Collection of House Dust Aerosols Complemented with Common Allergen Proteins: Comparison of Sampler Efficiencies with MARIA™ Allergen Assay

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Introduction

AlburtyLab personnel conducted aerosol comparative challenge testing for the InnovaPrep ACD-200 Bobcat Aerosol Collector for collection of allergens and bacteria. The work was intended to give InnovaPrep LLC updated performance data on their sampler.

The ACD-200 Bobcat Aerosol Collector is a commercially available portable lightweight dry filter air sampler with a unique wet-elution system. Ideally suited for the collection of bioaerosols and particulate matter; including submicron sized particles and airborne molecular contamination. The rapid 5-sec filter elution system effectively flushes particulate matter from the filter into a 6 to 7 mL liquid sample ready for rapid analytical methods.

Bobcat Sample Collection and Handling Procedures

The InnovaPrep dry filter collector system consists of a self-contained medium volume, high efficiency aerosol collector which includes a replaceable dry electret filter and a simple to operate electret filter biological sample elutor. The aerosol collector is battery operated and will draw ambient sample air at a controlled flow rate of up to 200 liters per minute, dependent on the selected setting. The collector incorporates a dry electret filter as the collection media.

Deployed, Inlet open

5-Second Dry Filter Elution Kit

Following aerosol collection, the filter is removed from the collector, capped on one side and snapped onto the sample cup. The assembly was then transported to the lab bench for foam elution. To extract the captured particles from the filter, a can containing the elution foam is simply pressed to a fitting on the elutor cap.

The elution can is designed to hold a volume of carbonated extraction fluid at pressures up to 300 PSI. The elution can is equipped with a push valve fitting that opens when it is pressed into the fitting on the elutor cap. The elutor cap will fit directly onto the filter housing used in the collector module. It is designed to direct the wet foam from the elution can evenly through the filter. The wet foam passes through the interstitial spaces of the flat electret filter to efficiently extract any particles.

Testing Scheme

The aerosol testing was conducted at AlburtyLab's downtown engineering laboratory located in Drexel, Missouri.

House dust samples that had been complemented with allergen proteins by Indoor Biotechnologies were disseminated into the aerosol test chamber (ATC) using a dry dissemination system developed at AlburtyLab, referred to as a Tapper.

(a) (b)

Tapper—Dry Powder Disseminator
(a) Close-up (b) Location relative to test chamber

Medical nebulizers were used to introduce the liquid suspensions of *Bacillus atrophaeus* into the ATC.

During the allergen protein tests the samples were collected and shipped to Indoor Biotechnologies for MARIA™ Allergen Assay. During the *Bacillus atrophaeus* tests the samples were collected and the *Bacillus atrophaeus* titer in each sample was determined by plating.

The MARIA Allergen Assay is a multiplex assay kit manufactured by Indoor Biotechnologies Inc. (Charlottesville, VA) for the simultaneous quantitative determination of nine common indoor allergens: house dust mite allergens Der p 1 (*Dermatophagoides pteronyssinus*), Der f 1 (*Dermatophagoides farinae*) and Mite Group 2, animal allergens Fel d 1 (cat, *Felis domesticus*), Can f 1 (dog, *Canis familiaris*), Mus m 1 (mouse, *Mus musculus*), and Rat n 1 (rat, *Rattus norwegicus*) and mold allergens Asp f 1 (*Aspergillus fumigatus*) and AveX (an unidentified *Aspergillus versicolor* antigen). The kit is used for analysis of the above indoor allergens in environmental samples, such as house dust extracts or air filter samples and other biologic or environmental samples.

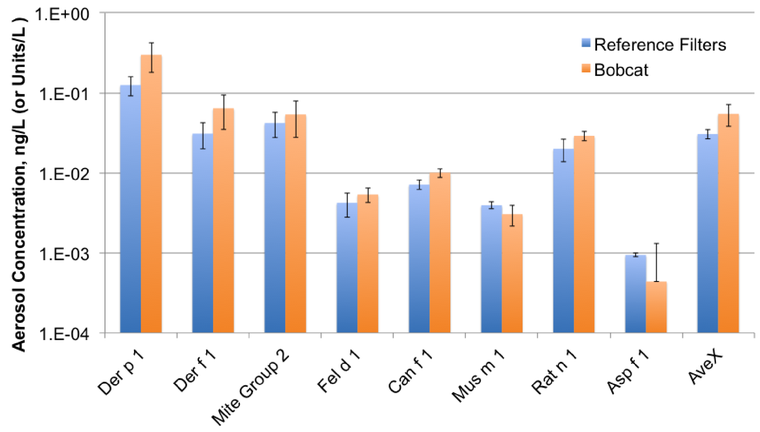
Two filters were used as reference samples in order to determine the challenge aerosol concentration during each of the 30−minute test runs. The filters were 47−mm black polycarbonate filters (0.8 µm pore size, GE-1222028, Pargreen Process Technologies) that were loaded in plastic open face filter housings (Nucleopore Inc., Pleasanton, CA). Following the conclusion of the test run series, each of the reference filters was transferred to an individual 15−mL centrifuge tube (during the allergen testing) or to an individual 50−mL centrifuge tube (during the bacteria testing).

For the allergen test runs, the samples were packed on ice and transferred to Indoor Biotechnologies for analysis.

For the bacteria test runs, 20 mL of 0.01% triton X-100/PBS was pipetted into each 50 mL centrifuge tube with the filter. Each tube was agitated by hand to make sure the filter was submerged in liquid and then the tubes were vortexed for 10 min on a multi−tube vortexer.

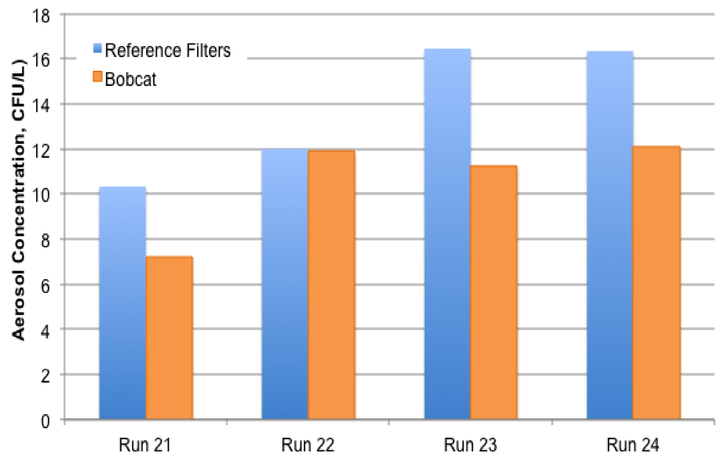
Testing Results

The graph below contains a comparison of the average aerosol concentration determined from the Reference Filters and the Bobcat Aerosol Collector during the allergen test runs. The Bobcat Aerosol Collector and its associated elution system proved effective in collecting and releasing the allergen complemented house dust to the liquid sample.



Summary of Allergen Aerosol

The graph below contains a comparison of the average aerosol concentration determined from the Reference Filters and the Bobcat Aerosol Collector for the bacteria test runs based on plating results. The corresponding A&REs for the four runs were 69.9%, 99.2%, 68.2%, and 73.9%. This high variability can be attributed to the variation in *Bacillus atrophaeus* levels in the ATC over the 30−minute run, since the Bobcat Aerosol Collector only sampled during five 1-minute time periods throughout the run.



Summary of *Bacillus atrophaeus* Results

Conclusions

The InnovaPrep ACD-2000 Bobcat Aerosol Collector performed at very high efficiencies for the collection of allergen proteins contained within aerosolized house dust and aerosolized bacterial spores. In many cases the determined aerosol concentration exceeded that determined by the reference method.