Protocol Optimization on Bioaerosols Analysis in Tropical Buildings

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Introduction

Bioaerosols refer to the airborne particles that contain living organisms or were released from living organisms (e.g., fungi, bacteria or viruses...etc). They are of concern due to their potential impacts on human health and productivity.

Bioaerosols are typically abundant in tropical urban environment because of the warm and humid climates. The major sources of indoor bioaerosols include human occupants, indoor dust, organic waste, and the ventilation system. As more than 95% of local office buildings are air-conditioned, the ventilation system might served as an important reservoir for biological aerosol in the indoor environment.

Current Issues and Objectives

The main problem currently faced in bioaerosols studies is the lack of reliable protocols for both qualitative and quantitative examinations. The bioaerosols concentrations are typically very low, while most of the current analysis methods are designed for liquid based sampling which have considerably higher concentration compared to air samples.

The current work aims to compare, analyze and further optimize various bioaerosols analysis methods in order to develop a solid and reliable protocol for further evaluation of healthy indoor environment.

This tool is essential for creating the fundamental knowledge in the relationship between building operation, indoor environmental quality, indoor microbial community, human activities, human health and productivity. It helps to identify the source populations and provide information on the processes that suspend and disseminate microbes and microbial products in indoor environment.

Methodology Overview

Sample Pre-Treatment:
- Bead beating process
- Filter cutting/segmentation
- Other concentration method

DNA Extraction & Purification:
- MagNa Compactor (Automated DNA extraction)
- Isolation Kits (manual DNA extraction with some cell lysis buffer solutions)

Quantification & Speciation:
- qPCR (DNA based quantification approach)
- Gene sequencing (identify species for health assessment and mitigation)

Bioaerosol Sampling:
- Filter based sampling
- Culture based sampling
- Other possible approaches

Bioaerosol Existence Check:
- Culture Incubation in 30°C & 37°C
- Filter Staining & Microscopic Image

DNA Extraction and Bioaerosols Quantification

DNA extraction is done by using quantitative polymerase chain reaction (qPCR) which amplifies the targeted DNA strands by temperature cycles.

The preliminary results showed the inhibiting effects from the environmental samples, indicating the needs for optimizing sample pre-treatment process as well as DNA purification & extraction methods.

Future Plans

- Further optimizing various parameters in the detection protocols including filter materials, extraction methods, DNA isolation and purification approaches, and PCR amplification processes, etc.
- Develop capability for bioaerosol speciation