A new bioaerosol chamber for validation of bioaerosol samplers

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The aim of the project was to develop a bioaerosol chamber to enable a biological calibration of bioaerosol sampling devices. This is a pressing matter, as exposure to bioaerosols can cause serious health problems but results from measurements can differ up to several hundred percent (BDB 2007). At the moment there is no standardized biological calibration for sampling devices.

To provide the means for biological validation the dynamic bioaerosol chamber CCB 3000 with a laminar airflow was constructed. Physical validation was performed with test dust to confirm the even distribution of aerosols within the chamber (Konlechner et al., 2013). Four measuring points with low variation in particle concentration were selected for the biological validation.

To confirm the survival of microorganisms and their homologous distribution within the chamber, five control points (CP) were established to follow particles from the original material (suspension, solid matter) to the sampling (see table 1). For all tests suspensions of *Trichoderma longibrachiatum* were nebulized with a Liquid Sparkling Aerosolgenerator (CH Technologies).

For CP1 the germination rate was calculated by the ratio of viable counts (cfu on RCS-T media) to total counts (Neubauer improved chamber). Medium germination rates for *T. longibrachiatum* were 51%. For CP2 and CP3 the bioaerosol leaving the nebulizer was trapped in 0.01% Tween 20 and viable and total counts were determined as for CP1. The efficiency of the aerosol generation was in the assumed range matching the tests of Mainelis (2005). The effects of the nebulizer on the viability of spores were insignificant with a reduction < 2% of the germination rate.

To verify CP4 and CP5, particles in the chamber were counted with a ParticleScan CR (INCEN AG) and collected with the bioaerosol sampling device MAS-100 NT (Merck Millipore Corp.). Particle concentration in the chamber was in the expected range indicating complete particle transfer from the nebulizer to the chamber. Viable spore counts after bioaerosol sampling were approximately 50% of the maximum rate. This reduction is a combined effect of loss of viability after release from CP3, sampling efficiency of the sampling device and loss of viability due to sampling.

Table 1. Validation control points (CP)

CP1	Total and viable count of microorganisms in the original material (= % germination rate)
CP2	Aerosolization efficiency of nebulizer
CP3	Viability loss due to nebulizer
CP4	Efficiency of particle transfer from nebulizer to bioaerosol chamber
CP5	Collecting efficiency of bioaerosol samplers

After ensuring constant bioaerosol production and even distribution of spores in the bioaerosol chamber, different bioaerosol measurement devices where compared to each other, following the sampling procedures of filtration, impaction, impingement and cyclonic separation. Figure 1 shows the results for tests with *T. longibrachiatum*. Results (CFU) of each bioaerosol sampler were compared to a reference device, the MAS-100 NT. Similar experiments were conducted with bioaerosols made of gram$^+$ or gram$^-$ bacteria, yeast and phage λ.

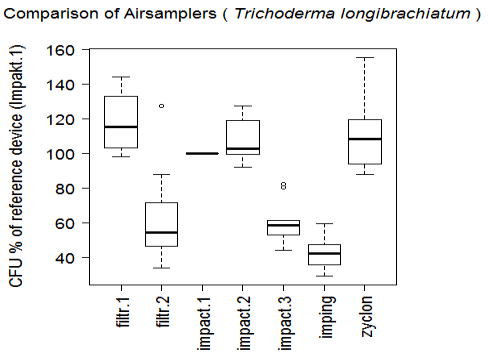

Figure 1. Efficiency of bioaerosol measuring devices to collect *T. longibrachiatum*.
Methods: **filtra**tion; **impact**ion; **imping**ement; **zyclon**

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