Assessment of the link between evidence and crime scene through soil bacterial and fungal microbiome : A mock case in forensic study

INTRODUCTION

Forensic investigations in homicide cases can make it difficult to determine if the suspect or suspects are killers. Because of their great adhesion to things, earth traces can give useful evidence in forensic investigations by indicating the origin of a sample or the link between a crime scene and a suspect. Soil evidence is one of the most effective methods for determining criminal cases, particularly in wealthy nations. According to a study on soil DNA sequencing, soil type significantly affects the topologies of microbiome communities, suggesting that soil microbial identification can be improved for forensic purposes.

AIM OF THE STUDY:

The purpose was to evaluate the viability of employing the soil's various bacterial and fungal microbiomes as admissible evidence in homicide cases. In this example, a forensic murder scenario was used to evaluate the microbiome diversity and fungal areas of soil evidence, as well as the analytical parallels between bioinformatics research and evidence.

MATERIALS & METHODS

- The murder case explored the use of soil microbial structures as evidence.
- The analysis of the crime scene and the corpse revealed that the murder did not occur in the location where the body was discovered.
- In June 2020, 12 soil samples were obtained from Turkey's Marmara area, with an average yearly precipitation of 79.8 mm and a temperature of 22 °C.
- The murder scenario was represented by two individuals, one as the victim and the other as the offender.
- Samples of the top layer of soil (0–2 cm) were obtained and placed in sanitized plastic falcon tubes. After that, the samples were brought to the laboratory.
- After collection, all samples were stored at 4°C until DNA was extracted, which happened within a day.
- Every 0.25 g of soil was used to isolate soil DNA.
- To prevent contamination, the crime scene, control samples, and evidence were removed independently.

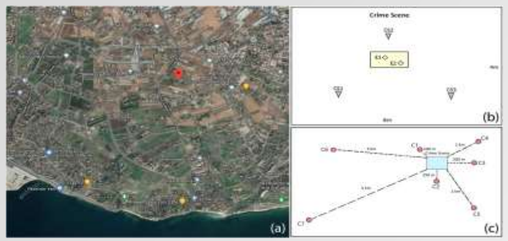

Fig. 1. Mock homicide case crime scene satellite map

STATISTICAL ANALYSIS AND RESULTS

- Raw data was gathered. Before cutting the barcode and primer sequences, samples were assigned paired-end readings based on their unique barcodes.
- The ribosomal Database Project classifier was used to taxonomically classify representative sequences that were selected for every OTU.
- To assess differences in species complexity among samples, beta diversity was estimated using PCoA analysis (based on unweighted UniFrac distance). QIIME 2 was used to do cluster analysis.
- The typical and unique OTU counts in the evidence, crime scene, and control samples were totaled using a Venn diagram.
- The Wilcoxon test was employed to make pairwise taxonomic comparisons between sample groups.

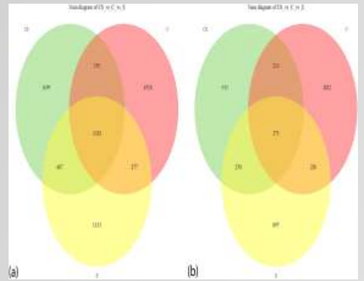

Fig. 2. Venn diagram of the bacterial (a) and fungal (b) community OTU diversity of sample groups.

- Results point to the difficulty in separating crime scene and evidence samples from controls at the phylum and class levels, although differentiation is possible at the genus and species levels.
- PCoA results revealed that the distance between evidence samples and reference samples were less than that of non-crime scene control samples.
- Bacterial and particularly, fungus DNA in soil has the potential to significantly help the resolution of forensic cases.

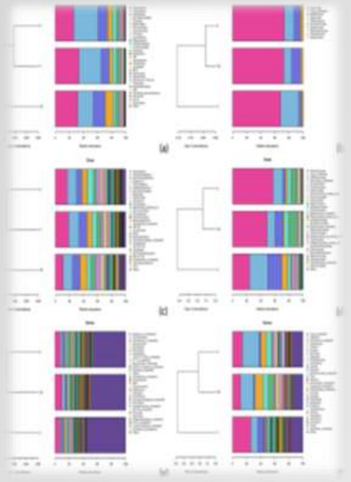

Fig 3. Cluster analysis diagrams

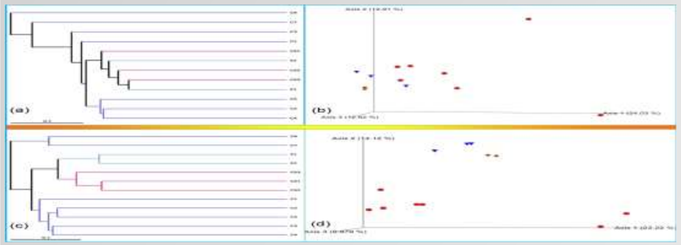

Fig.4 PCoA analysis of bacterial (a), (b) and fungal (c), (d).

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SIGNIFICANCE

This study lays the groundwork for the use of soil bacterial and fungal microbiomes in forensic investigations, introducing a novel and effective tool for correlating evidence to crime scenes with high reliability and accuracy. The study's findings may have implications in court proceedings. The capacity to objectively correlate evidence to a specific site offers support for a suspect's case.

DISCUSSION

- In the study regions were examined combined, and the effectiveness of metabarcoding techniques in resolving real-life forensic cases was investigated
- The findings show that certain soil types and places have a different microbial profile, lending to the idea that soil microbiomes might act as a unique fingerprint for forensic investigations.
- OTU counts from the crime scene and control samples indicated that the victim was present at the crime site. The research was conducted to examine the amount of relationship between evidence samples and control samples at various distances.
- The findings of this study have important consequences for forensic practice. This is especially beneficial in situations where standard approaches may fail, such as when evidence has been relocated or there are many crime sites.

CONCLUSION

This study shows that bacterial and fungal DNA can help forensic experts identify soil samples and establish a link between a case and the crime scene. Future studies might examine larger and more diverse sample sets, other types of crime scenes, and environmental changes to validate and expand on these findings.

REFERENCE

Karadayı, S., 2021. Assessment of the link between evidence and crime scene through soil bacterial and fungal microbiome: A mock case in forensic study. *Forensic Science International*, *329*, p.111060.