B32 Use of Blood Volatiles as Trace Evidence

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Learning Overview: After attending this presentation, attendees will understand how Volatile Organic Compounds (VOCs) released from human blood can be used to indicate the time since deposition.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating a scientific basis for the use of blood VOC profiling as a tool to determine time since deposition and establishing a sequence of events.

The detection of blood at a crime scene can provide critical information about the nature of events that occurred, the order of events, and possibly the identity of the individuals involved. Therefore, the detection of blood has always been an important aspect of forensic investigations. Establishing an accurate VOC profile of blood can assist with developing and improving existing forensic methods to locate blood. This can be relevant at a crime scene or may also apply to the search for living and deceased individuals using scent detection canines or portable detection devices. In recent years, the possibility to train scent detection canines on blood has become more popular by forensic agencies. In order to provide more information about such applications, thermal desorption comprehensive two-dimensional gas chromatography (TD-GC×GC) coupled to time-of-flight mass spectrometry (TOFMS) with flow modulation and variable-energy electron ionization (EI) has been proposed as a novel analytical tool that can increase the ability to separate and identify blood VOCs to better understand which target molecules are involved in blood aging. Classical and soft EI (e.g. 70 eV and 14 eV) were applied to each sample in subsequent injections. This allowed effective mass spectral library-searching using classical EI spectra, while providing complementary soft EI spectra, with enhanced molecular ion and reduced fragmentation for confirmation of compound identity. In addition, the use of flow modulation in comparison to thermal modulation permitted the detection of compounds with low molecular weights, allowing the detection of compounds that may have been previously undetected in blood VOC research. The implementation of an internal standard mix allowed semi-quantitation of a subset of the detected compounds.

Statistical analysis such as Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA) demonstrated that differences in blood VOC profiles due to sample aging surpassed inter-individual variations. The results further confirmed that distinctive patterns existed between fresh and aged blood, but also demonstrated that TD-GC×GC-TOFMS was able to highlight subtle differences in VOC profiles within the first week of aging. Improved understanding of the evolution of VOC profiles will help to improve the training of scent detection canines. In addition, the proposed method can be further developed to provide an analytical tool to indicate time since deposition. Such evidence can be crucial and can assist during crime investigation.

This research is significant because the study contributed to the exact determination of the blood VOC profile during degradation which can used to improve scent detection canines training. Furthermore, it was demonstrated that monitoring blood VOC profiles can indicate status of degradation, related to the time since deposition, which can serve as trace evidence providing crucial investigative information during crime investigation.

Blood Degradation, Volatile Organic Compounds (VOCs), Trace Evidence