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SEWAGE WATER AS INDICATOR FOR TRANSMISSION OF SARS-COV-2

Shivbrat Upadhyay, Sahabjada Siddiqui, Rumana Ahmad*, Anamika Gupta*, Ishrat Husain*

*Department of Biotechnology, Department of Biochemistry**

Era's Lucknow Medical College & Hospital, Sarfarazganj Lucknow, U.P., India-226003

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Address for correspondence

Dr. Sahabjada Siddiqui
Department of Biotechnology
Era's Lucknow Medical College & Hospital, Lucknow-226003
Email: sahabjada@erauniversity.in,
Contact no: +91-9452688313

ABSTRACT

Covid-19 disease, a pandemic condition, is extremely challenging for entire world and human being. The virus, officially called coronavirus 2 (SARS-CoV-2) severe acute respiratory syndromes, is widely recognized as the COVID-19 virus is recently discovered virus and the subsequent disease known as the COVID-19. In a large percentage of cases, SARS-CoV-2 was released due to faecal matter during in the currently underway outbreak of COVID-19. This eventually proves that human wastewater could be the cause of SARS-CoV-2. Through its function, the sewage filtration system is a manifestation of microbial pathogens with the potential to support transmissible of viruses such as SARS-CoV-2 in certain conditions. The involvement with sewage surveillance through monitoring the spread of SARS-CoV-2 among our populations has been underlined in the current review, which may integrate existing medical surveillance restricted to the most severe COVID-19 patients. Although there is little success here, sewage surveillance is nevertheless a continuous field of vigorous research and could be promising in future research.

KEYWORDS: COVID-19, Fecal matter, Plumbing system, SARS-CoV-2, Sewage water, Sewage surveillance.

INTRODUCTION

COVID-19, an ongoing viral disease, has been identified to be associated with a spread of pneumonia in a town area Wuhan in China (1). Indeed the source of the outbreak was the new severe acute respiratory coronavirus-2 syndrome (SARS-CoV-2). The epidemic has transmitted across China and many other countries from Wuhan to other cities. The WHO declared an epidemic in March 2020 after the virus was identified in more than 100 nations. This virus resembles with Severe Acute Respiratory Syndrome Corona Virus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV), which caused outbreaks of coronavirus in 2003 and 2012, respectively (2).

MERS-CoV and SARS-CoV have similar physical and biochemical properties as well as similar transmission paths as SARS-CoV-2. SARS and MERS coronavirus substitute records are the basis for concluding, analysing and minimising the risks in the unmitigated absence of comprehensible SARS-CoV-2 data (3). The route of transmission of coronavirus is through large secretions by people in form of sneeze, cough or breathing out plus can be propagated by human faeces (4). In addition to respiratory symptoms, 16-73 percent of SARS patients were reported to have diarrhea and the spread of SARS *via* fecal water droplets and through air filtration system was also reported in Hong Kong (5-6). Diarrhea has also been reported in a significant proportion and early studies have shown that this new virus is also being identified inside the fecal specimens of COVID-19 instances (7-11).

Strain variants of coronavirus and their stability in different mediums

Four sub-variants of coronavirus are there including alpha, beta, gamma, and delta. HCoV-OC43, HCoV-HKU11, SARS-CoV-2, SARS-CoV-1 and MERS-CoV are beta human coronaviruses (HCoVs) (12-13). Alpha coronaviruses are a handful of HCoV-229E and HCoV-NL63 human coronaviruses. The stability of major coronavirus variants in different environment including aerosol and various metal surfaces of our daily life uses has been studied. On various metal surfaces, the coronavirus could last for extended periods, ranging from minutes to weeks (14-16).

SARS-CoV-2

SARS-CoV-2 seems to be enshrouded, single stranded, positive-sense RNA genome ranging from 60-140 nm in diameter that belongs to the family Coronaviridae (17). This viable virus enters living human tissue through its binding with angiotensin-converting enzyme 2 (ACE2) receptor. SARS-CoV-2 aerosol stability is evaluated on various surfaces for up to three hours and up to seven days. This virus could be detected live on plastic for 72 hours and on stainless steel for 48 hours. After 4 hours on copper, this effective pathogen cannot be assessed. SARS-CoV-2 is unable to be identified on cardboard after 1 day (14,18). In recent times, survival of SARS-CoV-2 against glass surfaces is being illustrated at ambient temperature and 65% relative humidity which showed that the virus persisted infective for 2 days.On surgical facemask, the most important precautionary material, it survived for 4 and 7 days on inner and outer layers, respectively. On cloth and banknotes, this virus is detectable for 24 hours to total destruction after 48 hours. Fortunately, this virus can survive for only 30 minutes on paper (19). In 2005, Wang et al. studied that SARS-CoV-2 can stay alive for 2 days in municipal wastewater at ambient temperature. The viable virus can stay for up to 14 days in Dulbecco's Modified Eagle Medium (DMEM) (20). Corona viruses could stay alive up to 96 hours, based on the nature of fecal specimen (12,19).

SARS-CoV

SARS-CoV virus which causes SARS is an enshrouded, positive-sense single-stranded RNA pathogen that afflicts the cells of humans, bats, and palm civets within the lungs. This virus enters through ACE2 receptor into host cells (21). In perspective of survival, SARS-CoV could be analyzed live for 3 days on plastic and 2 days on steel surface. This beta virus could not be evaluated later than 8 hours on cardboard and copper. The aerosol stability of SARS-CoV is observed for 3 hours (18).One more study has found that SARSCoV-1 retained its plastic ground infectivity for about one month at room temperature and 40-50 percent relative humidity (22). On glass at ambient temperature, SARS-CoV-1 sustained its virulence for 4 days (23). In additament, SARS-CoV has also been found in sewage to persist through faeces, urine, water and wastewater for periods of up to 48 hours at 20°C, at least 14 days at 4°C, and to live for 96 hours in diarrheal patient stools samples with alkaline pH in spiked samples (24-25). At room temperature, the feasible virus remained measurable up to 72 hours inside the water and stays alive for 6 days on petri dishes of polystyrene (23,26). A further study revealed only 2 days of persistence at room temperature for both chlorinated and dechlorinated water, and complete decay after 3 days of this virus (24).

MERS-CoV

MERS-CoV, a species of beta coronavirus, infects humans, bats, as well as camels (27). In the context of survivability, MERS-CoV could be detectable for 1 hour in aerosol (28). Stability on plastic has been shown up to 2 days for MERS-CoV which gets completely inactive after 3 days. This could be viable on the surface of stainless steel at room temperature for up to 48 hours (18, 26, 29).

HCoV-229E

HCoV-229E is a member of the genus alpha coronavirus, infects both humans and bats. HCoV-229E is also a shrouded single-stranded positive-sense RNA pathogen situated inside the intestinal, renal microvillar and other plasma membranes that enters into host cell through the aminopeptidase N (AP-N) receptor (30). In case of survivability, CoV-229E could remain infectious for 2 days on plastic surface. On ambient temperature and relative humidity 30-40%, CoV-229E exhibited lower constancy on brass for 10 minutes to 2hours, from 20 minutes to 1 hour on nickel. It may viable for 5 days on steel and glass surfaces (26, 29). The virus has been perceptible for 3 hours on surgical gloves, 2 hours on aluminum surface and could survived up to 72 hours on silicon rubber at ambient temperature (31-32).

HCoV-OC43

HCoV-OC43 is another human beta coronavirus 1, infects both humans and cattle. The pathogen binds with N-acetyl-9-O-acetylneuraminic acid receptor (Neu5, 9Ac2) to infect the host cell. Previous research found that CoV-OC43 could stay alive for just 2 hours on aluminum and less than 1 hour on surgical latex gloves at room temperature (12,31).

SARS-CoV-2 in Sewage

For the first time, Medema G. et al led to the identification of SARS-CoV-2 incidence in sewage in the Netherland in March 2020 (33). Before this finding, there was no significant information which showed that SARS-CoV-2 was communicated via the drainage facilities of waste water. Although plausible, it was still not clear how well this virus lives in fresh groundwater or wastewater. Fluids of nasal are, however, present in sewage due to tissue flushing and thus, SARS-CoV-2 is most ready to affect wastewater systems (34).

In a recent study in the Netherlands, during resurgence of COVID-19, waste water samples from seven cities and airports were checked by real-time PCR against one envelope and three nucleocapside protein gene fragments (N1-3) for the identification of SARS-CoV-2 presence (33). This study revealed that as identified on February 27, 3 weeks until the first case there in the Netherlands, no SARS-CoV-2 was found in the February 6 samples. The N1 fragment was identified in wastewater at 5 locations on March 5th. Fragment N1 was analyzed in sewage at 6 sites on 15 and 16 March and fragment N3 and fragment E have been identified on five and four sites in that order. It was the first sewage sample study for SARS-CoV-2. Even if the prevalence of COVID-19 is small, sewage viral infection tracking suggests that wastewater detection could become an effective way of checking the transmission of the virus within the community. In another study, in a group of nine cases, the spread of SARS-CoV-2 has been observed and 107 RNA copies/g of faecal matter were detected within one week after symptom onset and reduced to 103 RNA copies/g within three weeks after symptom onset (35). Effective SARS-CoV-2 has been found with elevated RNA copies in stool specimens (36). Though wastewater has unlikely turn into an essential communication route in favor of SARS-CoV-2 (37) and thus, increased transmission of pathogen within the community would enhance the load of virus inside our municipal sewage.

Transmission control by drainage plumbing systems:

In order to determine whether there has been no risk to sewage labourers and whether sewage eavesdropping could have been used to monitor the spread of SARS-CoV-2 among our populations, it is necessary to collect data on the incidence and providence of such a latest sewage virus that could complement current clinical surveillance limited to COVID-19 infected patients to the most intense signs (38). In addition, wastewater data collection may provide an advance indication of COVID-19 re-emergence in towns, similar to the poliovirus sewage monitoring used for this reason (39). The substantial load of virus to the wastewater plumbing network could be suggested as a viable SARS-CoV-2 spreading route in conjugation with conveyance of aerosolized inhalation of the pathogen. Therefore the sewage system may have been a natural source of pathogenic microorganisms that may allow infectious agents spreading such as SARS-CoV-2 that triggers COVID-19. SARS-CoV-2 virus is an enveloped virus, which is supposed to be more vulnerable to disinfection than non-enveloped viruses such as coxsackievirus, Hep A and adenovirus (24). Respiratory spreading of SARS-CoV-2 is another possible mode of transmission and its exposure in waste water could create a health risk. But, environmental monitoring of SARS-CoV-2 may serve as a source of data, indicating whether the virus circulates in the human population.

While Covid-19 virus is already recognized inside a significant proportion of stool samples with real time PCR analysis (7-8), previous studies have also reported infectious virus culture from stool (36, 40). Medema G. et al has also analyzed the SARS-CoV-2 presence in sewage in March 2020 in the Netherlands (12). There is no information by any country to date that wastewater is a spreading path of SARS-CoV-2 but unlikely to turn out to be an significant transmission route for SARS-CoV-2

CONCLUSION

Aim of the present review is to highlight the SARS-CoV-2 incidence in city's domestic sewage during or after the COVID-19 outbreak and to underline the strain variants of coronavirus and their stability in different mediums. Water samples from sewage of different sites across the country could be utilized for investigation of SARS-CoV-2 presence through RNA extraction then real-time PCR evaluation from the concentrated sewage samples. Using such SARS-CoV-2 RNA analyzes from sewage water may serve as a tool for testing the transmission of viruses in cities or smaller towns. Wastewater monitoring may be used in our populations for measuring the spread of SARS-CoV-2 also may serve as a source of data. The virus concentration level would be an indication of the number of virus infections in the population, and can signify a new outbreak in advance. The analysis of the virus strength at different temperature and different time period could help us to take precise precautionary action.

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