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COVID-19: DISINFECTION OF SURFACES WITH CHLORINE WATER

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ABSTRACT

Chlorine water (bleach) is used for various using in the sanitation of the living environment. It is one of the approved cleaners and disinfectants effective against COVID-19, and is also a very unstable solution. Our study has shown that degradation factors and counterfeits are a problem for the effectiveness in the fight against this pandemic through the cleaning and disinfection of different surfaces on a contaminated site or no in some African countries. This could contribute to the transmission of COVID-19 variants, despite the vaccination strategy put in place. It is concluded that there is a need to inform citizens about the practices of using chlorine water disinfectants in these African countries.

KEYWORD: COVID-19, Bleach, disinfection, transmission, Africa.

INTRODUCTION

Since 2019, the world is confronted to pandemic of a respiratory infection whose number of infected continues to grow. This respiratory infection, coronavirus disease 2019 (COVID-19) is caused by SARS-CoV-2 whose main routes of transmission are close contact and respiratory droplets but also the airway during medical procedures generating aerosols.[1]

Contaminated objects or surfaces could be a mode of transmission. Indeed, an experimental study on hamsters showed that transmission of SARS-CoV-2 via contaminated surfaces was possible in this animal.[2] Although no cases of human transmission clearly and specifically attributable to contact with fomites have been noted in the literature[3,4], World Health Organization (WHO) and the scientific community have concluded that this mode of transmission is possible.[5,6,7] Therefore, to avoid a new transmission by contact on surfaces, it is therefore essential that they are properly cleaned and disinfected, in particular where patients of COVID-19 were taken care, by standard methods of disinfection.[8]

Among the cleaners and disinfectants commonly found on the market and approved as effective against COVID-19 appear hypochlorite products in its various liquid (sodium hypochlorite), solid or powder (calcium hypochlorite) formulations.[9]

According to the COVID-19 environmental health committee of the National Institute of Public Health of Quebec (INSPQ) and approved by the WHO, a dilute solution containing 0.1% to 0.5% hypochlorite is largely effective against the virus with a recommended minimum contact time of 1 minute.[10]

In an approach of barrier measures against Covid, some African countries, in particular Benin, in the first hours of the fight against this pandemic, initiated the installation of hand washing points and disinfestation cabins with chlorine solution.

In a continuation of this fight, a study on hypochlorite disinfectants is done. We have reported in this article, the quality of certain hypochlorite products purchased on the African market, particularly in Benin, and its impact on the fight against COVID-19. In addition, a correlation is done on the high transmission of the new omicron variant whose current evidence of transmission, severity is very uncertain.[11,12]

To our knowledge, this study which consisted in describing an effective strategy for effective disinfectant solutions of hypochlorite in these southern countries has never been described in the literature.

MATERIAL AND METHODS

MATERIAL

Chlorine water is an aqueous solution containing chlorine active, i.e. capable to give chlorine through the presence of hypochlorite ions (ClO-) and hypochlorous acid molecule (HClO) forming an acid/base couple at pKa=7.5.

Commonly called bleach and Dakin's liquor (which give chlorine) depending of the proportion of hypochlorite ion (ClO-), hypochlorous acid molecule (HClO) and solution' pH. It has a disinfectant, bactericidal, fungicide, virucide and sporicide properties.[13]

Bleach concentrates (sodium hypochlorite solutions) are expressed in two unity depending to country; in Gay Lussac chlorometric degree (abbreviated: ° chl.) or in percentage of active chlorine (abbreviated: % c.a.).

We would to respect the European directive EN 862, decree n°2001-881 of September 25, 2001 repealing the unity "chlorometric degree"[14], but on the indication of bleach, subject of this present study, the concentrations are expressed in chlorometric degrees unity.

The three (03) samples of bleach purchased under various form and names were collected.

Pure crystallizable acetic acid, pure potassium iodide, sodium thiosulphate and soluble starch used are purchased by the chemical industries Prolabo, Sigma-Aldrich, Riedel-de Haën.

METHODS

The dosage of active chlorine was done according to the official methods published in the decree of July 23, 1968[15] whose principle is "Oxidation of potassium iodide in an acetic medium and titration of the iodine released by a decinormal solution of sodium thiosulfate".

In 10 mL of each sample solution diluted to 1/10, is added 50 mL of a KI solution (10% by mass) and 1 mL of glacial acetic acid. The mixture is then allowed stand for 2 minutes. After stirring, the determination of the iodine formed by titration with a solution of sodium thiosulfate of concentration C = N/10.

The titration is stopped when the yellow mixture becomes blue after the addition of some 10 drops of starch and pass to colorless during at least 1 min.

The different volumes V of the sodium thiosulphate solution measured are allowed to check the indication of the chlorometric degree" (° chl) of the samples.

$$\% c.a = \frac{M(Cl_2).^\circ \text{ chl.}}{V_m \cdot \rho_{javel}}.100$$

$$^\circ \text{chl.} = [ClO^-].V_m \; ; \; [ClO^-] = \frac{C.V_{eq}}{2V}$$

RESULT AND DISCUSSION

The average titration volumes for three measurements of each of the samples are summarized in Table 1. % c.a. was evaluated by an approximate value according to the maximum and minimum values of the density ρ of the bleach.

The correspondence table of the bulletin of the French Society of Hospital Hygiene[16] was used to choose the minimum value of ρ_{min} and maximum ρ_{max} (g/L).

Table 1: Chlorometric degree of samples titration.

	average volumes Veq (mL)	% c.a.	% c.a.	° chl
Sample A, indication 12 ° chl	1.77	ρ_{min} = 1038	ρ_{max}= 1050	2
		0.61	0.60	
Sample B, indication 8° chl	5	ρ_{min} = 1026	ρ_{max}= 1036	5.6
		1.73	1.71	
Sample C, indication 9 ° chl	5.8	ρ_{min}= 1033	ρ_{max} = 1043	6.5
		1.99	1.97	

All data were expressed as means ± standard deviations of triplicate measurements.

Bleach is a very unstable solution. Mechanisms linked to the formation and degradation of hypochlorite have been studied by some authors.[17,18] This degradation of hypochlorite is strongly dependent on pH and also on temperature. Ultraviolet rays and certain organic compounds also have an influence on decomposition. These ultraviolet rays allow the formation of free radicals, while the organic compounds that react with hypochlorite and metals to catalyze reactions normally negligible.[19]

The variation of the °chl of the samples would be explained by the factors of the decomposition of the hypochlorite ion. Nevertheless, the strong difference of 10° chl observed for sample A shows the existence on the market of a bad quality of this disinfectant solution.

Indeed, in the first hours of the fight, disinfection or decontamination was one of the strategies adopted, thus counterfeits were produced on the market through substances similar to bleach such as chlorine dioxide used in certain Latin American states.[20]

In addition, for the preparation, a dilute solution containing 0.1% to 0.5% hypochlorite[10] for efficacy against the coronavirus ; a knowledge of % c.a. or ° chl. initial is necessary.

In some northern countries, between March and June 2020, an increase in phone calls related to poisoning from exposure to surface and hand disinfectants (e.g. bleach, chlorine/chloramine gas)[21] and a strong case of exposure by inhalation[22] was observed, it shows that the disinfection approach as a strategy to fight against this pandemic.

The authors of this study in these northern countries concluded the need to inform citizens about safe cleaning and disinfection practices.[23]

The situation in Africa is simply the opposite, our study shows that few cases of poisoning cannot be notified; which would be explained by the quality of chlorine water (bleach) whose concentration and storage conditions do not a good preparation of a disinfectant solution.

In addition, in some African countries, the disinfection and decontamination strategy of the surface has completely given way to the vaccination strategy against covid-19. However, although vaccination is the probable preventive approche, undisinfected of surfaces contaminated or environments could be a factor in increasing the propagation of covid -19 and its variants.

CONCLUSION

This present study establishes the effectiveness of chlorine water (bleach) in the fight against the propagation of covid through the disinfection-cleaning of surfaces in African countries. It should be concluded that citizens should be well informed about the practices for the use of cleaning agents related to the storage conditions and the need to check the chlorometric degree of the stock solutions for the preparation of the diluted solution recommended by the WHO.

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CONFLICT OF INTEREST STATEMENT

The authors declared no conflict of interest.

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