USING FORENSIC MICROBIOLOGY TO LINK VEHICLES AND THEIR COMPONENTS

Madalena **Antunes**[1], Paulo Mascarenhas[2], Zoé Vaz da Silva[2], Madalena Salema Oom[2]

[1] Egas Moniz School of Health & Science, Campus Universitário, Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal.

[2] Egas Moniz Center for Interdisciplinary Research (CiiEM); Egas Moniz School of Health & Science, Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal

ABSTRACT

Conventional forensic techniques for identifying vehicles primarily involve analysing traces, fingerprints or DNA[1]. However, microbial communities in vehicle-associated dust are emerging as valuable forensic markers[2,4]. The surfaces of vehicle parts, such as side mirrors and rims, accumulate environmental debris that can provide information about a vehicle's history or the connections between its parts[2,3]. This approach is particularly useful in hit-and-run cases, where fragments may be left behind at the scene[4,5]. This pilot study will assess the feasibility of identifying vehicle parts by analysing fungal communities in dust samples. Samples will be collected from three exterior sites (grille, wheel and side mirror) and three interior sites (carpet, steering wheel and upholstery) of various vehicles using sterile swabs. After inoculation in a medium selective for fungi, the isolated colonies will be examined microscopically for morphological identification and validated by DNA sequencing where necessary. Statistical analysis will then be used to assess the associations between the microbial profiles. This study aims to demonstrate the potential of forensic mycology as an additional tool for vehicle tracking, crime scene investigation, and environmental tracing, particularly when conventional evidence is limited.

AIM

Association between external parts of the same vehicle

Association between interior and exterior parts of the same vehicle

CONCLUSION

The bar graphs show that genra *Cladosporium* shows a high frequency on both surface types (interior/exterior) and on all models.

On the other hand, genra *Penicillium* and *Rhizopus* are point markers - present only on a few cars, which increases their potential forensic value when detected.

The frequency per car reinforces that *Rhotodorula* and *Cladosporium* are strong candidates for origin markers, while *Fusarium* works as an absence marker. It is important to emphasise that these results are provisional, as they will be confirmed by DNA analysis.

SAMPLES

The sample will consist of three vehicles, from which dust will be collected from six different locations.

Exterior

Interior

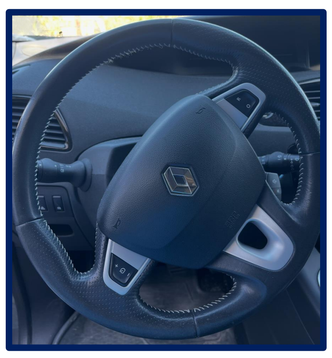
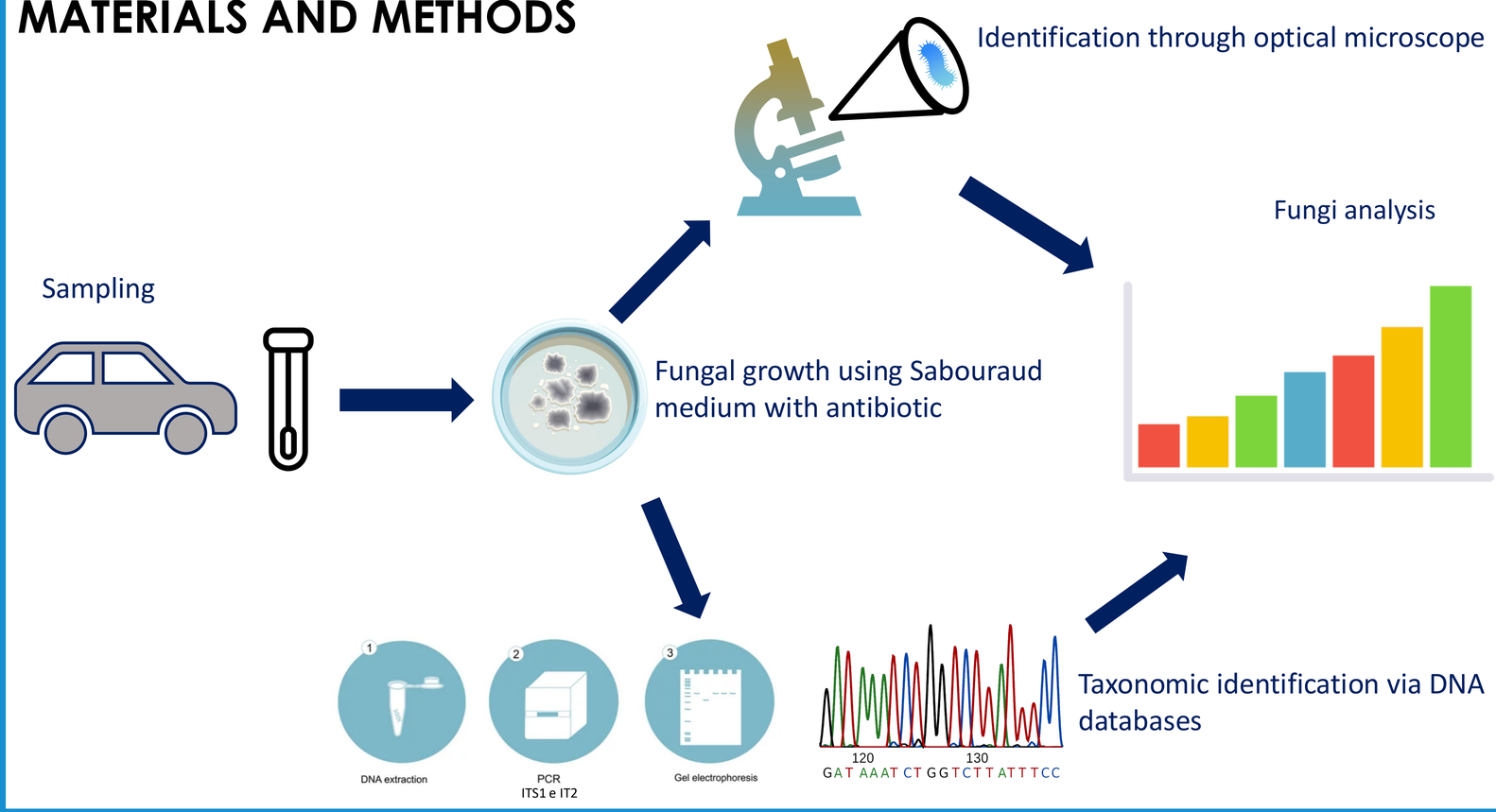


Figure 1. Photographs of the six collection sites for each vehicle, divided into exterior sites (from left to right: wheel, rear-view mirror and front grille) and interior sites (from left to right: steering wheel, carpet and upholstery).

MATERIALS AND METHODS



RESULTS

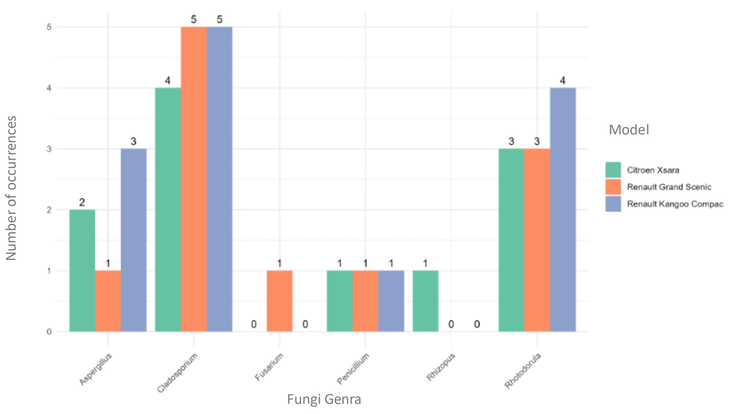


Figure 2. Frequency of fungi by vehicle model.

The second graph, presented on figure 2, is also a grouped bar chart showing the frequency of the same genera, organised by vehicle model. This analysis enables possible associations between certain fungi and specific models to be identified.

The first graph, on figure 3, is a grouped bar chart showing the frequency of fungal genera according to surface type, distinguishing between the interior and exterior of vehicles. This representation enables the distribution of fungi to be assessed according to the location of the sampling.

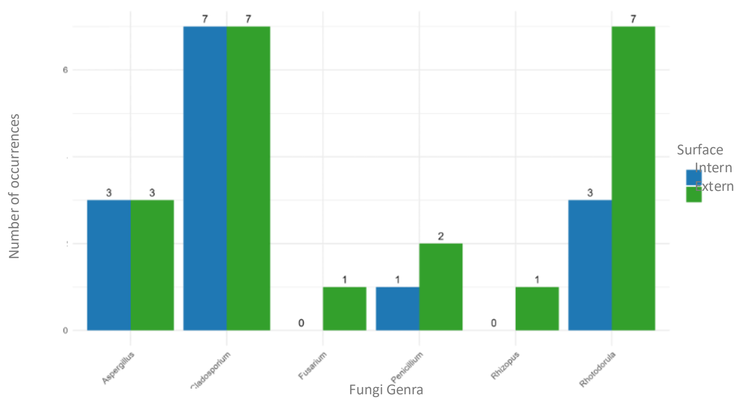


Figure 3. Frequency of fungi per surface.

References:

1. Tambuzzi, S., Maciocco, F., Gentile, G., Boracchi, M., Bailo, P., Marchesi, M., & Zoja, R. (2023). Applications of microbiology to different forensic scenarios– A narrative review. In *Journal of Forensic and Legal Medicine* (Vol. 98). Churchill Livingstone. https://doi.org/10.1016/j.jflm.2023.102560
2. Giampaoli, S., Alessandrini, F., Frajese, G. V., Guglielmi, G., Tagliabracci, A., & Berti, A. (2018). Environmental microbiology: Perspectives for legal and occupational medicine. In *Legal Medicine* (Vol. 35, pp. 34–43). Elsevier B.V. https://doi.org/10.1016/j.legalmed.2018.09.014
3. Helen Adekanmbi, O., Temitayo Ogundipe, O., & John Walter, O. (2021). Pollen: A silent witness in forensic investigations of crime. *Journal of Scientific Research & Development*, *20*(1), 90–103. http://jsrd.unilag.edu.ng/index.php/jsrd
4. Buitrago, N. D., Savdie, J., Almeida, S. M., & Verde, S. C. (2021). Factors affecting the exposure to physicochemical and microbiological pollutants in vehicle cabins while commuting in Lisbon. *Environmental Pollution*, *270*. https://doi.org/10.1016/j.envpol.2020.116062
5. Morgan, R. M., Flynn, J., Sena, V., & Bull, P. A. (2014). Experimental forensic studies of the preservation of pollen in vehicle fires. *Science and Justice*, *54*(2), 141–145. https://doi.org/10.1016/j.scijus.2013.04.001