Air Purification of Airborne SARS-CoV-2 by Genesis Air Technology

Genesis Air, Inc. contract

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To

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Objective

Genesis Air, Inc., has developed technology that can eliminate microbial contaminants by creating powerful oxidizers that can inactivate microbes. Genesis Air technology has demonstrated the ability to inactivate fungal spores and MS2 virus in prior lab tests. These findings suggest Genesis Air technology would also be effective at eliminating airborne SARS-CoV-2.

The objective of this study was to test the ability of a device manufactured by Genesis Air, Inc., to inactivate airborne SARS-CoV-2.

Experimental Procedure

Virus

SARS-CoV-2, strain USA_WA1/2020, was used for the study. SARS-CoV-2 virus suspensions were prepared on the day of bioaerosol runs from frozen seed stock initially generated (one passage) in Vero C1008 (E6) cells (BEI Resources, NR-596, Lot 3956593) from lyophilized material provided by the World Reference Center for Emerging Viruses and Arboviruses at UTMB (TVP 23156). Next generation sequencing confirmed 100% consensus sequence-level match to the original patient specimen (GenBank accession MN985325.1).

$TCID_{50}$ assay

One day prior to assay execution, a well-characterized, low-passage Vero E6 cell bank (originating from BEI Resources NR-596) was used to seed 96-well culture plates at 2 x 10^4 cells per well. Cells were incubated under optimal conditions (37°C/5% CO_2) for 16-24h or until greater than 90% cell confluence was achieved. On the day of testing, each sample collected during the aerosol tests was serially diluted (10-fold) in dilution medium (Minimal Essential Medium/2% heat-inactivated fetal bovine serum [HI-FBS]). Sample dilutions were added to replicate wells (0.1 mL per well, five wells per dilution). For each 96-well plate, a positive virus-only control and negative media control were incubated in parallel. Cultures were incubated under optimal conditions for SARS-CoV-2 (37°C/5% CO_2) for 72h after which cytopathic effect (CPE) was observed microscopically. Results were tabulated and used to calculate the 50% tissue culture infectious dose ($TCID_{50}$).

Aerosol generation and sampling

Figure 1 is a photograph of the aerosol setups. The aerosolization was performed using a Biaera aerosol control platform (Aero3G, Biaera Technologies, LLC). The viral aerosol was generated using a 6-jet Collison nebulizer (flowrate set to 14.0 LPM), and it was combined with a standard volume of air to deliver a given concentration of virus into the test units. For each nebulization, 10 ml of the viral inoculum at concentrations of 1-5 x 10^7 TCID50/ml was used. The duration of aerosolization was 15 minutes. Aerosol samples were collected during aerosolization (15 minutes) at approximately 11.5 LPM before (pre-unit) and after (post-unit) the test units using BioSamplers (SKC, Inc.) containing 20 ml of collection medium. The total airflow to the aerosol setup was 30.0 LPM.

Figure 1. Aerosol testing setups

Genesis Air devices

Two units manufactured by Genesis Air, Inc., were used in the study, an experimental unit (Unit B) and a control unit (Unit A). The experimental unit was equipped with both a panel and filter. The control unit was similar to the experimental unit, but it did not have a filter. For operation, both units were plugged into a 110V outlet within the chamber, and they were allowed to run for at least 15 minutes prior to initiation of the test (Unit A remained off for selected test runs). To verify that both lamps within the units were

functioning, a multimeter was placed on the unit electrical cord to determine if ~0.73 amps were being supplied to the units.

Results

Table 1 provides the log reductions in viral concentration for the control (Unit A) and experimental (Unit B) units. As shown, all unit tests were performed in triplicate. In the case of the experimental unit, the measured post-unit viral concentrations were below the assay lower limit of quantitation (LLOQ) which was 63.2 $TCID_{50}$/ml or 1.80 logs. Therefore, the range in net log reduction of virus, calculated by subtracting the post-unit concentrations from the pre-unit concentrations, was ≥3.17 to ≥3.57, with an average of ≥3.37 which equates to a ≥99.96% (nearly 4 logs) reduction in viral concentration. The average net log reductions in viral concentration for the control unit while off and on was 0.31 and 1.55, respectively.

Table 1. Log reduction in viral concentration

Aerosol run	Test unit & parameters	Pre-unit concentration (log $TCID_{50}$/ml)	Post-unit concentration (log $TCID_{50}$/ml)	Net viral reduction (log $TCID_{50}$/ml)	Average net viral reduction (log $TCID_{50}$/ml)
1	Unit A (unit off; panel & no filter)	5.37	5.03	0.34	0.31
2		4.65	4.65	0.00	
3		5.17	4.57	0.60	
4	Unit A (unit on; panel & no filter)	4.74	3.81	0.93	1.55
5		5.37	3.37	2.01	
6		5.28	3.57	1.72	
7	Unit B (unit on; panel & filter)	4.98	≤1.80	≥3.17	≥3.37
8		5.37	≤1.80	≥3.57	
9		5.17	≤1.80	≥3.37	

Summary

The Genesis Air technology inactivated airborne SARS-CoV-2 to undetectable levels. The results show that, when accounting for the LLOQ, the percent reduction in virus achieved with the fully operational unit (Unit B while on) was ≥99.96%; however, since no virus was detected after using the experimental unit, the true percent reduction could have been greater.