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HAND SANITIZERS: CRITICAL EVALUATION OF COMMONLY USED ALCOHOL AND NON-ALCOHOL BASED HAND SANITIZERS IN CONTEXT TO EFFICACY TOWARDS CORONAVIRUS

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ABSTRACT

The world is facing an emergency for public health due to increasing corona virus infection these days. Hand hygiene is considered as a simple and effective tool to interrupt the transmission chain of virus in normal population and health care settings for mitigation of this pandemic. A range of hand sanitizers are available with various combinations of ingredients and mode of delivery these days. But every disinfectant is working on a different mode of action with different contact periods and efficacies. In this scenario it is important to understand which type of hand sanitizers are preferable against this novel corona virus. This review is a venture to provide an insight on different types of disinfectants that we can use to prevent the spread of COVID-19, an ample literature search was performed to draw enough conclusion on the active ingredients, mechanism of action of sanitizers and comparison between the effectiveness of alcohol based/non alcohol based hand sanitizers against corona virus.

KEYWORDS: Corona virus. Hand sanitizers. WHO.

INTRODUCTION

Emergence of COVID-19 pandemic has posed a serious challenge to global public health.[1] COVID-19 is a corona virus disease caused by the severe acute respiratory corona virus 2 (SARA-CoV2). It is a member of family *coronaviridae*, which are enveloped single stranded RNA viruses.[2] Since there are only supportive therapeutic strategies available to combat with this pandemic, reducing transmission is the other supportive method at this time.[3] Centre of Disease control and prevention (CDC) has promoted hand hygiene by hand washing or via use of hand sanitizer. Due to either lack of access to running water or lack of time to wash hands thoroughly, hand sanitizing is considered to be a good practice to prevent spread of COVID-19.[4]

There are many hand sanitizers available with various combinations of ingredients. Due to popularity of hand sanitizers during this pandemic, it is very crucial to understand which type of sanitizers are effective against corona virus. In this review, we will discuss various hand disinfectants with respect to their formulations, contact time and their effectiveness against corona virus.

Hand Sanitizers

Hand sanitizers are mainly divided in two groups: Alcohol based (ABHS) and Non alcohol based or alcohol free hand sanitizers (NABHS). Alcohol mainly include ethyl alcohol and isopropyl alcohol. Ethyl alcohol at concentration 60 -80% is an efficient virucidal agent and inactivates all lipophilic viruses can be used against coronavirus as well. Alcohol free or NABHS mainly include chemicals with antimicrobial activity such as chlorhexidine, povidone iodine, hydrogen peroxide, benzalkonium chloride.[5]

Mechanism of Action

Every disinfectant has a different mechanism of action i.e., some attack at cell membrane, others at proteins or nucleic acid, whereas many factors affect the efficacy of a disinfectant such as presence of organic matter, contact time, concentration of the disinfectant etc. Alcohol works by denaturing the proteins in plasma membrane. It is the mainstay of almost all the available hand sanitizers as it is easily available and has efficient activity against wide range of microorganisms including bacteria and viruses. Although the efficacy may decrease in presence of organic matter (Especially proteinaceous material).

Alcohols are flammable in nature and must be stored in a cool, well-ventilated area. They evaporate rapidly.[6]

Other than alcohol hydrogen peroxide which is a clear, colorless, liquid, and a strong oxidizing agent. It liberates toxic free hydroxyl radical that attack the membrane lipids and DNA, which explains its mode of action against microorganism. It has broad spectrum activity against viruses, bacteria and fungi.[7] Hydrogen peroxide can be used in concentration ranging from 1% - 6 % as topical ointment for wound care but it has many side effects such as redness, irritation and it is no longer used as active ingredient of hand sanitizers.[8]

Chlorhexidine is another alternative often formulated with gluconate and acetic acid to make it water soluble. It is colorless, odorless and bitter in taste.[9] It has good efficacy against enveloped viruses. Its activity is not affected by presence of organic material. It is safe to use as skin disinfectant, but higher concentration can cause dermatitis.[6]

Iodine was once an effective antiseptic used for skin disinfection. It can penetrate the microbial cell wall and form complexes with amino acids or unsaturated fatty acids to impair the synthesis of cellular components.[10] However povidone–iodine is the most commonly used iodophor, combination of poly vinyl pyrrolidone and iodine. It has germicidal activity of iodine but unlike iodine it is non-staining, less toxic and irritant in nature.[5] Iodine attacks the surface protein of enveloped viruses and have good efficacy against enveloped viruses such as Influenza and Adenoviruses.[11] It is used in a concentration of 7.5% - 10% for hand hygiene.[7]

Benzalkonium chloride is a Quaternary ammonium compound (Quats). It has broad spectrum of activity against bacteria, fungi and enveloped viruses.[12] Although its antimicrobial activity is highly affected by presence of organic matter.[6] (Table 1)

Methods

In this review the available literature for various hand sanitizers along with their potential of eradication of pathogens is reviewed. The search terms used are hand sanitizers ABHS, Non-ABHS, contact period, mechanism of action and efficacy over Coronavirus. The data extracted for this review contains the major findings of the studies with author name, place and year.

RESULTS

Efficacy of Alcohol – Based Hand Sanitizers Against Coronavirus

WHO have recommended two alcohol based sanitization formulations to prevent the spread of pathogens in general.[6]

Formulation I:*

- Ethanol — 80% by volume (vol/vol)
- Glycerine (also known as glycerol) — 1.45% vol/vol
- Hydrogen peroxide — 0.125% vol/vol

Formulation II:*

- Isopropanol (also known as 2-propanol or isopropyl alcohol) — 75% vol/vol
- Glycerine — 1.45% vol/vol
- Hydrogen peroxide — 0.125% vol/vol

It has been reported that SARS Co -V, Middle East Respiratory Syndrome coronavirus (MERS), Zika (Zika V), Ebola virus (Ebola v) and other enveloped viruses could be inactivated by these WHO formulation of hand sanitizers within 30 seconds of exposure time.[13] Other studies also proved the same results with different concentrations of alcohol against various pathogenic viruses with a short contact period.[4,13-15]

Table 1: Different types of disinfectants along with their properties.

Disinfectant	Combination	Contact period	Mode of action	Advantage	Disadvantage
Alcohol	WHO formulation I and II	30 seconds	Dissolve the lipid membrane and denatures protein	Have rapid action .	-Flammable in nature -Can cause dryness of skin -Efficacy decreases in presence of proteinaceous material
Hydrogen peroxide	-Isopropanol- 75% vol/vol -Glycerine-1.45% vol/vol -Hydrogen peroxide-0.125% vol/vol	30 seconds	Eliminate spores on the bulk solution	Used in low concentrations	-Corrosive in nature -Cause redness and irritation on
Chlorhexidine	-Chlorhexidine Gluconate solution IP- 5% v/v -Ethyl alcohol IP -61% w/v	1 minute	Disrupt cell membrane	-Good activity against enveloped viruses -Not affected by presence of organic	Not efficient against coronavirus used in combination with alcohol

				material	
Povidone iodine	5-10% povidone iodine solution (polyvinylpyrrolidone with iodine)	15 seconds	Attacks the surface proteins of enveloped viruses	Good activity against bacteria, fungi and enveloped viruses	-Stain skin with its color - Increased concentration may cause skin irritation
Benzalkonium chloride	0.12% benzalkonium chloride	5 minutes	Inactivates enzymes and degrade the cell – proteins	Good activity against enveloped viruses	-Antimicrobial activity is highly affected by presence of organic material - Requires much time for activity

Table 2: Review of various studies in relation to use of disinfectants, their combinations, efficacy and concentrations.

Study	Disinfectant	Concentration	Efficacy
Siddharta A et al, 2017[13]	Alcohol	Formulation I and II*	WHO formulations I and II of hand sanitizers inactivate SARS Co-V, MERS, Zika V, Ebola V in 30 seconds of exposure time
Kratzel A et al ,2020[4]	Alcohol	Formulation I and II*	WHO formulations I and II of hand sanitizers inactivate SARS Co-V 2 in 30 seconds of exposure time
Rabenau HF, Kampf G, Cinatl J, Doerr, 2005[15]	Alcohol	45% iso-propanol, 30% n-propanol and 0.2% mecetronium etilsulphate	inactive SARS Co-V in 30 seconds of exposure time
Kampf G, 2018[14]	Alcohol	42.6% of ethanol	Inactivate SARS and MERS in 30 seconds of contact period
Kariwa H et al[19]	Povidone iodine	0.23%,0.25% and 1% of PVP-I	inactivates the SARS Co-V in 1 minute of contact period
Eggers M et al, 2015[18]	Povidone iodine	4%, and 7.5% of PVP-I	inactivate MERS Co-V in 15 seconds of exposure time
Saknimit M et al, 2018[20]	Benzalkonium chloride	0.05% 0f Benzalkonium chloride	inactivate coronavirus in 10 minutes of exposure time
Chin AWB et al, 2020[21]	Benzalkonium chloride	0.1% of benzalkonium chloride	can inactivate SARS Co-V 2 in 5 minutes of exposure time
K. -S. LIM et al, 2008[9]	Chlorhexidine	0.001% and 0.01% of chlohexidine	Active against all corona viruses
Chin AWB et al,2020[21]	Chlorhexidine	0.05% of chlorhexidine	inactivate SARS CoV-2 in 5 minute of contact period
Siddharta A et al, 2017[13]	Hydrogen peroxide	0.125% hydrogen peroxide	kill SARS Co-V in 30 seconds of exposure time

Efficacy of Alcohol Free Hand Sanitizers Against Corona Virus

On the other hand, the alcohol-free sanitizer makes use of chemicals with antiseptic properties to exert the antimicrobial effects. These chemicals have a different mode of action and function according to their chemical functional groups. A they are nonflammable and often used at low concentrations, they are relatively safer to use among children as compared to ABHS.[16,17] A review has been done in context to various disinfectants, their concentrations and efficacy against microorganisms.[18-21] (Table 2)

CONCLUSION

With all the available literature, it is hard to recommend one hand sanitizer over another. It can be concluded that soap and water is superior over sanitizer. Although unavailability of water for hand washing a sufficient volume of hand sanitizer with all its recommendation must be used to ensure complete hand coverage. The use of Alcohol based hand sanitizer is found to be most common due to their fast action and efficacy against wide range of microorganism including coronavirus. But in some conditions hand washing is preferred over ABHS i.e, when the hands are visually dirty. Finally,

after predicting the data on viruses similar to SARS - CoV-2, this virus could be effectively inactivated with currently available hand sanitizers, although future research should attempt to determine this directly.

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