A38 The Optimization and Evaluation of the Headspace Analysis of Head Hair Samples for the Application as a Human Scent Source

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After attending this presentation, attendees will have been presented the most efficient methodology for the headspace analysis of head hair samples with the intention of using this matrix as an alternative source of human scent.

This presentation will impact the forensic society by demonstrating how the application of this work will be in using the specific chemical profile of volatile organic compounds emanating from the headspace of these specimens as an alternative human scent source which can differentiate the person it was collected from. There is great utility of this work due to the high frequency hairs are found within crime scenes. Currently, hairs cannot be used to identify from whom it originated from, unless there is nuclear DNA present, but it can only generally characterize the type of person it derived from. However, further investigation into the chemical odor profiles found from hair could provide a new usefulness to this type of physical evidence.

A tool of increasing applicability within the field of forensic science is human scent evidence. Human scent is defined as the most abundant volatile organic compounds (VOCs) identified in the headspace above a scent sample. It is believed that the chemical composition which constitutes human odor is a physical characteristic of the person from whom it originated, thus a new form of identification. Human scent profiles have more commonly been employed when using human scent discriminating canines for the search and rescue of missing or deceased people when implementing the idea that people leave a trail of their human scent wherever they go.

Traditionally, human hand odor is used for the analytical characterization of an individual's human scent. It is obtained when a subject places a piece of sterile gauze between their hands and clasps it for a prescribed period of time, allowing the gauze to retain the VOCs present in the hand secretions. It is then collected, separated and identified in the headspace of the collected sample by using Solid Phase Microextraction- Gas Chromatography Mass Spectrometry (SPME- GC/MS). These human scent profiles produced are reproducible and unique to the individual who provided it. However, it is of interest to the forensic community to evaluate extraction methods of additional biological sources of human scent. Thus, the present study focuses on the optimization of the headspace extraction and identification of VOCs emanating from head hairs for the use as an alternative human scent source.

Head hair is a biological sample of interest for human scent identification owing to its structure. Hair is made up of a durable protein called keratin. The crystalline keratin is extruded from the hair follicle and appears as the hair shaft that is often associated with the appearance of hair. However, the hair follicle is surrounded by sebaceous glands and apocrine glands and the scalp is also covered in eccrine sweat glands. The secretions from these three glands coat the hair and impart it with characteristic odors. Historically, hair analysis has consisted of various steps including washing, segmentation, pulverization of hair strands and traditional digestion methods which will reduce the hair into a liquid form, prior to analytical evaluation. These extraction methodologies entail a longer extraction time and an exposure of the hair to chemicals that yield to hair decomposition. The work presented here provides a novel application of Solid Phase Microextraction (SPME) for the optimal extraction of volatiles emanating from hair samples within a variable population. The study utilized SPME in combination with Gas Chromatography/Mass Spectrometry (GC/MS) for the separation and identification of the extracted hair volatiles.

Various experiments were conducted to determine the most efficient way to extract and analyze the headspace of hairs using SPME. First, it was important to determine the best way to prepare the sample, prior to analysis. There were two considerations for the type of hair used in these experiments; should the hair closest to the scalp be analyzed or should the whole hair strand be used for the characterization of volatiles present in hair. Second, it was important to deduce the most efficient way to extract the headspace from the collection vial. Thus, conditions such as sample equilibration time and headspace extraction time were determined to ensure that the compounds present within the sample were collected and detected. Present within this study are the results for the most efficient method for sample preparation, headspace extraction and analysis of hair samples using SPME-GC/MS.

Hair Analysis, Solid-Phase Microextraction (SPME), Gas Chromatography/Mass Spectrometry (GC/MS)

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