

Stability of SARS-CoV-2 in different environmental conditions

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To the Editor,

SARS-CoV-2 has been spreading globally¹. We previously reported the detection of SARS-CoV-2 in stools and respiratory secretions². 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 TCID₅₀/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 TCID₅₀ 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 TCID₅₀ 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- μ L droplet of virus culture (~ 7.8 Log unit of TCID₅₀/mL) was pipetted on a small surface (Table B; ~ 1 cm² per piece). The inoculated objects were retrieved at various time points and each object was then immediately soaked with 200 μ L 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 ($\sim 0.1\%$ 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-PCR³ (N=39; data not shown).

We also tested the virucidal effects of disinfectants by adding 15 μ L of SARS-CoV-2 culture (~ 7.8 Log unit of TCID₅₀/mL) to 135 μ L 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*

Time	Virus titre (Log TCID ₅₀ /mL)									
	4°C		Room Temp (22°C)		37°C		56°C		70°C	
	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*

Time	Virus titre (Log TCID ₅₀ /mL)									
	Printing paper		Tissue paper		Cloth		Stainless steel		Surgical mask (Outer layer)	
	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*

Disinfectant (Working concentration)	Virus titre (Log TCID ₅₀ /mL) at different time point		
	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 TCID₅₀ assay is 100 TCID₅₀/mL, except reactions containing hand soap/chloroxylenol (detection limit: 10³ TCID₅₀/mL) or reactions containing povidone-iodine/chlorhexidine/benzalkonium chloride; detection limit: 10⁴ TCID₅₀/mL) because of their cytotoxicity effects. N.D.: not done, U: undetectable.

[#] Only one of the triplicate reactions was positive in the TCID₅₀ assay.