Coupling Next-Generation Sequencing with culture-dependent techniques in assessing the bioaerosol load in the Historical Museum of Crete (Greece)

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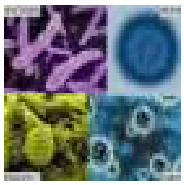
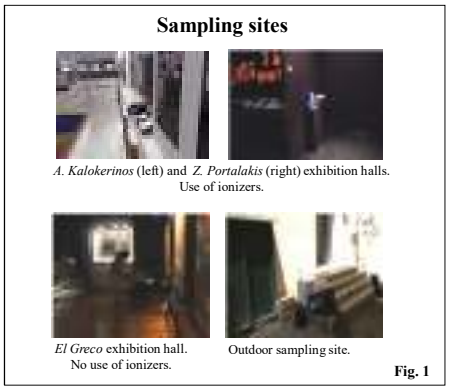


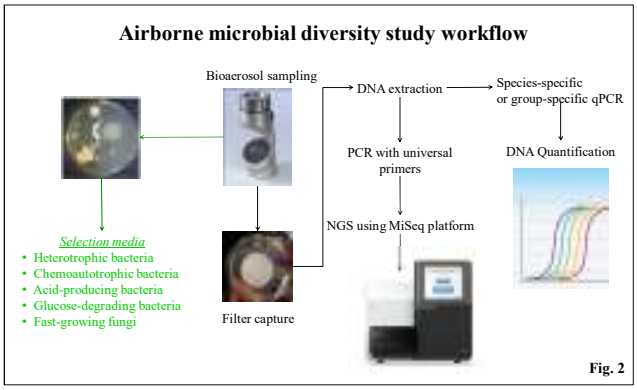
INTRODUCTION

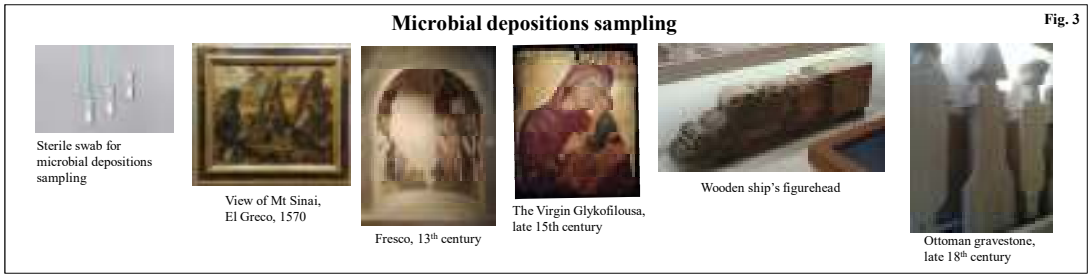
Bioaerosols are natural particles of biological origin suspended in the air and may consist of bacteria, fungi, viruses, microbial toxins, pollen, plant fibers etc. While size of bioaerosol particles varies from below 1 μm to 100 μm in aerodynamic diameter, viable bioaerosol particles can be suspended in the air as single cells or aggregates of microorganisms as small as 1–10 μm in size. The deposition and subsequent colonization of airborne microbes on surfaces is another aspect of microbial contamination of indoor environments. Therefore, the microbial signature of indoor air in human-occupied environments exhibiting artifacts of cultural heritage, like museums, is of major importance not only for its public health implications, but also as a causative agent of artifacts biodeterioration. In this study, we employ a combined approach of both molecular tools and classic cultivation approaches for qualitative and quantitative determination of the microbial load in the Historical Museum of Crete located in Heraklion, Greece.

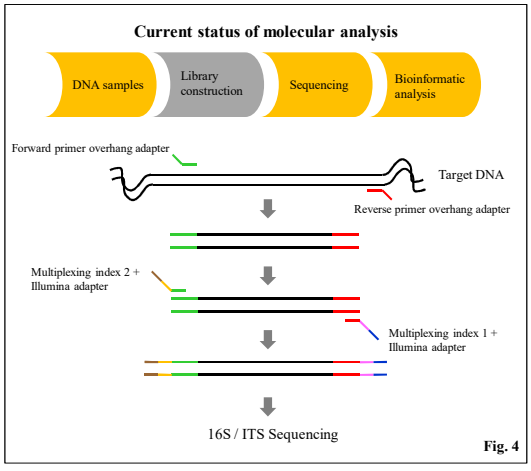
SAMPLING SITES AND METHODOLOGY

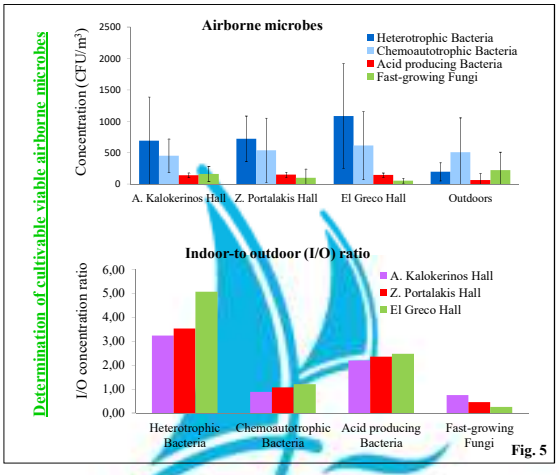
Airborne microorganisms sampling was performed on eleven independent dates spanning summer and autumn of years 2018 and 2019 in the Historical Museum of Crete (Heraklion, Greece). Three different exhibition halls and one spot in the outdoor environment were selected for the campaigns (**Fig. 1**). Photocatalytic ionizers were used as precautionary measures against airborne microorganisms in two of the exhibition halls (*A. Kalokerinos* and *Z. Portalakis* hall). Bioaerosol sampling was performed using the MAS-100 NT microbial air sampler (Merck Millipore). Biological material was collected either on different microbiological growth media for cultivation of viable airborne microbes (Lazaridis et al., 2015 & 2018) or on sterile filters for subsequent DNA extraction – work in progress (**Fig. 2**). Microbial deposition sampling was performed using sterile pre-wet swabs (**Fig. 3**). Surfaces of works of art (100 cm^2 each) of different materials were scanned using the swab and the collected material was subjected to subsequent DNA extraction for molecular analysis.











RESULTS – CONCLUSIONS

- Airborne viable cultivable bacteria presented higher concentrations indoors than outdoors (**Fig. 5**).
- Airborne fast-growing fungi were not enriched indoors and exhibited higher concentrations outdoors.
- Exhibition halls without air purifiers (*El Greco* room) showed Indoor-to-Outdoor ratio (I/O) 1.5 times higher for opportunistic pathogenic heterotrophic bacteria (**Fig. 5**).
- The photocatalytic ionizers showed higher efficiency for airborne opportunistic pathogenic heterotrophic bacteria whereas chemoautotrophic bacteria and acid-producing bacteria that can be particularly biodeteriorating museum items, were not removed efficiently.
- NGS fingerprinting and qPCR are expected to provide a deeper understanding on the microbial taxa present both as airborne microorganisms and as potentially biodeteriorating depositions.

References

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