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Side Effects of Using Disinfectants to Fight COVID-19

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Coronavirus refers to a group of widespread viruses. The name refers to the specific morphology of these viruses because their spikes look like a crown under an electron microscope. Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered crown-shaped virus. Human-to-human transmission of the coronavirus is through coughing, sneezing, discharge from the nose and mouth. The virus can be transmitted from 1 to 2 meters through coughing or sneezing. Another way of transmission is by hand contact with the environment and virus-infected surfaces. Various substances are used to disinfect the body and surfaces. However, improper and unsafe use of these disinfectants can lead to other toxic effects in people that can be far more dangerous than the virus itself.

Introduction

Coronavirus refers to a group of widespread viruses. The name refers to the specific morphology of these viruses because of the spikes on their surface that look like a crown under an electron microscope [1]. Coronaviruses are a large family of viruses, infecting animals and humans with diseases ranging from colds to more severe illnesses such as Middle East Respiratory Syndrome (MERS-CoV) and Acute Respiratory Syndrome (SARS-CoV) [2][3][4]. In November 2019 a new coronavirus was described in China that has never been seen in humans before [5]. On February 11, 2020, the Corona Virus Research Group of the International Committee for the Classification of Viruses officially named it SARS-CoV-2 and identified it as the SARS-CoV sister virus [6][7][8].

The disease caused by SARS-CoV-2 is called Coronavirus Disease 2019 (COVID-19) [7]. Coronavirus belongs to the genus Coronavirus, the family Coronaviridae, and the order Nidovirales. The virus has the largest genome known among RNA viruses [9]. So far, the coronavirus infection has only been seen in vertebrates, causing respiratory, gastrointestinal, and neurological diseases in humans and animals. Many of the viruses that infect humans are essentially viruses that are transmitted from animals. When viruses mutate in animals, they can infect humans, multiply in the human body, and spread among humans [10][11][12]. Most people infected with the COVID-19 virus experience mild to moderate respiratory illness and recover without special treatment. Older people and people with major medical problems such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to get a serious illness. The best way to prevent and slow down the transmission is to be fully aware of the COVID-19 virus, the disease, and how it spreads. Washing your hands or disinfecting them with alcohol-based items repeatedly and without touching your face can prevent its spread. Currently, there is no specific vaccine or treatment for COVID-19. However, many clinical trials are underway that assess potential treatments. According to the latest information, the human-to-human transmission of the coronavirus is through coughing, sneezing, discharge from the nose and mouth. The virus can be transmitted from 1 to 2 meters through coughing or sneezing. Another way to transmit, contact hands with the environment and virus-infected surfaces such as equipment, door handles, desks and chairs, valves, stair railings, switches, and electrical outlets, and all common items (banknotes, documents) hand in hand and so on, so it is important to wash hands and face with soap and water after contact with any person or suspicious objects [1][13][14][15][16][17]. The table below shows the persistence of the coronavirus on different surfaces (Table 1)[18].

Type of surface	Virus	Strain/Isolate	Inoculum (viral titer)	Temperature	Persistence
Steel	MERS-CoV	Isolate HcoV-EMC/2012	105	20°C	48 h
	HcoV	Strain 229E	103	21°C	5 d
Aluminium	HcoV	Strain 229E and OC43	5×103	21°C	2-8 h
Metal	SARS-CoV	Strain P9	105	RT	5 d
Wood	SARS-CoV	Strain P9	105	RT	4 d
Paper	SARS-CoV	Strain P9	105	RT	4-5 d
	SARS-CoV	Strain GVU6109	106	RT	24 h
			105		3 h
			104		< 5 min
Glass	SARS-CoV	Strain P9	105	RT	4 d
	HcoV	Strain 229E	103	21°C	5 d
Plastic	SARS-CoV	Strain HKU39849	105	22-25°C	≤ 5 d
	MERS CoV	Isolate HcoV-EMC/2012	105	20°C	48 h
				30°C	8-24 h
	SARS-CoV	Strain P9	105	RT	4 d
	SARS-CoV	Strain FFM1	107	RT	6-9 d
	HcoV	Strain 229E	107	RT	2-6 d
PVC	HcoV	Strain 229E	103	21°C	5 d
Silicon rubber	HcoV	Strain 229E	103	21°C	5 d
Surgical glove (latex)	HcoV	Strain 229E and OC43	5×103	21°C	≤ 8 h
Disposable gown	SARS-CoV	Strain GVU6109	106	RT	2 d
			105		24 h
			104		1 h
Ceramic	HcoV	Strain 229E	103	21°C	5 d
Teflon	HcoV	Strain 229E	103	21°C	5 d

Table 1: Persistence of coronaviruses on different types of surfaces [18].

*MERS = Middle East Respiratory Syndrome; HcoV = Human Coronavirus; SARS = Severe Acute Respiratory Syndrome; RT = Room Temperature

The human coronavirus is sensitive to ultraviolet and heat rays [19][20]. It can survive for several years at -60° C. But as the temperature rises, the resistance of the virus decreases. Coronavirus can be effectively inactivated after 30 minutes at 56° C. The human coronavirus is not resistant to acids and alkalis, and the optimum pH is 7.2 [21][22][23]. Fat-soluble solvents such as ether, 70% ethanol, chlorine-containing disinfectant solutions, proxy acetic acid, and chloroform can inactivate the virus. But chlorhexidine can’t effectively inactivate it. Antiseptic agents are used on inanimate surfaces while disinfectants are used on the skin, mucosa and living surfaces. Antiseptic agents are harmful to the skin and healthy areas, while disinfectants can be used on the skin and healthy areas and are harmless. Antiseptic agents have the most destructive and killing effects of bacteria (biocidal), while disinfectants are more likely to inhibit the growth of bacteria (biostatic). Alcohol has both disinfectant and antiseptic properties. There are different types of disinfectants in physical and chemical groups [1-24].

Physical disinfectants

1.Heat 2. Exhausted by cold 3. Drying 4. Radiation (heat is used in various forms such as burning, boiling, intermittent heat of water vapor with pressure and dry heat) [24].

Chemical disinfectants

Aldehyde (formaldehyde), formal chemical sterilizers (such as ethylene oxide ETO), acids (acetic acid, hydrochloric acid), alcohols, phenols and their derivatives (phenol, detol, hexachlorophene, chlorhexidine, chlorhexidine), alkalis (bicarbonate), bicarbonate sodium, sodium (oxygenated water), halogens (oxygenated water), heavy metals such as mercury, surfactants or detergents including: cationic surfactants, anionic surfactants (soaps), non-ionic surfactants (sulfate derivatives in dishwashing liquid and detergent powder), amphoteric surfactants (main surfactants and carpet shampoos, baby shampoos) [25][26].

The following Table shows the effect of several samples of disinfectants and antiseptics recommended for coronavirus (Table 2).

Biocidal agent	Concentration	Virus	Strain / isolate	Volume / material	Organic load		Reduction of viral infectivity (log10)
Ethanol	70%	HcoV	Strain 229E	20 µl/ stainless steel	5% serum	1 min	>3.0
Benzalkonium chloride	0.04%	HcoV	Strain 229E	20 µl/ stainless steel	5% serum	1 min	<3.0
Sodium hypochlorite	0.5%	HcoV	Strain 229E	20 µl/ stainless steel	5% serum	1 min	>3.0
	0.1%	HcoV	Strain 229E	20 µl/ stainless steel	5% serum	1 min	>3.0
	0.01%	HcoV	Strain 229E	20 µl/ stainless steel	5% serum	1 min	<3.0
Glutardialdehyde	2%	HcoV	Strain 229E	20 µl/ stainless steel	5% serum	1 min	>3.0

Table 2: Inactivation of coronaviruses by different types of biocidal agents in carrier tests[18].

Due to the harmful effects of improper and unsafe use of those antiseptics and disinfectants, which in some cases lead to severe side effects in people, the effects and consequences of these substances on humans are discussed below.

Sodium hypochlorite

The use of sodium hypochlorite in the production of bleach for disinfection and polishing of surfaces has been common for 200 years as 10-15% solution and pH = 13 for industrial use and 5% concentration with pH = 11 for in-home use. The American Industrial Hygienists Association (AIHA) has stated that the amount of sodium hypochlorite encountered every 15 minutes is 2 mg per cubic meter. (AIHA / WEEL-STEL: 2mg / m3) It should be noted that, according to chemical hazard rhombus, the above substance has a slight instability (code 1), the risk of oxidation (OX) and the serious risk of damage to the respiratory system (code 3) [27-28]. Sodium hypochlorite is a toxic substance. Its color is close to yellow and its taste and smell are spicy [29]. Its antiseptic properties are due to the production of free chlorine [30]. When sodium chloride is used, chlorine gas is emitted, which is one of the uses of chlorine gas, due to its toxic nature, for military purposes and as a chemical weapon. For the first time during World War I on April 22, 1915, the Germans used this gas against British forces [31-32]. Since then, chlorine gas has been classified as a chemical weapon by the group of Chocking Agents [33]. One of the causes of gas poisoning in non-industrial environments such as homes is the mixing of acidic compounds (pipe openers and scavengers) with household bleaching products that contain hypochlorite, especially indoors and without proper ventilation [34]. Adding acid to a solution containing hypochlorite causes chlorine gas to evaporate. Adding ammonia to this type of product may cause active chlorine species such as chloramine. The signs and symptoms of chlorine gas poisoning appear in different forms depending on the concentration and time of contact with it [30]. At concentrations below 1 ppm, the signs and symptoms are mild and minor. At concentrations of 1-5 ppm, mild irritation of the mucous membranes occurs. 5-15 ppm concentrations may lead to moderate stimulation of the upper airways. Higher concentrations than 30 ppm may cause shortness of breath, nausea, chest pain, and coughing immediately. The results of the studies showed that exposure to chlorine gas at concentrations of 35-31 ppm for one hour may be fatal. Inhalation of 1000 ppm chlorine gas may be fatal for several minutes [35]. Chlorine gas at high concentrations (such as in industrial accidents) can damage the mucous membranes of the airways [31]. The hydrochloric acid produced by the reaction of chlorine with water may also cause secondary tissue damage [30]. In contact with low chlorine concentrations (such as the release of chlorine gas due to the addition of acid to household cleaning products), irritation occurs in the airways [35]. Chlorine irritates the respiratory tract, causing gas to swell in the mucous membranes and burn the skin in the liquid state [36]. Its 3.5 ppm value is required to be recognized as a distinctive odor, and its 1000 ppm value is lethal [37]. That’s why chlorine was one of the gases used during World War I [31]. Exposure to this gas should not exceed 0.5 ppm (with an average weight of 8 hours - 40 hours per week) [38]. Intense exposure to large amounts of concentrated chlorine (but not lethal) can cause lung edema or dehydration, which is a very serious condition. Constant contact with small amounts of it weakens the lungs and increases the vulnerability of the lungs to other diseases, especially coronavirus [35].

Methanol

Methanol has detrimental effects on eyes and is absorbed through the skin [39]. Between methanol with metals such as potassium, magnesium, oxidizers such as barium chloride, bromine chlorine, hydrogen peroxide, and sodium have explosive condition if there is heat. Methanol reacts strongly with chloroform, dimethyl zinc, cyanide chloride, and nitric acid. In the case of thermal decomposition, methanol is produced into carbon dioxide ($CO2$, CO) and formaldehyde [40-43]. Methanol is a toxic substance, and drinking it causes blindness and even death. Masks and gloves should be used when using methanol because it can also be absorbed through breathing, skin, and drinking. Symptoms of methanol drinking include headache, dizziness, nausea, imbalance, anxiety, drowsiness, and eventually anesthesia and death [44].

Hydrogen Peroxide

In the past, oxygenated water was used to dress up infectious wounds due to its antiseptic properties, but today it is no longer used in dressings due to its damage to adjacent tissues and is only occasionally used to disinfect equipment or surfaces [45-46]. Because it sometimes used to treat bad odors. In erythema tablets, 36% of hydrogen peroxide is bound to 64% urea, and when these tablets are placed in the mouth, it releases oxygen. So it kills germs in the mouth and bleaches teeth [47]. Dilute oxygenated water is also used for gargling and is effective in making cold medicines. Hydrogen peroxide solution can corrode when used on metal objects for a long time [48]. In many countries, hydrogen peroxide is used to purify drinking water. However, high doses of this substance can cause blisters in the mouth and inflammation of the abdomen and can lead to diarrhea and vomiting. Concentrated hydrogen peroxide catches fire immediately if it is placed next to flammable materials. Hydrogen peroxide compounds are highly reactive and volatile [49-50]. Safety precautions must be taken when using this compound. If you use this compound regularly, you must protect yourself against the side effects of this compound.

Safety Tips Use of Disinfectants

Buy disinfectants and alcohol in the required amount, avoid excessive storage, and keep out of the reach of children. When preparing a disinfectant solution, follow the safety tips and do not do it front of children. so do not use methanol on hot surfaces, near gas flames, and light cigarettes. and turn it off if it catches fire by using extinguishers other than water. Avoid contact of disinfectants antiseptics agents and methanol with the eyes. Cleaning your personal equipment that impregnated with alcohol or after use put in the trash. When using disinfectants and antiseptics agents use appropriate filter or cartridge respirators with enclosed glasses, appropriate clothing, hats and other personal protective equipment's safely. Also, for using them refer to material safety data sheets.

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