D5 Development of an Improved Extraction and Analysis Technique for Human Scent Evidence Analysis

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After attending this presentation, attendees will understand principles on how human scent can be used as evidence and how an improved extraction and analysis method lowers the detection limit of human scent residues.

This presentation will impact the forensic science community by demonstrating that human scent residues can be collected, analyzed, and differentiated at lower than-ever-before levels, allowing for the detection of smaller human scent traces.

The human body produces odors made up of a variety of Volatile Organic Compounds (VOCs), which are a class of chemical compounds that have high vapor pressures at room temperature. The combination of these VOCs in different abundances produces a scent, referred to as human scent, which is different for each individual. Human scent is defined as the most abundant VOCs that are identified in the headspace of a collected scent sample. The VOCs that constitute human odor have been shown to be qualitatively similar among individuals. However, the quantitative abundances of individual VOCs and their relative ratios make them characteristic to the individual from whom they are derived. The study of human scent is of substantial interest to the medical and forensic science communities. In the medical community, the VOCs released by the human body can be used as diagnostic tools for diseases. Previous research has identified VOCs that can serve as biomarkers for different diseases. In the forensic science community, human scent evidence is used as an investigative tool that allows for the use of human scent-detection canines in law enforcement.

The current standard for the analysis of VOCs from human scent samples is Headspace Solid Phase Microextraction (HS-SPME), followed by Gas Chromatography/Mass Spectrometry (GC/MS). HS-SPME is a fast, simple, solvent-free extraction method and is suitable for the extraction of VOCs as it reduces interferences due to the sample matrix. However, SPME is a non-exhaustive, highly selective technique and some compounds present in the sample might not be extracted. Also, the aging of the fiber from repeated use results in low reproducibility and this would be disadvantageous when quantitative measurements are required.

Therefore, the current method was developed using dynamic headspace concentration for the recovery of the VOCs from human scent samples. Similar to SPME, dynamic headspace extraction is also fast, simple, and solvent-free; however, this manner of sampling is also exhaustive, providing a more accurate representation of the sample's chemical composition. Also, as degradation of the SPME fiber is not an issue, it can exhibit higher reproducibility and better accuracy when quantitative measurements are obtained. For this work, a standard mixture of compounds that have been previously observed in human scent samples was prepared. This mixture was spiked on cotton gauze, extracted using dynamic headspace extraction, and analyzed using GC/MS. Various extraction parameters were assessed to determine the optimum conditions to ensure the best recovery of the compounds in the standard mixture. Following this, hand odor samples were collected on cotton gauze. The VOCs collected were extracted by dynamic headspace, using the optimized parameters, and analyzed by GC/MS. These results were compared to results obtained using SPME-GC/MS. The dynamic headspace method was able to extract a wider range of compounds and a lower limit of detection was achieved.

Human Scent, Dynamic Headspace, Volatile Organic Compounds

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