B154 The Scent of Death: Analyzing the Molecules of Decomposition and Influence on Insect Succession via Solid Phase Microextraction (SPME)

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Learning Overview: After attending this presentation, attendees will develop a better understanding of thanatochemistry (or the chemistry of death), the Volatile Organic Compounds (VOCs) that are released from decaying remains, and its relationship with insect succession. Additionally, attendees will learn more about the human decomposition process and how analytical techniques were used to collect the emitted compounds.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a temporal evolution profile of the decompositional-related VOCs via the use of an easy method for detecting and quantifying the released compounds. Attendees will be provided with a correlation between insect succession and cadaveric VOCs.

Decomposition is the complex process in which chemical compounds are broken down into simpler organic or inorganic matter. The first stage of decay, or autolysis, begins the immediately after death, which causes the body to become more acidic in nature due to the build-up of carbon dioxide. As the pH changes, cells begin to lose structural integrity, resulting in cell membranes rupturing, releasing enzymes that begin eating the body from the inside out.[1] Subsequently, VOCs begin to release. Despite the fact that there has been an increased interest in researching VOCs related to decomposition, there continues to be a lack of an in-depth cadaveric VOC profile. Decompositional-related VOCs can provide scientists with vital forensic information that can aid scientists in developing a portable device used for search and recovery of victims or dead human remains in police investigations. Due to an arthropod's life cycle and predictable sequence of entomofauna succession, insects provide a valuable tool, which may be used to estimate a Postmortem Interval (PMI) range.[2] Due to the highly nutritious source that human remains provide as well as the olfactive properties associated with decomposition, insects and other arthropods can colonize a body within five minutes of death.[2] The particular order of succession between different species is dependent on the stage of decay as well as the purpose of colonization. Though it is known that certain species of insects are attracted to the VOCs released by a corpse during different stages of decay, the specific chemicals each species is picking up on is still unknown. Therefore, it is important to determine if there is a correlation between emitted VOCs, stage of decomposition, and insect succession. In this study, the VOC temporal profile of pig (Porcus) carcasses as human proxies are used to determine if there is a correlation between the presence of specific chemical compounds or mixtures and insect succession.

Stage one of the study involved collecting, identifying, and quantifying VOCs emitted from decomposing biomedical swine carcasses. Collection was conducted using a fast and easy technique that incorporated Solid Phase Microextraction (SPME) fibers and the VOCs were further analyzed using Gas Chromatography/Mass Spectrometry (GC/MS). The project focused on the examination of released compounds in a controlled, indoor environment as well as in an outdoor setting to determine whether or not insect activity conditions had any impact on the formation and distribution of the VOCs from the cadaver during the decomposition process. The data obtained was then compared to a previous study that evaluated the VOCs that were released during the outdoor decomposition process of human cadaver analogs. Differences, as well as similarities, in the compounds detected will be discussed in this presentation, as well as the impact that insects have on the release of VOCs from decomposing remains. Stage two entails preliminary studies on the relationship between released cadaveric VOCs and insect succession using fly traps. These traps contained a variety of released chemical compounds during decomposition placed for outdoor field testing in 48-hour increments to determine ecological correlation. After the allotted time period, the fly traps are collected in order to identify any trapped insects. It is predicated that there will be an association between the two factors, providing more insight into insect succession during decomposition.

Reference(s):

1. Lee Goff, M. Early Post-Mortem Changes and Stages of Decomposition in Exposed Cadavers. *Experimental & Applied Acarology* 49, no. 1–2 (October 2009): 21–36. https://doi.org/10.1007/s10493-009-9284-9.
2. Verheggen, François, Katelynn A Perrault, Rudy Caparros Megido, Lena M Dubois, Frédéric Francis, Eric Haubruge, Shari L Forbes, Jean-François Focant, and Pierre-Hugues Stefanuto. The Odor of Death: An Overview of Current Knowledge on Characterization and Applications. *BioScience* 67, no. 7 (June 7, 2017): 600–613. https://doi.org/10.1093/biosci/bix046.

Volatile Organic Compounds, Decomposition, Insect Succession