Title

Prolonged viability of SARS-CoV-2 in fomites

Authors

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Text (400 words)

SARS-CoV-2 has spread worldwide, demonstrating a great potential for direct and indirect transmission between humans. Whether coronaviruses can keep their infectivity in fomites through remaining viable on dry surfaces for periods exceeding hours, as shown for SARS-CoV and MERS-CoV, remains debated (1). Whether this is also true for SARS-CoV-2 remains uncertain; specifically there is no data about the role of proteins on virus viability in the environment. We evaluated the stability and infectivity of SARS-CoV-2 deposited on polystyrene plastic, aluminum and glass for 96 hours at 45-55% relative humidity and 19-21°C temperature range using a 10^6 $TCID_{50}$/mL inoculum; these experiments were conducted with and without bovine serum albumine (BSA, 10g/L) for mimicking the protein content (interfering substance) within body fluids of the respiratory system such as cough droplets, sputum, and airways mucosal secretions (2). Briefly, 50µL of virus was deposited on the various surfaces and recovered sequentially by adding 150µl of cell culture medium; infectiousness was immediately quantified by end-point titration on Vero E6 cells. Each experiment was replicated three times. The limit of detection was about $10^{0.5}$ $TCID_{50}$/ mL. Regardless the type of surface, virus viability decreased of approximately one log10 within 2 hours; afterwards, three drastically different profiles were observed depending of surface type: (i) steady viability with a <1 log10 drop over 92 hours on polystyrene plastic, (ii) a 3.5 log10 decrease along 44 hours on glass, and (iii) a sharp 6 log10 drop in less than 4 hours on aluminum (3, 4). The probable adsorption of viral particles onto polystyrene surface was associated with prolonged viability, whereas the drastic drop on aluminum suggests an intrinsic virucidal activity of this metal (3). Interestingly, SARS-CoV-2 viability was remarkably preserved in the presence of BSA regardless the type of surface. The 10g/L BSA condition used in our study is closely mimicking respiratory fluids (mucus, airways secretions, sputum) possessing protein concentrations higher than 10g/L (2). This resembles what happens when a COVID-19 patient is coughing or depositing infected airways secretions on surfaces. In conclusions we showed that

even moderate protein concentrations in droplets increased drastically the viability of SARS-CoV-2 as for other viruses (5). Accordingly, it is plausible that contaminated fomites containing viable SARS-CoV-2 play a significant role in the person-to-person dissemination. This supports surface cleaning as a necessary action to be enforced and repeated since it may play a key role in halting SARS-CoV-2 transmission and mitigating the COVID-19 pandemic.

Acknowlegments

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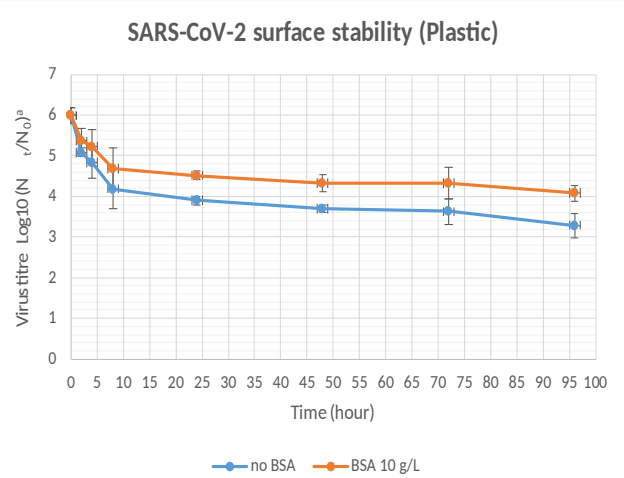
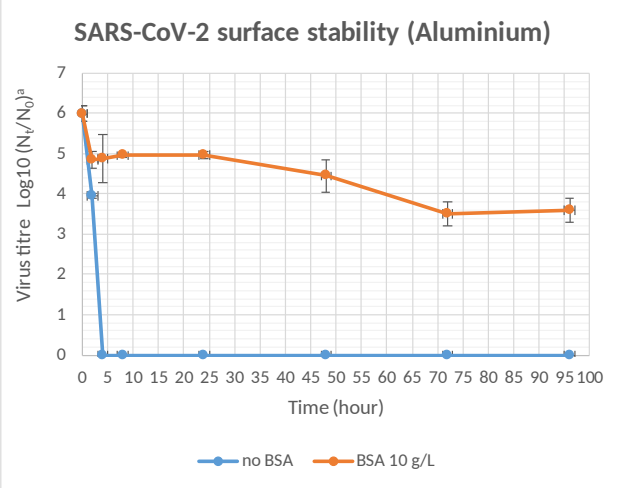
References

1. van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. N Engl J Med. 2020; 382:1564-67. doi: 10.1056/NEJMc2004973.
2. 2: Stockley RA, Mistry M, Bradwell AR, Burnett D. A study of plasma proteins in the sol phase of sputum from patients with chronic bronchitis. Thorax. 1979; 34: 777-82.
3. Rabenau HF, Cinatl J, Morgenstern B, Bauer G, Preiser W, Doerr HW. Stability and inactivation of SARS coronavirus. Med Microbiol Immunol. 2005; 194: 1-6.
4. Vasickova P, Pavlik I, Verani M, Carducci A. Issues Concerning Survival of Viruses on Surfaces. Food Environ Virol. 2010; 2: 24-34. doi 10.1007/s12560-010-9025-6
5. Kormuth KA, Lin K, Prussin AJ 2nd, et al. Influenza Virus Infectivity Is Retained in Aerosols and Droplets Independent of Relative Humidity. J Infect Dis. 2018; 218: 739-47. doi: 10.1093/infdis/jiy221.

Figure. Kinetics of SARS-CoV-2





Virus titre (Log $TCID_{50}$/ml)[a]

Time (hour)	Glass		Aluminium		Plastic	
	Without interfering agent	With interfering agent (BSA 10g/L)	Without interfering agent	With interfering agent (BSA 10g/L)	Without interfering agent	With interfering agent (BSA 10g/L)
0	6 ±0.2					
2	3.7 ±0.5	5.1 ±0.1	4 ±0.1	4.8 ±0.2	5.1 ±0.1	5.4 ±0.3
4	3.5 ±0.5	5.1 ±0.4	ND	4.8 ±0.5	4.8 ±0.4	5.2 ±0.4
8	3.4 ±0.2	4.9 ±0.2	ND	4.9 ±0.1	4.2 ±0.5	4.6 ±0.5
24	2.7 ±0.5	4.7 ±0.3	ND	4.9 ±0.1	3.8 ±0.1	4.5 ±0.1
48	ND	4.8 ±0.1	ND	4.4 ±0.4	3.7 ±0.1	4.3 ±0.2
72	ND	4.1 ±0.2	ND	3.4 ±0.3	3.6 ±0.3	4.3 ±0.4
96	ND	3.9 ±0.3	ND	3.6 ±0.3	3.3 ±0.3	4.1 ±0.2

ND, not detected; [a], mean value of three replicates +/- SD; Plastic stands for polystyrene plastic (Corning Inc.), aluminum (Thermo Scientific) and glass (Thermo Fisher Scientific).