B11 Laboratory Experiments for the Optimization of Non-Contact Human Scent Sampling

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After attending this presentation, attendees will understand the importance of careful absorber material selection in the field of human scent evidence collection as well as the scientific validation and optimization of the Scent Transfer Unit (STU-100) as a viable collection medium in non-contact human sampling.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of careful selection of absorber material for scent evidence collection as well as the evaluation of the most efficient flow rate for maximum trapping capabilities of the scent sorbent material in question. Furthermore, it provides the forensic community with a scientific approach to the usefulness of the Scent Transfer Unit (STU-100) as a scent collection device for actual canine field sampling.

The increased use of human scent in criminal investigations has launched this type of evidence as a viable forensic tool to establish associations between individuals and crime scenes. Human scent discrimination by canine can be admitted into court as per the Kelly/Frye rules of evidence if the person utilizing the technique uses the correct scientific procedures and the methods used by the dog handler are reliable. Traditionally, human scent can be described as a combination of volatile compounds released from the body which are directly affected by factors such as heredity, environment, and bodily functions.

As it relates to the collection of human scent, some law enforcement agencies within the U.S. are implementing a portable device referred to as the Scent Transfer Unit (STU-100) for non-contact human scent sampling. The concept for the operation of this collection device lies in the idea that scent can be transferred from one surface to another with or without direct contact. The STU-100 uses dynamic air flow to capture human scent from the object of interest onto a sterile gauze medium. The Scent Transfer Unit allows for the ability to perform non-contact sampling using dynamic airflow and, thus, the collection of human scent from objects without contaminating or altering the object of interest. The materials and the methodology employed for scent collection have not been previously optimized or standardized within the law enforcement community. This study presents various laboratory experiments designed to optimize sample collection methods with a focus on enhancing the reliability of the Scent Transfer Unit as an instrument for collecting human scent evidence. The STU model used in this project has been modified to include a Teflon coated hood and an air flow controller. Various absorber materials of both natural and synthetic fiber composition were evaluated to optimize the flow rate speed for collecting scent samples above a standard mixture of previously reported human scent originating volatile organic compounds. The nine different airflow rates, with air flow ranges that have been determined to be 27.3 - 46.7 ft^3/min, were evaluated to establish the speed which will produce the greatest trapping efficiency of the standard mixture of compounds, which vary in functionality and include a range of molecular weights. The compounds within the standard mixture consisted mainly of five groups by functionality: alcohols, aldehydes, alkanes, acid esters, and ketones. Some of these compounds included: 2-furanmethanol, phenol, 2-furancarboxaldehyde, nonanal, decanal, 6-methyl-5-hepten-2-one, 6,10-dimethyl-5,9- undecien-2-one, octanoic acid methyl ester, and hexanedioic acid, methyl ester. The selection of the organic volatile compounds in the standard mixture was based on a previous population study investigating hand odor samples taking the highest frequency compounds detected into consideration.

Headspace solid phase micro-extraction in combination with gas chromatography / mass spectrometry (SPME-GC/MS) has been utilized as the instrumental approach for the analysis of the non-contact standard mixture airflow samples. The different absorber materials implemented in the experiments were pre-treated using a methanol-modified supercritical fluid extraction (SFE) procedure to ensure the analytical cleanliness of the collection material prior to use. The collection process consisted of placing the STU-100 device approximately 1-inch away from a 10 mL glass vial containing the standard mixture and consequently running the airflow system at varying speeds directly above the mixture for a period of 1 minute, as formulated to mirror the Federal Bureau of Investigation's Standard Operating Procedure for the collection of human scent evidence. These samples were analyzed for a period of 21 hours using a divinylbenzene/carboxen on polydimethylsiloxane SPME fiber prior to GC/MS analysis. The experiments were conducted both indoors in a laboratory environment of approximately 25°C and relative humidity of 45% as well as outdoors at an approximate temperature of 35°C and relative humidity of 90% in order to evaluate the effects of environmental contamination on the collected scent pads. The optimal flow rate was chosen based on both the presence and abundance of the compounds of interest.

Human Scent Evidence, Scent Transfer Unit (STU-100), SPME-GC/MS

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