A149 Persistence of Volatile Organic Compounds Associated With Human Decomposition on Carpet Samples

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After attending this presentation, attendees will understand the persistence of chemical residues associated with human decomposition on carpet samples, presenting the "range of detection" for the residues representing putrefied samples, including air flow as a variable.

This presentation will impact the forensic science community by informing attendees of the persistence of volatile compounds associated with human decomposition on carpet samples, giving investigators a better understanding of the presence of select compounds associated with the putrefaction stage of death after a victim's body is removed.

There are few published studies examining the process of human decomposition odor analysis. Recent research suggests that certain chemicals, such as sulfur compounds, are present in early decomposition and can become detected in smaller traces as time progresses. Research is needed to determine the persistence of these Volatile Organic Signatures (VOS) in different environments, especially when the source has been removed. Investigators could determine whether a decomposing body had been removed from a certain location, such as the trunk of a car, by taking an air sample from the location. This study proposes depositing volatile compounds associated with decomposition onto carpet samples, then using SPME to collect and analyze the persistence of these compounds over time.

The volatile compounds chosen for this study were compounds known to be released by human cadavers during the putrefaction stage of decomposition. There are several reasons as to why compounds produced during putrefaction were selected in preference of compounds produced during other stages. Volatile odor compounds cannot be detected during the fresh or autolysis stage. Even though many of the compounds are expected to exist in higher concentrations at the decaying stage rather than the putrefaction stage, the stages of decay and diagenesis can take several months to years to complete. It stands to reason that if a perpetrator had to move the victim's body, the removal would be performed during the first few months since death.

According to the Decompositional Odor Analysis Database, there are 478 separate volatile compounds associated with buried decomposition. Of those 478 compounds, 30 were found to be key substances in human decomposition in soil. Of those 30 substances, 12 are the most significant. They are carbon tetrachloride, toluene, ethane (1,1,2-trichloro-1,2,2-trifluoro), 1,4 dimethyl benzene, benzene, ethyl benzene, decanal, nonanal, hexane, benzenemethanol (alpha-alpha, dimethyl), 1,2 benzenedicarboxylic acid (diethyl ester), and undecane. Cadaverine and putrescine are two notable products associated with human decomposition; however, they have proven difficult to detect due to their low volatility.

This study proposes to adapt previously published headspace analysis method for testing materials that have been exposed to the compounds listed above.[1]

A solution was prepared containing chemicals that might be detected in an enclosed space after a putrefied body has been removed from the area. The chemicals used for analysis were: carbon tetrachloride, toluene, ethane (1,1,2-trichloro-1,2,2-trifluoro), 1,4 dimethyl benzene, benzene, ethyl benzene, decanal, nonanal, hexane, benzenemethanol (alpha-alpha, dimethyl), 1,2 benzenedicarboxylic acid (diethyl ester), and undecanal. The exact quantities of each compound in this solution will be determined following initial experiments detecting the compounds individually.

A total of 20 (2 in. x 2 in.) olefin carpet samples were placed in 20 separate Erlenmeyer flasks. An aliquot of 1mL of the chemically synthesized putrefied sample was deposited onto each carpet substrate. Air samples were taken over an eight-week period.

Ten flasks were sealed with silicone to prevent air from interfering with the samples, and placed in a dark storage area. Ten flasks remained unsealed in a chemical hood. Each week, a sample from both conditions was collected using headspace-SPME. Once removed from the hood, the unsealed flask was sealed to allow for the headspace sample collection.

The extraction method involved the placement of sorbent material (SPME fiber) into the headspace of the two flask samples. A solution containing either chlorobenzene or bromobenzene was used as an internal standard. For this study, the exposure time for each sorbent material began at 30 minutes. The SPME samples were analyzed using gas chromatography/mass spectrometry.

Reference:

1. Vass, AA, Smith RR, Thompson CV, Burnett MN, Wolf DA, Synstelien JA, Dulgerian N, Eckenrode BA. Decompositional odor analysis database. J Forensic Sci 2004;49(4):760-9.

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