Chasing away the smell of death

GCxGC-TOFMS characterization of cadaveric VOCs

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Amongst the various fields of application of comprehensive two-dimensional gas chromatography time-of-flight mass spectrometry (GCxGC-TOFMS), the analysis of biological samples for target or screening purposes represents quite a growing area of interest. Both signal and peak capacity enhancement properties of the technique are challenged through strategies ranging from, for example, low pg target analyses of selected persistent organic pollutants (POPs) in human matrices [1] to characterization of variations in complex metabolite fingerprint as a result of the progression of a disease [2]. The analysis of volatile organic compounds (VOCs) released from various biological sources is also a challenging area of research, especially in the field of cadaveric decomposition...

Soon after death, the decay process of mammalian soft tissues begins and leads to the release of hundreds of cadaveric VOCs in the surrounding environment. The study of postmortem decomposition products is an emerging field of study in forensic science. However, a better knowledge of the smell of death and its volatile constituents is required for further applications in forensic sciences.

The complex processes of decomposition produce a variety of chemicals as soft tissues and their component parts are broken down. These decomposition by-products include the VOCs responsible for the odor of decomposition. Human remains detection (HRD) canines utilize this odor signature to locate human remains during police investigations and recovery missions in the event of a mass disaster. Currently, it is unknown what compounds or combinations of compounds are recognized by the HRD canines. Furthermore a comprehensive decomposition VOC profile remains elusive. This is likely due to the difficulties associated with the non-target analysis of complex samples.

This presentation will illustrate recent advances in the characterization of human analogue decomposition VOCs using thermal desorption (TD) coupled to GC×GC-TOFMS. Decomposition headspace of pig carcasses [3,4], grave soils [5], and HRD canine training solutions [6] have been investigated so far.

The additional peak capacity of GCxGC, the spectral deconvolution algorithms applied to unskewed TOFMS signals, and the use of a robust data mining strategy allowed for the generation of a profile of decomposition VOCs across the various stages of soft-tissue decomposition. Several hundreds of postmortem compounds have thus been identified.

We believe these results will help to better design thanatochemistry and geoforensic applications that would possibly be of added values in forensic investigations.

1 Focant *et al.* (2004) Anal Chem 76: 6313
2 Welthagen *et al.* (2005) Metabolomics 1: 57
3 Dekeirsschieter *et al.* (2012) PLoS ONE 7: e39005
4 Stadler *et al.* (2013) Anal Chem 85: 998
5 Brasseur *et al.* (2012) J Chromatogr A 1255: 163
6 Stadler *et al.* (2012) J Chromatogr A 1255: 202