B198 Forensic Analysis of the Soil Microbiome: Linking a Piece of Evidence to a Location

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Learning Overview: The goal of this presentation is to share an interesting case where a soil microbiome (community of microorganisms) was used to assist law enforcement in identifying a probable location visited by a murder suspect.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by showing how soil microbiome analysis, a trending area of biological research, may be able to provide a new investigative tool to law enforcement by associating a piece of evidence with a particular location.

Advancements in DNA sequencing technologies have allowed scientists to learn about the diverse population of microorganisms that inhabit the human body and the world around us. Understanding microbiome diversity has become increasingly important in a wide range of research from human health to bioremediation. In forensics, changes in the microbiome upon mammalian death has already been analyzed in many studies and can be used to accurately estimate the time of death. Different soils harbor their own community of microorganisms that vary based on many factors, including location. This inherent variation may be useful for forensic purposes.

In 2017, the Flagstaff Police Department requested assistance in locating a missing woman. A suspect in the case was in custody and a sock believed to have been worn by this individual was in the possession of the police department. Importantly, police suspected that the corresponding shoe had been lost between the time the woman went missing and the eventual arrest. Police hoped an analysis of the sock might indicate a possible location of the missing woman. During discussions about whether this type of analysis was possible, the body of the missing woman was recovered. Nevertheless, an analysis of the sock was completed to show proof of concept with the hope that the results could be useful for future investigations.

DNA was extracted from the sock and from soil collected at a variety of locations around Arizona. Two methods were used to extract DNA from the sock. The first was to extract DNA from a cutting of the sock itself. The second method was to swab the exterior of the sock with a moistened cotton swab and then extract from the swab. The latter method was found to contain less human-associated bacteria and was therefore determined to be the better method for obtaining the soil bacterial community. A highly variable portion of the 16S gene found in microbes was amplified and sequenced. The resulting 16S sequences were analyzed using Qiime™ 2, a microbiome bioinformatics tool. The microbial community composition from the sock samples were compared to that of the soil collected at locations that the suspect visited. The soil samples from different locations were varied in their microbial composition and abundance, and the microbial community composition of the sock was most like a single location. Therefore, the authors were able to narrow down the options of where the soil on the sock had originated, given a known set of possible locations. The results indicate that a piece of evidence may be linked to a general location and microbial community analysis could be used as an investigative tool for law enforcement.

Microbiome, Soil, Qiime™ 2