Investigation on human cadaveric VOC by TD-GC×GC-TOFMS

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Introduction

Every human emits Volatile Organic Compounds (VOCs). This smelling profile can change with the situation. When people are stressed, afraid, injured or dead the volatile signal is different. In natural disasters, these changes in the volatile profile are detected by rescue dogs. In this study, we compare VOC profile in the early stage of decomposition between human and pig bodies (used like human analogues). The complete understanding of this phenomenon could help rescue dog trainers during the training process. Some people are also developing electronic device to detect trapped bodies[1,2].

Challenges

The complete analysis of decomposition VOCs requires: powerful separation and robust data processing. In this study, we show the power of a TD-GC×GC-TOFMS instrument to describe complex VOC profiles. Our data handling method is based on statistical comparison for fast analysis of dense data sets.

Conclusions

The use of **TD-GC×GC-TOFMS** for the separation and **the data handling,** based on Statistical Compare alignment feature, **allow the full analysis of VOCs complex mixtures**.

Multivariate analysis (PCA) allows **user-friendly visualization of the results**. Based on this tool, we can investigate which **biomarkers can be used to detect trapped human**. These results also confirmed that the decomposition of a pig is a bit faster than for human, certainly due to the mass of the corpse.

On the practical point of view, the validation of **this results** could possibly yield to **new detection methods and improve rescue dogs training**.

➔ The combination of TD-GC×GC-TOFMS, coupled to a strong data processing method, is a powerful approach for the analysis of complex VOCs profiles.

Methods

1. **Sampling**: The VOCs from dead bodies were trapped on multisorbent tubes (Tenax and Carbopack B) by pumping the headspace above corpses. Controls samples were also took at 50m away from each bodies.

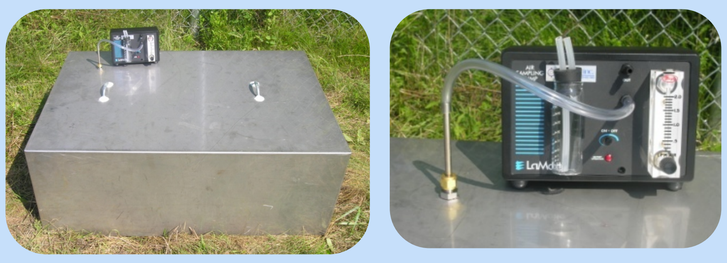

Fig1: Sampling system for complete VOCs trapping

2. **GC×GC Analysis:** The tubes were thermally desorbed on GC×GC using a Rtx-5 (30m x 0,18mm x 0,2μm) as ^{1}D and a Rxi-17 (1m x 0,1mm x 0,1μm) as ^{2}D.

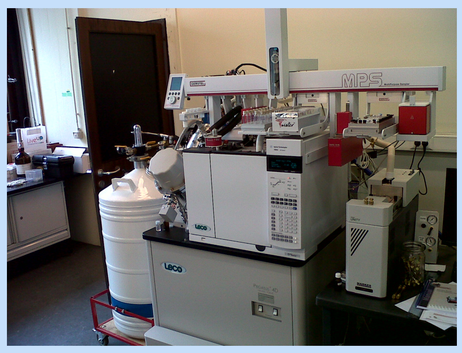

Fig2: Pegasus 4D GC×GC-TOFMS from LECO and Unity 2 TD from Markes

3. **Data processing:** The data were preprocessed for peak reconstruction, mass identification, and area calculation. Statistical Compare feature was used to align and to compare the humans *vs* controls samples. Fisher ratio allowed us to select decomposition-specific compounds.

4. **Statistical treatment:** The specific compounds were exported in an Excel file to undergo the last statistical treatment for statistical analysis and display.

Results & Discussions

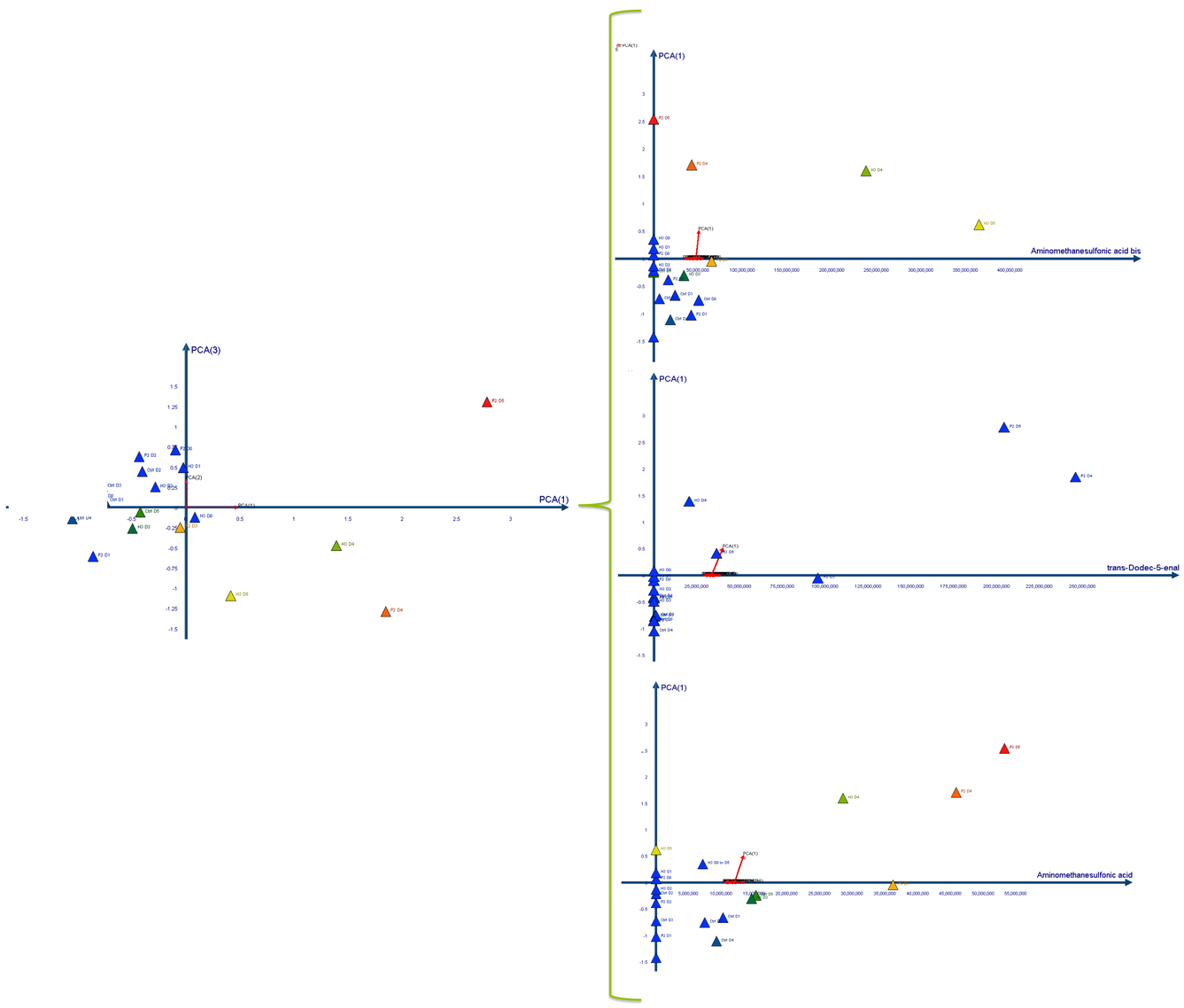

Fig 3: PCA show the separation between the controls and the two first days of decomposition.
Day 4 and Day 5 are separated from the others for the pig and the human.

Fig 4: PCAs plot vs the most intense compounds help to fin biomarkers.
This representation help to determine which compounds are responsible of the separation.

References

[1] M. Statheropoulos *et al*., Combined chemical and optical methods for monitoring the early decay stages of surrogate human models. *Forensic Science International* **210**, 154-163 (2011).
[2] M. Statheropoulos *et al*., Discriminant Analysis of Volatile Organic Compounds data related to a new location method of entrapped people in collapsed buildings of an earthquake. *Analytical Chimica Acta* **556**, 207-206 (2006).