An end-to-end optimized procedure to study the DNA of airborne organisms

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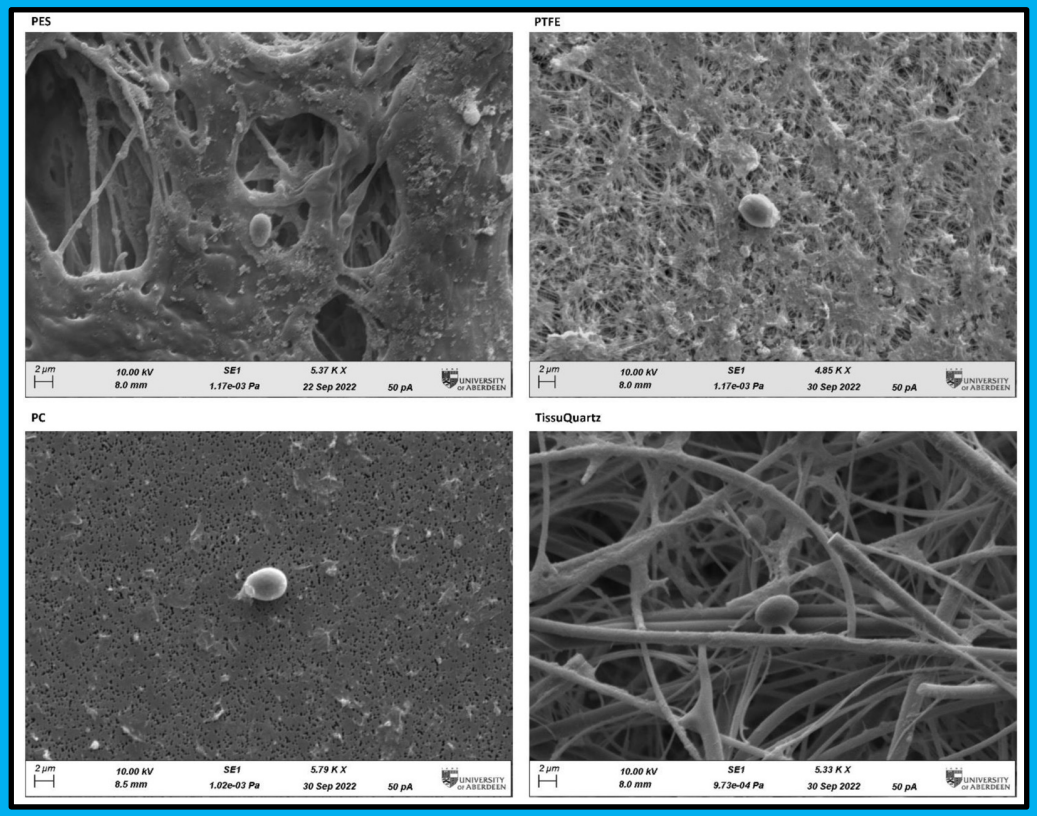

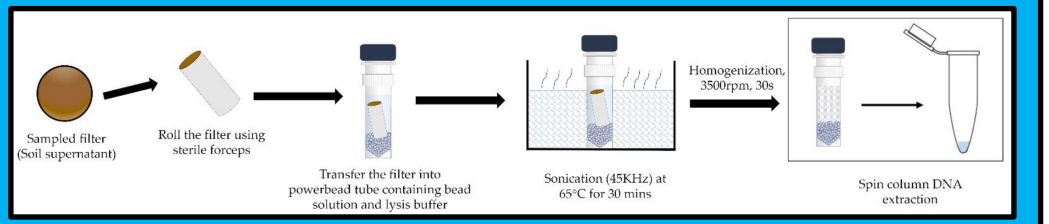

The atmosphere of a planet like Mars or Earth can transport and disperse aerosols including, in the case of Earth, particles of biological nature, such as living organisms that can proliferate elsewhere.

The amount of microbial biomass in suspension in the air is so low that it is extremely difficult to monitor and study these communities. Real-time genomic studies can provide a sensitive and rapid method to monitor changes in the composition of bioaerosols. However, the low abundance of deoxyribose nucleic acid (DNA) and proteins in the atmosphere, which is of the order of the contamination produced by operators and instruments, poses a challenge for the sampling process and the analyte extraction.

In this study, we designed an optimized, portable, closed bioaerosol sampler based on membrane filters using commercial off-the-shelf components, demonstrating its end-to-end operation. This sampler can run autonomously outdoors for a prolonged time, capturing ambient bioaerosols and avoiding user contamination. We first performed a comparative analysis in a controlled environment to select the optimal active membrane filter based on its ability to capture and extract DNA. We have designed a bioaerosol chamber for this purpose and tested three commercial DNA extraction kits. The bioaerosol sampler was tested outdoors in a representative environment and run for 24 h at 150 L/min. **Our optimized methodology can recover up to 4 ng of DNA during 24 hours of sampling close to the planetary surface**, which is sufficient for genomic applications.

This methodology is of interest for aerobiological studies on Earth, but also for space applications as a planetary protection control measure, to monitor bioburden in clean room facilities, and to study the microbiome of closed and space-adapted human habitats.

"An Optimized Active Sampling Procedure for Aerobiological DNA Studies"
J. Basapathi Raghavendra,T. Mathanlal, **M.-P, Zorzano** and J. Martin-Torres. Sensors 2023, 23(5), 2836; https://doi.org/10.3390/s23052836