VOC profile analyses for the development of sensors for rapid on-line slaughterhouse detection of boar taint in entire male pigs

Burgeon C.[a], Vercruysse A.[a], Martin H.[a], Debliquy M.[b], Lahem D.[c], Rodriguez J.[b], Ly A.[c], Fauconnier M-L.[a]

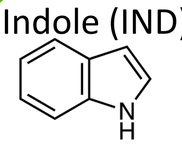
[a] Laboratory of Chemistry of Natural Molecules, Gembloux Agro-Bio Tech, Université de Liège, Passage des Déportés 2, 5030 Gembloux, Belgium
[b] Service de Science des Matériaux, Faculté Polytechnique, Université de Mons, Rue de l'Epargne 56, 7000 Mons, Belgium
[c] Materia Nova ASBL, Materials R&D Centre, Parc Initialis, Avenue Nicolas Copernic 3, 7000 Mons, Belgium

Context and objectives

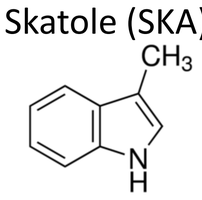
Boar taint is a strong unpleasant smell found in the meat of some uncastrated male pigs. This taint originates mainly from two molecules stored in the fat, androstenone and skatole and to a lesser extent indole. These molecules are emitted when cooking meat, releasing a urine- and fecal- like odour which leads to a strong consumer dissatisfaction. To ensure that tainted meat does not reach the consumer, detection of tainted carcasses is performed in slaughterhouses. Fast, cheap and accurate sensor-based methods are being developed to replace current human nose or colorimetric methods.

This study aims at determining which VOC could be aimed by sensors for boar taint detection during heating of the fat and understanding whether some VOC found in slaughterhouse's air could interfere with the correct functioning of the sensor.

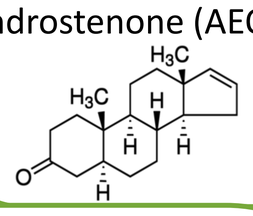
Indole (IND)



Skatole (SKA)



Androstenone (AEON)

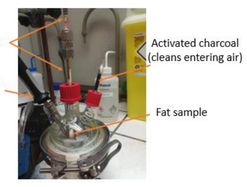


Method

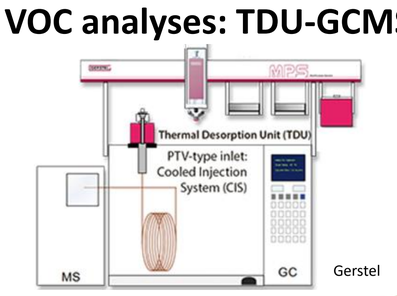
VOC sampling from:

Fat headspace: 440 °C, 30 s

Slaughterhouse:



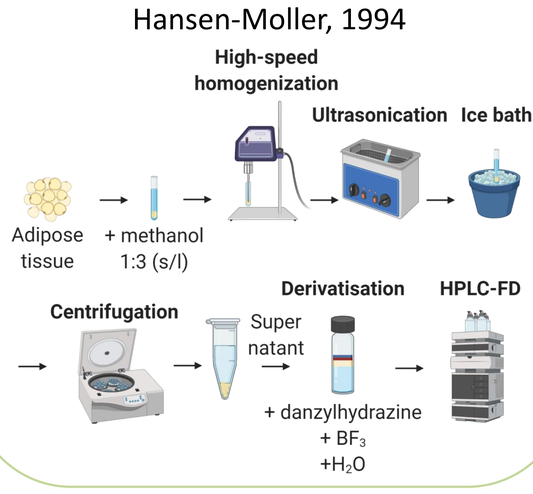
VOC analyses: TDU-GCMS



- Area of single ion chromatogram for IND, SKA and AEON
- Area of total ion chromatogram for profile characterisation

IND, SKA and AEON quantification in adipose tissue

Extraction and HPLC-FD method based on Hansen-Moller, 1994

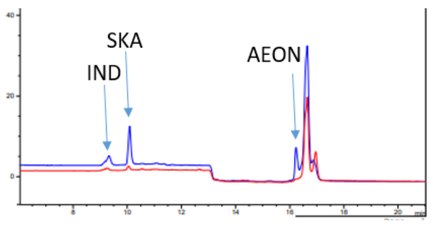


Concentration (ng/g adipose tissue)

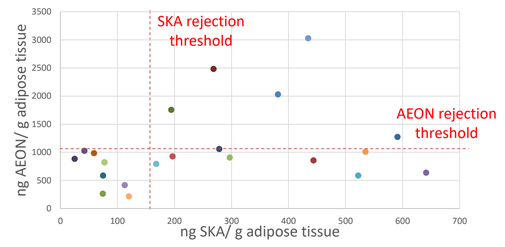
Results

HPLC-FD

HPLC-FD chromatogram (fat content)

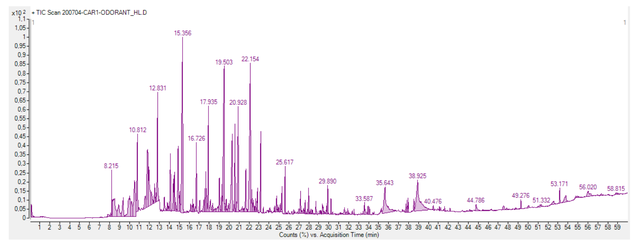


Concentration in fat

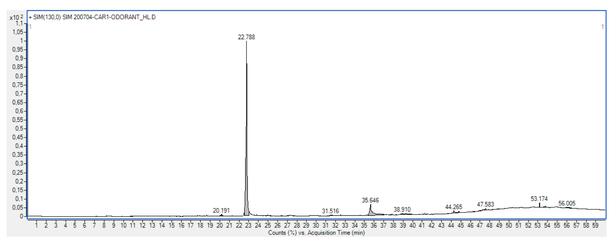


TDU-GC-MS

Total ion chromatogram (fat headspace and slaughterhouse ambiant air)



Single ion chromatogram (IND, SKA and AEON)



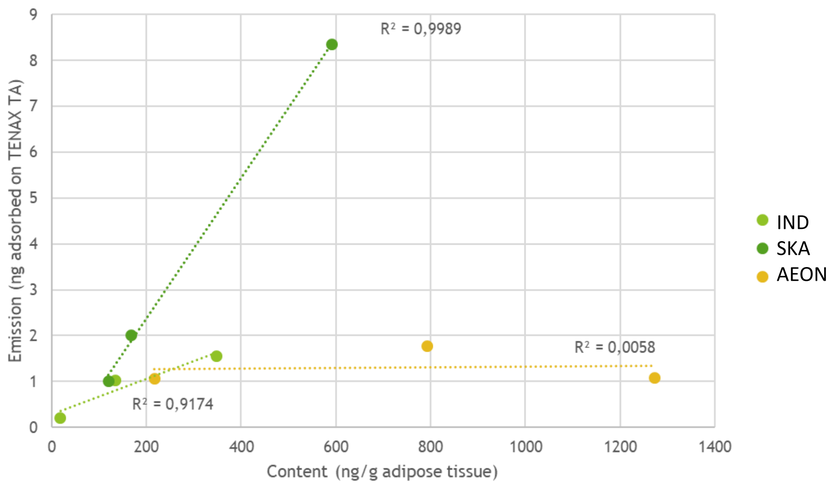
Ions analyzed

	IND	*SKA*	*AEON*
Quantitative ion	Ion 117	Ion 130	Ion 272
Qualitative ions	Ion 63 et 90	Ion 77 et 103	Ion 239 et 257

Molecules representative of heated tainted fat in the headspace?

Case of IND, SKA and AEON in odorant fat

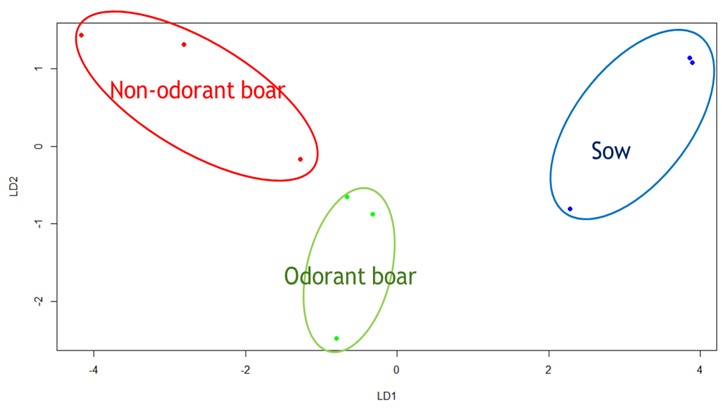
Correlation between content and emission of indole, skatole and androstenone



- Correlation for three samples with varying « taint » levels
- Potential use of IND and SKA for specific sensors

General analysis of heated fat's headspace

Linear discriminant analysis based on VOC profile of various heated fats



PLS-DA shows separation between the three fat categories analysed: sow, untainted boar, and tainted boar fat

Potential interfering molecules?

General analysis of slaughterhouse ambient air

Carboxylic acids

Molecule name	CAS	Number of carbons	% Area
Hexanoic acid	111-14-8	6	0,38±0,19
Nonanoic acid	112-05-0	9	1,05±6,27
Decanoic acid	334-48-5	10	0,48±0,37
Dodecanoic acid	112-80-1	12	0,44±1,55
Tetradecanoic acid	544-63-8	14	1,36±0,75
Pentadecanoic acid	1002-84-2	15	0,58±0,76
Cis-7-hexadecenoic acid	2416-19-5	16	1,87±1,91
N-hexadecanoic acid	57-10-3	16	11,15±0,72
Cis-9-octadecenoic acid	112-80-1	18	5,34±0,47
Octadecanoic acid	57-11-4	18	4,20±0,43

33 molecules correctly identified: aldehydes, alkanes and carboxylic acids
Carbox. acids = More than 25% of total profile

Sensors specific to IND and SKA as well as non-specific sensors can be developed for on-line detection of boar taint.

Conclusion

Results show that tainted and untainted fats display different general VOC profiles when heated at high temperatures. Additionally, high correlations were observed between the emission and the content results for indole and skatole compounds. Both specific and non-specific sensors could be developed for boar taint detection. However, attention must be paid to ensure that the VOC rich environment is taken into account during on-line detection of boar taint.

For more information

Burgeon Clément - cburgeon@uliege.be

Acknowledgements

The authors thanks the European Regional Development Fund (ERDF), the Walloon Region of Belgium and the AGROSENSOR project for their financial support .
Figure presented in "IND, SKA and AEON quantification in adipose tissue" was created with biorender.com