E20 Method Development and Optimization of Detection of Decomposition Products in Soil Using Headspace/Gas Chromatography/Mass Spectrometry (HS/GC/MS)

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After attending this presentation, attendees will better understand the compounds present in soil as a result of decomposition and the application of HS/GC/MS to detect and identify five decomposition products: dimethyl disulfide, heptanal, 1-hexanol, nonanal, and 1-Octen-3-ol.

This presentation will impact the forensic science community by providing additional analytical options to laboratories looking to identify human decomposition. The methods utilized in this study can be applied when searching for clandestine graves.

For years, detection of clandestine burial sites has relied on the use of Volatile Organic Compounds (VOCs); however, without specific instrumentation, detection of VOCs can be difficult. This research investigates the possibility of using HS/GC/MS to detect VOCs in a soil matrix. With little to no sample preparation, HS/GC/MS is a faster and easier method when trying to detect decomposition products. Piglets were used as a proxy for human cadavers and were obtained from the University of Pennsylvania Swine Unit in Kennett Square, PA (n=60). All pigs died of natural causes so that interactions with euthanasia drugs were avoided. The piglets were buried at four depths (0.5ft, 1.0ft, 1.5ft, and 2.0ft) in a wooded study area at 10ft horizontal intervals. Soil was sampled from around the piglets at three decomposition states (early, mid, and advanced) determined with the use of the Megyesi method and Accumulated Degree Days (ADDs).[1] ADDs were calculated from the time each piglet was buried. The target ADDs for early decomposition was 340.408. The targets for mid and advanced decomposition were 916.220 and 2387.811, respectively. All pigs were buried in an orientation with the snout pointed west and feet orientated south. At the time of burial, each piglet was given a unique identification number used to log weights and organize samples.

The five VOCs of interest in the project were dimethyl disulfide, heptanal, 1-hexanol, nonanal, and 1-Octen-3-ol. Based on previous literature research, these five compounds were found to be, in both pig and human decomposition, in higher frequencies. Since piglets were being used as a human cadaver substitute, having this crossover can relate back to the compounds that a decomposing human body will release.

Once the piglets reached the required ADDs, a 33-inch AMS® unplated soil probe was used to collect samples. A two-inch section of soil, weighing approximately 27g, was taken from the tip of the soil probe after it reached the correct depth. The depth of each sample depended on the depth the piglet was buried. For example, samples were taken horizontally from six inches below the surface for piglets buried at six inches. These soil samples were then placed in cut pieces of foil to avoid evaporation of the desired compounds. Each sample was labeled with the sample orientation (North or South of the carcass), the specimen number, and the distance from the piglet (0.5ft, 1.0ft, 1.5ft, and 2.0ft). Samples were then placed on ice for transport until they could be placed into a freezer for storage.

Samples were analyzed on an Agilent® 6890 HS/GC using a CTC Analytics® Combi Pal autosampler coupled with an Agilent® 5973 *Network* Mass Selective Detector. Approximately 1.5g of soil was placed into a headspace autosampler vial and analyzed. Aliquots were taken randomly from the collected soil samples and vortexed for approximately 30 seconds to homogenize. All compounds were successfully separated with good resolution and peak shape using the HS/GC/MS.

Reference(s):

1. Megyesi M., Nawrocki S.P., Haskell N.H. Using accumulated degree-days to estimate the postmortem interval from decomposed human remains. *J of Forensic Sci* 2005;5 (3): 618- 626.

Decomposition, HS/GC/MS, Soil

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