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“The persistence of respiratory viruses on filters of air handling units”

Victor BANDALY*^{a,b}, Yves ANDRES^a, Pierre LE CANN^{b,c}

^a GEPEA UMR CNRS 6144, école des Mines de Nantes, 4 Rue Alfred Kastler, 44300 Nantes

^b EHESP Rennes, Avenue du Professeur Léon Bernard-CS 74312, Rennes Cedex 35043, France

^c IRSET-Research Institute for Environmental and Occupational Health, Rennes, France

Corresponding author *: victor.bandaly@mines-nantes.fr

Introduction

Indoor as outdoor air pollution is one of the main public health problems of our century

We spend about 90% of our time in closed environments such as homes, workplaces, transport, etc.

Air transports microorganisms like bacteria, fungi and viruses from outdoors to indoors environments*

This bioaerosols indoor air pollution is associated with health problems, absenteeism at work and school and has high related costs resulting of short- and long-term exposition

Objective

The aim of this work is to understand the fate and the persistence of respiratory viruses in closed environments those using the air handling units with a specific fiberglass filter and the importance risk of non-release of virus from the CTA



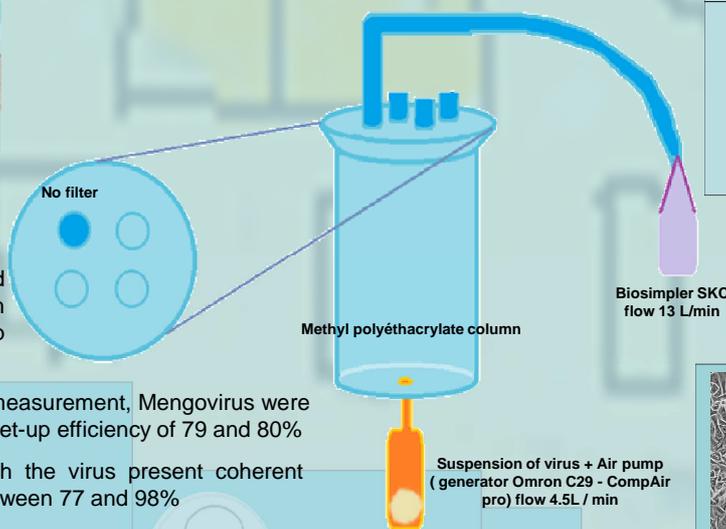
Fiberglass filter F7 (EN 779-2002)

Results

- The experimental set up and protocols have been validated with fluorescein leading to a set-up efficiency of 98.72% (no Data)

- Based on the qPCR and TCID test measurement, Mengovirus were recovered in the system leading to a set-up efficiency of 79 and 80%

- The experimental set up used with the virus present coherent results with filtration performances between 77 and 98%



Experimental pilot to study viral aerosol loss

Exp.1	Initial	Bios 1	Bios 2	Bios 3	Bios (no filter)	Filtr 1	Filtr 2	Filtr 3
Qualitative (PFU)	2,54E+11	3,18E+04	1,93E+04	3,25E+04	7,15E+05	4,03E+03	4,03E+03	3,42E+03
Quantitative (PFU)	2,63E+11	8,59E+08	3,30E+07	1,10E+09	1,09E+10	7,63E+07	4,28E+08	1,21E+08
Set-Up efficiency (Quantitative)	79,44							
Set-Up efficiency (Qualitative)	80,93							

The quantification and the infectiousness of the Mengovirus Plaque forming unit (PFU) on the filter and the biosimpler and the set-Up efficiency

- Quantitative comparison between :

- the biosampler without filter upstream and the initial virus quantity show a loss of 1.5 log in the system (confirmed in fluoresceine experiment) (no data)
- the biosimpler with filter upstream and the filter extract show more viruses pass through the filter

- Qualitative comparison between (infectivity) :

- the biosimpler without filter upstream and the initial virus quantity show a loss of 6 log from the initial infectivity
- the biosimpler with filter upstream and the filter extract show viruses remain infectious upstream and downstream of the sys

Materials and methods

A respiratory virus model was chosen: RNA virus (Mengovirus)

This virus is cultivated respectively on Buffalo green monkey kidney cells (BGM)

Aerosolization (Flow 4.5 L/min) by a medical nebulizer Omron C29 (CompAir pro) in a vertical column of polymethylmethacrylate

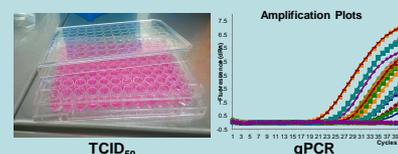
4 outputs whose 3 are equipped with a fiberglass filter F7 (EN 779-2002)

4 biosamples (SKB) collect samples of viral particles passing through the filter (Flow 13 L/min)

The detection of the virus on the filters and the samples is made by:

- qPCR for the quantitative detection
- Culture and titration by TCID₅₀ method for the viability and infectivity of the virus

Detection of the virus on the filters and the samples

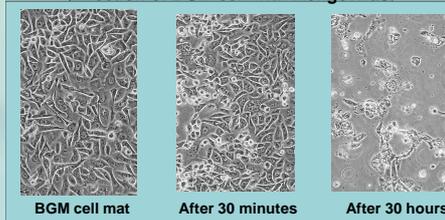


TCID₅₀

Amplification Plots

qPCR

Infection of BGM cell with Mengovirus



BGM cell mat

After 30 minutes

After 30 hours

Perspective

-Experiments are under progress to determine the rate of infectious viruses on the filters and those passing through in different time of aerosolization