Stability of SARS-CoV-2 in different environmental conditions

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To the Editor,

SARS-CoV-2 has been spreading globally[1]. We previously reported the detection of SARS-CoV-2 in stools and respiratory secretions[2]. The importance of indirect contacts for the spread of COVID-19 is not clear. Here, we report the stability of SARS-CoV-2 in different environmental conditions.

We determined the residual infectivity of SARS-CoV-2 at different temperature. The virus diluted by virus transport medium (VTM; final concentration: ~6.7 log $TCID_{50}$/mL) was incubated for up to 14 days (Table A). The virus was highly stable for an extended period at 4°C. There was only a 0.6-log unit reduction of virus titre at the end of incubation. A 3-log unit reduction of $TCID_{50}$ was observed after a 7-day incubation at 22°C (Room temperature, RT) and no infectious virus could be detected on Day 14. A 3-log unit reduction of $TCID_{50}$ could be detected after a 1-day incubation at 37°C and no infectious virus could be detected thereafter. No infectious virus could be detected after a 30-minute incubation at 56°C or a 5-minute incubation at 70°C.

We further investigated the stability of this virus on different surfaces at RT. In brief, a 5-µL droplet of virus culture (~7.8 Log unit of $TCID_{50}$/mL) was pipetted on a small surface (Table B; ~1 cm^2 per piece). The inoculated objects were retrieved at various time points and each object was then immediately soaked with 200 µL of VTM for 30 minutes at RT to elute the virus. For printing and tissue papers, no infectious virus could be recovered from these surfaces after a 3-hour incubation. No infectious virus from treated cloth and stainless steel could be recovered on Days 2 and 7, respectively. Strikingly, a significant level of infectious virus could still be detected on the outer layer of a surgical mask on Day 7 (~0.1% of the original inoculum), indicating SARS-CoV-2 is extremely stable on this surface. Representative negative eluents recovered from each surface were tested positive by RT-PCR[3] (N=39; data not shown).

We also tested the virucidal effects of disinfectants by adding 15 µL of SARS-CoV-2 culture (~7.8 Log unit of $TCID_{50}$/mL) to 135 µL of various disinfectants at working concentration (Table C). With the exception of a 5-min incubation with hand soap, no infectious virus could be detected after a 5-minute incubation at RT.

Overall, SARS-CoV-2 can be highly stable in a favourable environment, but it is also susceptible to standard disinfection methods.

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Table. Stability of SARS-CoV-2 at different environmental conditions.

A) Temperature*

	Virus titre (Log $TCID_{50}$/mL)									
	4°C		Room Temp (22°C)		37°C		56°C		70°C	
Time	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD
1 min	N.D	N.D	6.51	0.27	N.D	N.D	6.65	0.10	5.34	0.17
5 mins	N.D	N.D	6.70	0.15	N.D	N.D	4.62	0.44	U	-
10 mins	N.D	N.D	6.63	0.07	N.D	N.D	3.84	0.32	U	-
30 mins	6.51	0.27	6.52	0.28	6.57	0.17	U	-	U	-
1 hr	6.57	0.32	6.33	0.21	6.76	0.05	U	-	U	-
3 hrs	6.66	0.16	6.68	0.46	6.36	0.19	U	-	U	-
6 hrs	6.67	0.04	6.54	0.32	5.99	0.26	U	-	U	-
12 hrs	6.58	0.21	6.23	0.05	5.28	0.23	U	-	U	-
1 day	6.72	0.13	6.26	0.05	3.23	0.05	U	-	U	-
2 days	6.42	0.37	5.83	0.28	U	-	U	-	U	-
4 days	6.32	0.27	4.99	0.18	U	-	U	-	U	-
7 days	6.65	0.05	3.48	0.24	U	-	U	-	U	-
14 days	6.04	0.18	U	-	U	-	U	-	U	-

B) Surface*

	Virus titre (Log $TCID_{50}$/mL)									
	Printing paper		Tissue paper		Cloth		Stainless steel		Surgical mask (Outer layer)	
Time	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD
0 min	4.76	0.10	5.48	0.10	4.84	0.17	5.80	0.02	5.78	0.10
30 mins	2.18	0.05	2.19	0.17	2.84	0.24	5.23	0.05	5.75	0.08
3 hrs	U	-	U	-	2.21#	-	5.09	0.04	5.11	0.29
6 hrs	U	-	U	-	2.25	0.08	5.24	0.08	4.97	0.51
1 day	U	-	U	-	2.07#	-	4.85	0.20	4.73	0.05
2 days	U	-	U	-	U	-	4.44	0.20	4.20	0.07
4 days	U	-	U	-	U	-	3.26	0.10	3.71	0.50
7 days	U	-	U	-	U	-	-	-	2.79	0.46

C) Disinfectant*

	Virus titre (Log $TCID_{50}$/mL) at different time point		
Disinfectant (Working concentration)	5 mins	15 mins	30 mins
Household bleach (1:49)	U	U	U
Household bleach (1:99)	U	U	U
Hand soap solution (1:49)	3.6#	U	U
Ethanol (70%)	U	U	U
Povidone-iodine (7.5%)	U	U	U
Chloroxylenol (0.05%)	U	U	U
Chlorhexidine (0.05%)	U	U	U
Benzalkonium chloride (0.1%)	U	U	U

* All the virus titres were titrated using Vero-E6 cell. All experimental studies were done in three independent triplicates. Detection limit of a typical $TCID_{50}$ assay is 100 $TCID_{50}$/mL, except reactions containing hand soap/chloroxylenol (detection limit: 10^3 $TCID_{50}$/mL) or reactions containing povidone-iodine/cholorhexidin/benzalkonium chloride; detection limit: 10^4 $TCID_{50}$/mL) because of their cytotoxicity effects. N.D.: not done, U: undetectable.

\# Only one of the triplicate reactions was positive in the $TCID_{50}$ assay.