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2020

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Keywords: bioaerosol, infectious diseases, norovirus, biospot
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Introduction

Norovirus is the leading cause of viral acute gastroenteritis in the world and causes about 200 000 deaths per year globally. Norovirus is considered to spread mainly by contact with contaminated materials, but in recent studies, we and other researchers have detected airborne norovirus RNA in hospitals during outbreaks, suggesting that norovirus could also spread via air [Alsved, Fraenkel 2019, Bonifait 2015].

Since the methodology for cultivation of human norovirus is still under development, murine norovirus (MNV) is used as a model virus. By studying the infectivity of aerosolized MNV in laboratory experiments, the influence of environmental parameters on viral survival can be evaluated. In addition, there are several types of human noroviruses, as well as different types of MNVs, that may be less or more persistent in to aerosolization and airborne transport.

This study's aim was to develop and evaluate an experimental setup for aerosolization of viruses by bubble bursting (simulating real-life conditions) and atomization.

Methods

MNV was aerosolized by either a sparging liquid aerosol generator (SLAG, CH Technologies) or an atomizer (Model 3076, TSI Inc.) into a stainless steel flow tube, and collected in phosphate buffered saline (PBS) by a BioSampler® (SKC Inc.) or a BioSpot (Aerosol Devices).

The experimental setup was first characterized by its physical factor and then by the viral dilution factor, comparing concentrations in the starting solution with the collection liquid. The physical dilution was determined by aerosolization of a radioactive tracer (^{99m}Tc) and measurements by gamma ray spectroscopy using a iodine well count detector (1480 Wizard, Perkin Elmer). The corresponding viral dilution factor was determined by aerosolization of MNV and detection by quantitative reverse transcription PCR (qRT-PCR) of MNV concentrations.

Viral infectivity was evaluated by a cell infectivity assay, determining the 50% tissue culture infective dose ($TCID_{50}$) in RAW 264.7 cells.

Results

Characterization of the experimental setup showed that the physical dilution was lower when the atomizer was used as aerosol generator compared to the SLAG (Figure 1). The viral dilution factor was similar for both of the generators, suggesting that the particles collected from aerosolization by the SLAG contained higher MNV concentrations.

The $TCID_{50}$/mL in the aerosol samples was reduced due to viral dilution and reduced viral infectivity after aerosolization.

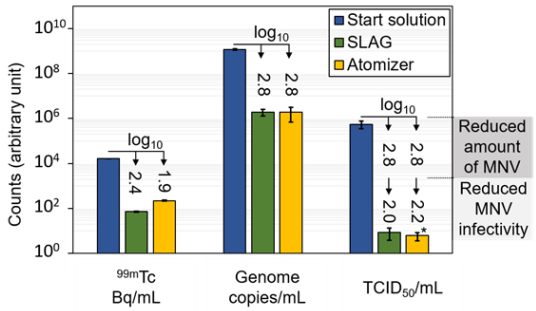

Figure 1. Comparison of the physical dilution factor (^{99m}Tc Bq/mL) and the viral dilution factor (MNV genome copies/mL) of the experimental setup. The viral infectivity ($TCID_{50}$/mL) was decreased due to the less MNV and reduced infectivity.

Conclusions

We developed and characterized an experimental setup for aerosolization of viruses. The small difference in viral infectivity from the two generators suggests that the aerosolization mechanism has little influence on viral infectivity. Instead, drying in air could be a reason for the reduced viral infectivity.

In the next step, we aim to improve the collection efficiency using a condensational growth tube collector (BioSpot, Aerosol Devices) and evaluate environmental parameters that may influence infectivity of airborne viruses.

This work was supported by AFA Insurances (180113) and FORMAS (2014-01460, 2017-00383).

Alsved, M, Fraenkel, C-J., et al. (2019). *Clinical Infectious Diseases*, DOI: 10.1093/cid/ciz584.
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