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Analysis of biogenic amines in grave soil and cadaver dog training aids using gas chromatography mass spectrometry

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In a forensic investigation of a missing persons or a suspected murder, finding human remains plays a vital role. Currently, the most common method to find these remains is the use of human remains detection dogs or HRD dogs. Although, these dogs can distinguish human remains from animal remains, and find human remains buried in significant depths, the scientific basis for this remarkable ability is not well understood. HRD dog's ability to detect human remains depends on the volatile organic compounds (VOCs) produced during the decomposition process. These VOCs contribute to the "smell of death" and the analysis of them is crucial to understand the differences between human and animal decomposition odor. Additionally, some HRD dogs are trained using cadaver dog training aids known as "pseudo corpse" due to the limited availability of decomposing human remains for training purposes. In some studies, these training aids are found to be less effective compared to real human remains. Although biogenic amines like putrescine and cadaverine are present in grave soil and decomposition odor, the presence of these compounds in decomposition odor is not well reported in literature. In previous work researchers have used gas chromatography mass spectrometry (GC-MS) in decomposition odor analysis. These amines often have high basicity, high polarity, and low volatility compared to other VOCs, and they tend to absorb and decompose in the GC column, sample vessels, and injection system making them hard to detect in low concentrations and difficult to analyze using GC-MS. To obviate these problems, the current work focuses on analyzing these amines by derivatizing them followed by the analysis using GCMS. Furthermore, an extraction method is developed to extract amines from soil samples. Three derivatization agents trifluoroacytalacetone (FAA), pentafluoroproponic anhydride (PFPA) and, isobutyl chloroformate (IBCF) were investigated and IBCF showed promising results. This method was used to analyze grave soil samples collected near to a partially decomposed human body and a relatively fresh human body and three commercially available cadaver dog training aids. Cadaverine and putrescine were present in one of the cadaver dog training aids at concentrations of 780. ± 6 mg/mL and 1440. ± 6 mg/mL respectively. Only cadaverine was present in the second training aid at a concentration of 426 ± 6 mg/mL. One training aid did not contain any amines in detectable levels. Soil obtained near the partially decomposed corpse showed a slightly elevated amount of cadaverine at a concentration of 37 ± 1 mg/g compared to the body that was recently placed which contained 31 ± 1 mg/g of cadaverine. Future work of this research involves the analysis of amines in grave soil during different stages of decomposition.

Keywords: Decomposition odor, derivatization of amines, cadaver dog training aids, biogenic amines