Decomposition Odor Analysis Techniques and Prospective Applications in Postmortem Examination

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After this presentation, attendees will understand the most recent chemical analysis techniques used to profile odor from decomposing mammals, as well as how these techniques are currently being applied to postmortem examination of human remains.

This presentation will benefit the forensic science community because it demonstrates a new method for obtaining information about the postmortem status of the remains by using a minimally-invasive postmortem technique.

After death, decomposition processes release numerous volatile organic compounds (VOCs) due to the breakdown of tissues by enzymatic and microbial degradation. These contribute to decomposition odor, which can be a tool used to locate human remains using biological detectors and/or chemical sensors. Since the first study of decomposition odor in 2004, methods for the collection and characterization of decomposition odor have evolved substantially, elucidating numerous new trends in the mechanism of cadaveric VOC production under different circumstances. Simultaneously, whole body postmortem computed tomography (PMCT) has become a more common technique used in medicolegal centers worldwide, providing a means of detecting pockets of gases containing cadaveric VOCs through virtual autopsy. The long-term goal of this research is to use PMCT scanning in combination with new gold standard techniques in decomposition odor analysis to provide quantitative taphonomic information in forensic postmortem investigations.

This presentation will provide an overview of the evolution of odor sampling techniques, as well as comprehensive two-dimensional gas chromatography – mass spectrometry (GC×GC-MS) for cadaveric VOC analysis. In addition, new applications of gas analysis for cadaveric VOCs have recently been demonstrated for minimally-invasive postmortem examination procedures. It is hypothesized that the combination of whole body post-mortem computed tomography, in combination with headspace solid-phase microextraction (HS-SPME) and GC×GC-MS analysis, could provide a valuable tool for postmortem examination procedures in the future.

A first proof-of-concept study was performed using PMCT gas reservoir sampling in combination with headspace solid-phase microextraction (HS-SPME) of VOCs from gas samples, and analysis by GC×GC-MS for gas samples from three bodies associated with forensic casework. This study demonstrated that chemical differences existed between samples collected from different areas of a body, as well as between the same sample collection regions for different bodies. This provided a foundation for a secondary study that focused on full optimization of HS-SPME parameters, introduction of a deuterated internal standard mix for quality control, stability testing, as well as an expanded study on 20 samples from five bodies associated with forensic casework. This optimized method can now be applied in future work to larger cohort studies as part of an established medicolegal network of laboratories who will contribute samples to a combined database. This will allow temporal trends to be better understood, and provide robust data for statistical correlation of VOCs with postmortem interval considering factors such as age, weight, gender, etc.

This research is significant because it provides foundational data for further studies aimed at establishing decomposition odor analysis as a valuable postmortem investigation tool, especially as an alternative to more invasive procedures aimed at taphonomic characterization of bodies.

Keywords: taphonomy, pathology, volatile organic compounds (VOCs)