Disinfection of Surfaces Contaminated with SARS-CoV-2 Surrogate, HuCoV229E

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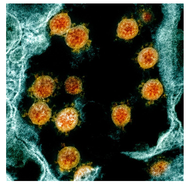
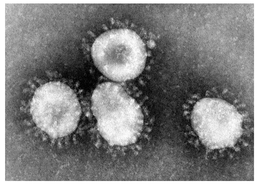
ABSTRACT

Exposure to respiratory droplets containing infectious SARS-CoV-2 virus is the principal route through which people were infected. In addition, the spread of infection has also been observed via contact with contaminated surfaces. Decontamination of infectious virus on surfaces requires use of virucidal chemicals. Here we report the virucidal efficacy of List N and experimental chemicals against bacteriophage, Phi6 (BSL-1), and human coronavirus, HuCoV229E (BSL-2), on three surfaces. The study was completed in two phases: a lab-scale with small coupons from military-relevant surfaces, and a sub-scale using components from a C-17 aircraft. Three chemicals selected from the EPA's list N were: Calla1452, Lysol, and bleach. Three experimental chemicals: DiChlor, OxiClean, and Bioxy, were also evaluated. The OECD test method was used for the lab-scale phase to evaluate the decontamination of keyboard plastic, aluminum and nylon webbing. A surface sampling approach was used for the sub-scale phase to recover the virus from the three aircraft components, control panel, seat cushion and seatbelt.

The results indicate a high variability in virus recovery and inactivation at the sub-scale level. These experiments were conducted in a closed environment using an electrostatic sprayer to deliver test chemicals. The three test chemicals, DiChlor, OxiClean, and Calla1452, partially inactivated the human coronavirus. Additional studies are needed to optimize and achieve complete inactivation of human coronavirus. A continued search for innovative technologies to rapidly and effectively inactivate emerging viral & bacterial threats will better prepare our war-fighter in the future.



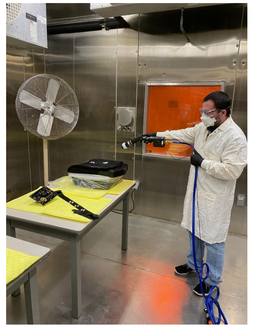
SARS-CoV-2



HuCoV-229E

Seat cushion Control panels Seatbelt

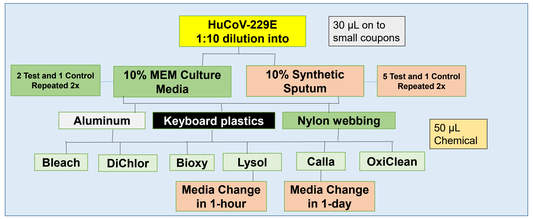
Articles for Sub-scale Studies (Ryan Adams)



OECD METHOD

- Small 1-cm² coupon inoculated with 30-microliter viral inoculum with and without SS
- Add 50-microliter disinfectant after coupon placement in the vial
- Add 10-ml MEM containing 2% FBS (20-ml for Lysol) after 5 min contact time
- Vortex for 1-min to dislodge the virus off the surface
- All dilutions in a 5-ml final volume

Summary of Lab-scale Virucidal Matrix with HuCoV-229E



Virus - HuCoV-229E
Test Method - OECD
Contact Time- 10 Minutes

Non Porous Materials- Aluminum and Keyboard Plastics

Virucidal Chemical	Description	+SS	-SS	Cytotoxicity	Media Change
1	Calla 1452 Neutral Disinfectant Cleaner				Yes
2	Lysol Clean & Fresh Multi-surface Cleaner				Yes
3	Clorox 8.25%				No
4	Dichlor Quick Dissolve Shock				No
5	Bioxy				No
6	OxiClean				No

Porous Materials- Nylon Webbing

Virucidal Chemical	Description	+SS	-SS	Cytotoxicity	Media Change
1	Calla 1452 Neutral Disinfectant Cleaner				Yes
2	Lysol Clean & Fresh Multi-surface Cleaner				Yes
3	Clorox 8.25%				No
4	Dichlor Quick Dissolve Shock				No
5	Bioxy				No
6	OxiClean				No

CONCLUSIONS

1. Greater than 3-logs virus recovery from all three test surfaces, i.e., aluminum, nylon webbing, and keyboard plastics
2. Significant cytotoxicity observed in the case of Lysol and Calla, which required change of media after one hour of infection
3. In the absence of bioburden, all six chemicals, i.e., Lysol, Clorox, DiChlor, Bioxy, Calla and OxiClean, effective virucidal on aluminum and keyboard plastics surfaces
4. Calla and OxiClean were found to be effective virucidal agent on nylon webbing
5. In the presence of bioburden, except for OxiClean on keyboard plastics, virus inactivation was 1-3-logs
6. 10% synthetic sputum therefore poses a formidable challenge on the effectiveness of tested chemicals against HuCoV-229E virus
7. At sub-scale level, the use of ESS sprayer was suitable in closed environment for spraying test chemicals on articles
8. High variability in virus recovery and log reduction values were observed in sub-scale phase of the study
9. Calla and OxiClean are concluded to be highly effective on sensitive military assets, including aircraft interiors. In addition, DiChlor can also be used on non-sensitive assets

CHALLENGES & FUTURE RECOMMENDATIONS

1. High degree of variability (range between 2.7 – 5.1 logs) at sub-scale level.
2. Sampling from seat cushion and seat belt are especially variable.
3. Wetness not standardized, even though ESS is sprayed with three passes over the test articles.
4. Viral recovery through sampling appears to be variable
5. Development of a test method for sub-scale with reduced variability is highly recommended.
6. Disinfection studies in the presence of different bioburden, to harmonize and standardize the test method is also recommended.
7. Evaluation of other spraying devices, in field conditions to assess effectiveness of disinfectant application in operational environment.

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