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Chlorine Dioxide Gas (CLO_2) can inactivate the coronavirus

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Motivation

Viruses have caused many epidemics throughout human history. The novel coronavirus [10] is just the latest example. A new viral outbreak can be unpredictable, and development of specific defense tools and countermeasures against the new virus remains time-consuming even in today's era of modern medical science and technology. In the lack of effective and specific medication or vaccination, it would be desirable to have a nonspecific protocol or substance to render the virus inactive, a substance/protocol, which could be applied whenever a new viral outbreak occurs. This is especially important in cases when the emerging new virus is as infectious as SARS-CoV-2 [4].

Inactivating viruses with ClO_2 in gas phase

The virus-inactivating reactions (the reactions of ClO_2 with the three amino acids) take place in an aqueous medium; consequently, ClO_2 can inactivate microbes in their wet state only. Therefore, ClO_2 gas that is moisturized can be an ideal agent against viruses both in their wet and dry states. *Viruses that are carried by water droplets could be easily inactivated even by ClO_2 gas* owing to the high solubility of ClO_2 in water [11]. A dry ClO_2 gas would be inappropriate as the water content of the aqueous droplet could evaporate, and in the absence of aqueous medium the reactions of ClO_2 slow down extremely. Indeed, atmospheric moisture - at least a 75-85% relative humidity – is indispensable to inactivate viruses. The advantage of using a moisturized ClO_2 gas is that its water content is also able to wet viruses in dry environment. Most viruses are found on hard surfaces indoor, but a small fraction of viruses are "airborn", attached to dust particles, which can also carry a single microbe or an aggregate of microbes.

Therefore, it is a prerequisite of an effective disinfection that all microbes in all parts of the room should be wet and should be in contact with ClO_2. If enough aqueous ClO_2 solution is sprayed into the room, the droplets will saturate the atmosphere with water vapor everywhere, moreover, the atmosphere will also contain gaseous ClO_2 everywhere. The great advantage of this method is that H_20 and ClO_2 molecules of the gas phase can reach the microbes in every small corner of the room. Finely dispersed water droplets containing dissolved ClO_2 can create an advantageous environment to maintain such conditions for a longer time. This method using high ClO_2 concentration allows fast disinfection of rooms when people are not present, e.g., intensive care units, buildings used as quarantine, or public transport vehicles. However, the application of ClO_2 gas is limited when people are present, as it is harmful for humans and animals above certain concentrations. The US Occupational Safety and Health Administration (OSHA) limits the concentration of ClO_2 gas allowed in workplace air to 0.1 ppm (VN) time-weighted average (TWA) for an 8-h exposure, and to a temporarily higher 0.3 ppm Short-Term Exposure Limit (STEL) only for a 15-min period (30).

Preventing the spread of viral infections using ClO_2

Based on the previous arguments, some propositions will now be put forward on how aqueous ClO_2 solutions could be applied for global and local (personal) disinfection purposes. Many of these propositions are based on hypotheses, and therefore can only be applied after careful research. It is a goal of the present work to initiate research to check these hypotheses and proposals experimentally, which could lead to new applications of high-purity ClO_2 solutions against viral or other infections. These ideas might be further matured in time, but due to the threat of a global pandemic, we have chosen to move fast.

Conclusion

In this editorial, we summarized the unique properties of chlorine dioxide, which make it an ideal and nonspecific antimicrobial agent at concentrations harmless to humans, and we reviewed previous research on preventing viral infections with gaseous ClO_2. Based on this background, we suggested some novel hypothetical methods using chlorine dioxide to disinfect rooms, prevent human infection, and slow down viral spread. These are nonspecific methods, which could be used against any newfound virus as a first line of protection until effective specific countermeasures are developed.

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