H114 Inter-Individual Variation in Soil Chemistry and Microbial Ecology During Human Decomposition

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Learning Overview: After attending this presentation, attendees will understand how cadaver-related factors influence chemical and microbial patterns in decomposition-impacted soil. This presentation will increase attendees' knowledge of human decomposition processes, including differential decomposition resulting from human variability, particularly as it relates to the soil environment.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by furthering the knowledge of cadaver-related factors (intrinsic factors), such as weight and health conditions, that influence soil chemical and biotic decomposition patterns.

Human decomposition is a dynamic process, and decomposition rate and soil chemical/ecological patterns are driven by a series of decomposer organisms, notably insects and microorganisms.[1,2] Prior studies demonstrate that extrinsic factors (e.g., temperature) influence decomposer activity; however, the effects of intrinsic factors (e.g., decedent body mass, disease status) on decomposer patterns have not been explored.[3] Decomposer activity and rate of decomposition differs between individuals experiencing the same environmental conditions, suggesting that intrinsic factors are responsible for the degree of individual variation.[4] Thus, the purpose of this research was to probe the effects of intrinsic factors on soil chemical and microbial decomposer responses to human decomposition.

Nineteen deceased human individuals were placed supine on the soil surface at the Anthropological Research Facility at the University of Tennessee (February 2019–March 2020) and allowed to decompose naturally. Prior to placement, each individuals' medical information (height, weight, etc.) and medical histories were recorded. Soil samples were taken at predetermined Accumulated Degree Hour (ADH) intervals until the end of active decomposition (here defined by cessation of decomposition fluid purging from the abdomen). Each soil sample was homogenized and hand-picked to remove debris (e.g., roots and insect larvae) larger than 2mm prior to analyses. To understand soil chemical patterns, soil pH and Electrical Conductivity (EC) were measured. Soil microbial activity was assessed via heterotrophic respiration and extracellular enzyme assays. Co-extracted bacterial and fungal DNA was quantified, and community composition was examined using 16S ribosomal RNA (rRNA) gene and Internal Transcribed Spacer (ITS) amplicon sequencing, respectively.[5-7]

Preliminary results indicate that an individual's end-of-life condition impacts soil chemistry and microbial ecology. While soil pH, EC, and heterotrophic respiration generally increased during active decomposition, change in EC over time exhibited greater reduction in individuals with respiratory illnesses than those without (Wilcoxon $p = 0.018$). Principal component analysis shows that soil chemical profiles do not cluster by environmental factors, such as season or location; instead, other factor(s) are likely driving variation between individuals. Soil microbial communities changed over time and varied among individuals, based on end-of-life condition. For example, individuals with cancer had lower richness estimates and distinct community composition (Permutational Multivariate Analysis Of Variance [PERMANOVA], $p<0.01$) compared to those without cancer.

This study provides evidence that intrinsic variability between donors originating from different end-of-life conditions influences chemical and microbial patterns in decomposition-impacted soil. These results have considerable implications for the construction of microbial-based postmortem Interval (PMI) models as well as assessing error rates within those models.[8]

Reference(s):

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4. Angela Dautartas et al. Differential Decomposition among Pig, Rabbit, and Human Remains. *Journal of Forensic Sciences* 63, no. 6 (Nov 2018): 1673-83.
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7. Melissa A. Cregger et al. The Populus Holobiont: Dissecting the Effects of Plant Niches and Genotype on the Microbiome. *Microbiome* 6, no. 1 (Feb 2018): 31.
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Differential Decomposition, Microbial Ecology, Soil Chemistry