SAMPLING EFFICIENCY COMPARISON OF FOUR BIOAEROSOL SAMPLERS AND TWO PARTICLE COUNTERS

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The bioaerosol sampler chosen by researchers for an experiment is often based on familiarity and availability. However, amongst the most popular general purpose samplers, is one more appropriate than the others for different sampling conditions? This project aims to examine 6 common samplers, in terms of their efficiency for detecting the total concentration and size distribution of airborne bacterium.

All experiments were carried out in a mechanically ventilated, class 2 aerobiological test chamber. The chamber has a volume of 32 m^3 (4.20 m x 3.36 m x 2.26 m) with a 7.6 m^3 ante-room between the chamber and the laboratory. The temperature, humidity, ventilation rate and ventilation regime within the chamber were externally controlled. Background samples were taken with each sampler. Then a known concentration of either *Staphylococcus aureus* or *Bacillus Subitilis* was continually introduced into the centre of the chamber via a six-jet Collision Nebuliser (CN 25, BGI Inc, USA) at a flow rate of 8 L m^{-1} and a pressure of 12 psi. Once steady state conditions were achieved within the chamber, a second set of samples were taken with each sampler. The particle counters used included an Aerodymanic Particle Sizer (APS) Spectrometer and a Geo-α Handheld Laser Particle Counter. The biosamplers used include: a single- and a six-stage Andersen Cascade Impactor, an SKC BioSampler® Impinger and an All Glass Impinger (AGI 30).

	Aerodynamic Particle Sizer Spectrometer (Model 3321)	**Geo-α Handheld Laser Particle Counter (Model 3886)**	**Single Stage Viable (Microbial) Impactor**	**Six Stage Viable Cascade Impactor**	**BioSampler® Swirling Aerosol Collector (SKC Impinger)**	**All Glass Impinger (AGI 30)**
Manufacturer	TSI Inc.	Kanomax Japan Inc.	Various	Various	SKC Inc.	Ace Glass Co.
Operating Principle	Particle spectrometer	Particle spectrometer	Inertial impaction	Inertial impaction	Liquid impingement	Liquid impingement
Size Range	0.5 - 20 µm	0.3- 5.0 µm	0.65 – 1 µm	0.65 - 7.0+ µm	D_{50}: 0.30 µm	D_{50}: 0.30 µm
Size Resolution	52 channels	5 channels	1 stage	6 stages	n/a	n/a
Time Resolution	1 s - 18 hrs	1 s - 99 mins	Typically a few - 30 mins	Typically a few - 30 mins	Typically 0.5 – 4 hrs	Typically 10 – 30 mins
Flow Rate	1.0 ± 0.2 L/min	2.83 L/min	28.3 L/min	28.3 L/min	12.5 L/min	12.5 L/min

Table 1. Summary of sampler specifications

The particle counters were located within the chamber near the ventilation extract and connected to a laptop in the ante-room to facilitate continuous monitoring of the chamber air. They were continuously counting and sizing the airborne particles within the chamber before, during and after the nebulisation of the bacterium. The bioaerosol samplers were located in the ante-room and sequentially sampled the chamber air through a tube located at the ventilation extract. Each piece of equipment was operated according the manufacturer's instructions.

The results for this study are yet to be analysed but comparisons will be made between each piece of sampling equipment, in terms of the total concentrations and the size distributions of airborne bioaerosols detected (as appropriate). The impact of sampler operating principle will be deliberated. The influences of ventilation rate and airborne bioaerosol concentration on the collection efficiency of each sampler will also be discussed. Finally, sampler repeatability and reliability will be examined.

Based on the results obtained in these experiments, recommendations will be made on the appropriate choice of bioaerosol sampler, for a range of sampling conditions. Furthermore, the experimental and environmental conditions which are necessary to achieve repeatable and reliable results will be determined. This will facilitate researchers in making informed decisions on their choice of biological sampler, hence generating more accurate studies in the field of aerosol science.

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