet tube are heated to 160 - 180 °C. This increased temperature reduces the time for reaching equilibrium between sample and headspace and increases the vapor pressure of the VOC's of interest.

PTR-TOF-MS results:

In Figures 5 and 6 the ion yield is shown for skatole and indole respectively corresponding to the masses shown in Figure 1.

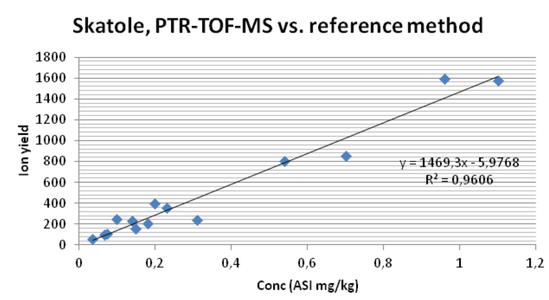


Figure 5

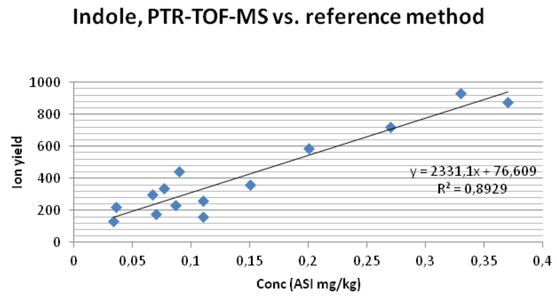


Figure 6

Discussion

The three boar taint compounds are very lipophilic and are not present in adequate amounts in the headspace above the back fat at normal room temperatures. However, at elevated sample temperatures the Proton Transfer Reaction - Time Of Flight Mass Spectrometry (PTR-TOF-MS) was successfully tested for measuring indole and skatole in the headspace above the back fat.

Work in the laboratory is taking place to improve the sample conditioning allowing the PTR-TOF-MS to be put at-line at a slaughterhouse where it will measure skatole and indole levels in entire male pigs.

PTR-TOF-MS is perfectly capable of measuring the presence of androstenone when the substance is placed as a pure crystal in the sample vial. However, androstenone is a larger molecule and more lipophilic than the other two boar taint compounds. This makes it more difficult to build up the adequate amounts in the headspace. Work is in progress to increase the concentrations in the sample headspace making it measurable by PTR-TOF-MS. Also, it is being tested whether androstenone is easily adsorbed on the surface of SPME (Solid-phase micro extraction) fibres from where it can be introduced to the PTR-TOF-MS inlet.