iJETRM
International Journal of Engineering Technology Research & Management

SANITIZATION CHAMBER BASED ON MICRO-CONTROLLER

Sushant Nagappa Imade
Shubham Subhash Mali
Sahil Kavishwar Sarang
Suraj Arvind Pednekar
Prof. Pranita Chavan
UG Student, Electrical Engineering department, Pillai HOC College of Engineering and Technology, Rasayani.
Assistant Professor, Electrical Engineering department, Pillai HOC College of Engineering and Technology, Rasayani

ABSTRACT-
Looking at the current situation of pandemics, sanitization has become the most vital part of our life. While carrying out every other daily activity, our whole body exposes to the outer environment and it becomes necessary to decrease the bio-burden levels on selected materials and the human body. The proper sanitization being not feasible and time-consuming in certain cases, faster and effective alternatives of sanitization processes are necessary. It was observed that with each degree rise in temperature and percent humidity, the contagiousness of the disease caused by the Coronavirus, named COVID 19 goes down significantly. To ensure all, we came with a project named a sanitization chamber. The main objective of the chamber is to prevent spreading infection by sanitizing each & every individual entering into any school, colleges, market places, homes, etc. So, while working on this project we are fulfilling today's need for sanitization, and simultaneously we are implementing electrical and electronics concepts such as Arduino-based microcontroller, Converter, Sensors, Battery Backup, etc. to meet the appropriate requirements of the project.

KEYWORDS:
Sanitization, Pandemic, Disinfectants, COVID-19, Virus, Contamination .

INTRODUCTION

The COVID-19 pandemic, also known as the coronavirus pandemic, is an ongoing pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), first identified in December 2019 in Wuhan, China the World Health Organization declared the outbreak a Public Health Emergency of International Concern in January 2020 and a pandemic in March 2020. As of December 2020, more than 63.5 million cases have been confirmed, with more than 1.47 million death attributed to COVID-19

COVID-19 spreads via some means, primarily involving saliva and other bodily fluids and excretions These fluids can form small droplets and aerosols, which can spread as an infected person breathes, coughs, sneezes, sings, or speaks. The virus may also spread by direct contact and it is unknown how often it spreads via fomites (contaminated surfaces).

Contaminated surfaces can be anything including railway, bus or car seats, holding rods, Staircase handrails so it is necessary to sanitize exposed body as well as body outfits with effectively and efficiently, so coming us with the idea of sanitization chamber which involves the main sanitizing with temperature sensing which will provide screening of human entering the chamber.

The sanitization chamber involves many more designing criteria for the safe operation of the chamber involving height, space, nozzle distance, and arrangement for an effective sanitizing process. Also, the safety parameters and guidelines by authorities need to be followed. and the automation part is also required to be fulfilled to reduce human effort and efficient sanitization process.

The designing part of the chamber, required circuitry, temperature sensing, occupancy detection, automation, and implementation of the chamber are discussed further in the report.

iJETRM
International Journal of Engineering Technology Research & Management

II. METHODOLOGY

There are three different routes of the transmission of C0VID-19 viruses from a contagious person to a healthy person. These are the direct route, indirect contact, and airborne transmission

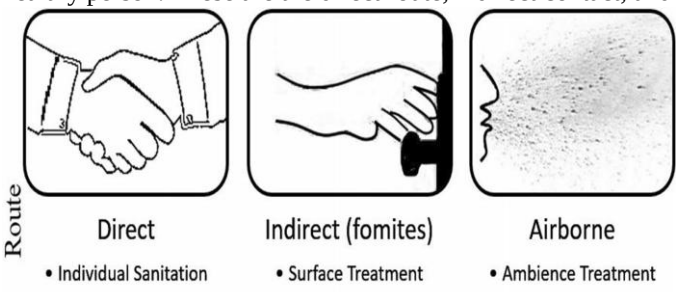


Fig. 1 ROUTES OF COVID-19 TRANSMISSION AND MODE OF SANITIZATION

The direct mode transmission implies the transfers of viruses between infected and susceptible hosts via person-to-person contact. While the indirect mode of transmission indicates the transmission of the virus from the objects used by the infected person or the immediate environment of the infected individual. The airborne transmission of the virus occurs through the droplet spray formed during natural human exhalation flows. To avoid the above transmissions of COVID-19 we have different categories of sanitization in the following section

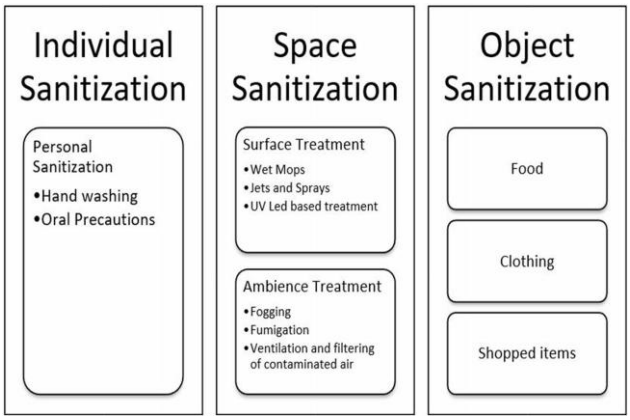


Fig.2 CATEGORIES OF SANITIZATION TO CONTAIN THE SPREAD OF COVID-19

INDIVIDUAL SANITIZATION

One should address the community-level spread of disease at individual scales before handling it on a social scale. Individual sanitization helps in reducing the mammoth spread of the virus and prevents it from taking a colossal shape for society as a whole. The crowd is made of individuals who are a part of a crowd, so it is incumbent on every individual to act for the benefit of the larger group. Masks and etiquettes of sneezing have largely been promoted since the outbreak of a pandemic. Different regulatory bodies have also stressed the central role of hand sanitization.

HAND SANITIZATION

For the disinfection of the hand, alcohol-based hand rub or soap with water are preferred. The alcohol-based hand rubs are mainly formulated with ethanol, propane-2-oil, or propane-1-oil. Alcohol-based hand rubs inactivate the virus. Hand wash containing 62-70% alcohol is an effective virus.

However, localities are lacking alcohol-based sanitizer or water and soap facilities. It is the usual practice of using ash, mud, and or rubbing of hand on the ground in rural areas of the Indian subcontinent. A survey in Kolkata India reported that 41% of slum residents and 26% of rural villagers use ash for hand washing. It is concluded that washing once hand running water with friction for the 20s is effective with marginal improvement on using soap. In the process of hand sanitization, mechanical removal is followed by disinfection using sanitizing agents like alcohol and soap to inactivate the virus.

iJETRM
International Journal of Engineering Technology Research & Management

ORAL PRECAUTIONS

With masks, being a mandatory precaution during this pandemic active sanitization of inspired and expired air is required. It is suggested that nasal applications of coconut oil as a protective measure. Although the claim is traditional and untested. The traditional practice of oil pulling too can be used alongside masks to capitalize on the virucidal ability of fatty acid.

Alongside the proposed active sanitization of breath flows regular cleaning and disinfection of masks is important. Cloth facemasks can be detergent washed and cleaned. N95 masks have found wide use as medical masks and they need regular disinfection and decontamination. It has been proposed use of microwave-generated steam to decontaminate N95 masks using commonly available materials like glass container, rubber band an 1100 w commercially available microwave. It has been established that the process of decontamination retains the respirator fit and function.

The methods established for sanitizing facemasks need an optimal operation. Overexposure to mentioned process will deteriorate the filtration function and fitness of the masks.

SPACE SANITIZATION

Sanitization for surfaces and ambiance can tackle the spread of the COVID-19 virus in professional and domestic spaces. The following sections briefly review the required sanitization process.

(A) SURFACE TREATMENT

A spray of respiratory droplets from an infected individual may also land on surfaces where the virus could remain viable and can serve as a source of transmission. It shows that viruses can persist on surfaces from 2h to 9 days. The survival time depends upon the type of surface, relative humidity, temperature, and the stain of the virus.

It is determined that the stability of the COVID-19 virus and the decay rate on different surfaces. It is reported that viruses on plastics and stainless surfaces could be viable for up to 72h. While, on copper and cardboard surface, the virus titer is less stable and can only survive for 4h to 24h respectively. Furthermore, it is reported same that the persistence of the virus reduces with time. The contaminated surfaces can be decontaminated within a minute using common surface disinfection procedures with 62-71% ethanol, 0.5% hydrogen peroxide, or 0.1% sodium hypochlorite.

So the following methods can be adopted for sanitizing surfaces: Mops, sprays, and UV-led based treatment.

WET MOPS

Chemical disinfectants applied to floors, doorknobs, table surfaces and surfaces in domestic and office use can be used to deactivate the corona spread. The measure to contain the spread of the virus needs the application of a fluid layer that has disinfectant added to it. One can wash the surfaces with water, soap, and/or USEPA identified disinfectants. Wet mops moistened with disinfectants perform the role of disinfection due to the inactivation of the virus.

JETS AND SPRAYS

Surfaces that are not accessible for mopping can be cleaned using jets and sprays. An aerosol created using disinfectant and the base fluid combination can be used to spray the inaccessible areas. The nanometer-sized corona embedded in micron-sized cough droplets can easily reach inaccessible areas when an infected person coughs or sneezes. So proper use of spray and jet should be employed to disinfect such inaccessible surfaces.

Better disinfection is obtained when large dust particles on the surfaces are removed using wipes or detergent. It is demonstrated that the use of 1.4% improved hydrogen peroxide spray for soft surfaces and inaccessible parts reduces contamination. The process does not need any mechanical wiping.

iJETRM
International Journal of Engineering Technology Research & Management

UV LED-BASED TREATMENT

For disinfecting N95 masks ultraviolet irradiation is an option to disinfect and decontaminate surfaces and inanimate objects like clothes, utensils, medical instruments. It is demonstrated that ultraviolet irradiation is effective to inactivate surface viruses. Although the UV LED is useful in decontaminating influenza viruses including the recent novel coronavirus, their effectiveness decreases with increasing relative humidity.

(A) AMBIENCE TREATMENT

The contagiousness of COVID-19 is acute due to its long half-life and airborne spread. So the transmission of virus by airborne route creates the necessity for ambiance sanitization. On a colony or street level, infected areas and containment zone become difficult regions for human involved sanitization.

Fig.3 APPLICATION OF DRONES FOR SANITIZATION

Nowadays agriculture spraying drones can be used for the sanitization of public places. It can carry up to 16 liters of spraying tank and can cover a 100,000 square meter area. Smaller ambiance can be sanitized by fogging, fumigation and ventilation, and filtering of contaminated air.

FUMIGATION

Fumigants have been traditionally employed for a long time for their germicidal tendencies. Fumigation using ozone gas and chlorine dioxide is effective for the influenza virus. It has been seen that contaminated surfaces can be disinfected using hydrogen peroxide fumigant. The use of paraformaldehyde for highly pathogenic avian influenza (HPAI) virus as a fumigant to decontaminate surfaces in the laboratory, but the use of vaporized hydrogen peroxide (VHP) as a safer alternative than formaldehyde especially to decontaminate enclosed areas. As mentioned earlier that the use of hydrogen peroxide as a fumigant to disinfect N95 masks.

Open-air fumigation of bigger areas are risk-prone due to tangential toxicity of the disinfectants employed. If there is an alternate, safer and non-toxic fumigant, full air fumigation can be employed. Any fumigation method employs chemical disinfectant and has potential risk for people around. It is advisable to properly ventilate the ambiance and renew the air before human use.

FOGGING

The fogging device spray disinfectant mist of various particle sizes and disperse into the air as aerosol. It can be used for both surface and ambiance sanitization. The effectiveness of the generator depends on the particle size, humidity, and contact time of the disinfectant. The droplet size of the aerosol is one of the most significant factors that decide the success of spraying insecticide. The fogging technique is frequently used in agriculture for the application of pesticides, mosquito control and the food industry.

The fogging technique is a rapid approach to control the outbreak of the infectious disease in epidemic situations and to control flying insect pests. This technique requires the minimum exposure time to kill insects

iJETRM
International Journal of Engineering Technology Research & Management

or disease viruses. However, it is an expensive method and may not be perfect for all situations. It is used for the decontamination of the suspected area, which cannot be properly cleaned with mopping.

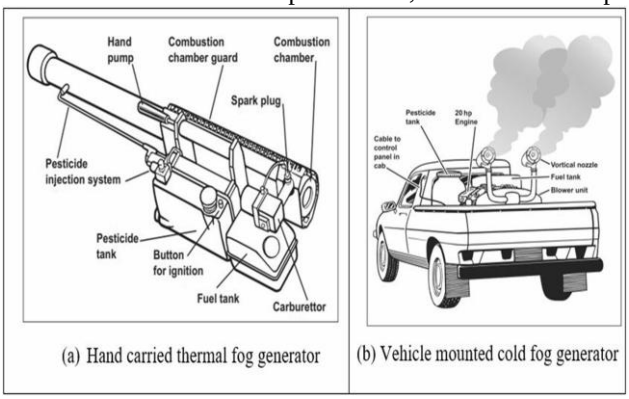


Fig. 4 FOG GENERATORS

There are two types of ground or aerial sprayers: thermal and cold fog generators. Thermal fog requires a carrier fluid generally oil to dilute the concentration of insecticide. A hot gas heats the oil decreasing its viscosity which emerges from the fog generator's nozzle as a vapor. Whereas spray from the cold fog is generated by mechanical means without using any heat source. The selection of the fog generator depends on the applications, such as type of space and accessibility of the target area.

The size of the aerosol coming out from the nozzle should be in the range of 10-30 micrometers which can remain in the atmosphere for a longer time.

VENTILATION AND FILTERING CONTAMINATED AIR

Understanding the flow pattern in a building is an important necessity to manage the quality of indoor air and to have an efficient exchange of air with the surroundings. The overall study accounted for removal of a contaminant.

In addition to the sanitization process, public places have seen sprouting of sanitization chambers or disinfectant tunnels. The disinfection tunnel can be installed at crowded public places such as shopping malls, vegetable markets, hospitals, industry, etc. The entry of people to commonplace should be restricted through the tunnel only.

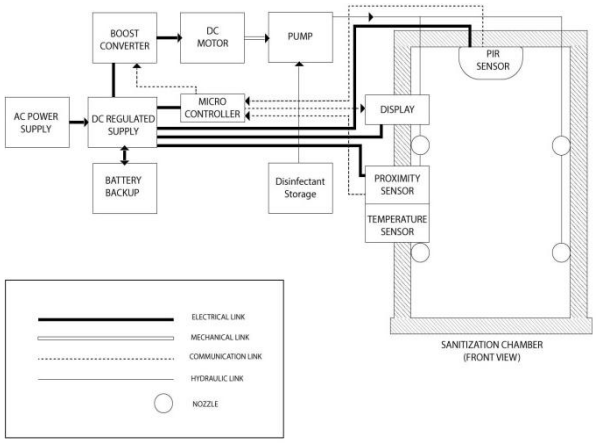
OBJECT SANITIZATION

Ultraviolet irradiation and cleaning of surfaces using approved disinfectants are crucial modes of sanitization of objects in domestic and office spaces. Use alcohol wipes to disinfect stethoscopes. Similarly, alcohol-based soap/detergent wipes can be used to clean tables, computers, and other inanimate objects.

Clothes can be sanitized by proper wash. Vegetables and fruits can be sanitized using water, although alcohol-based vegetable wash is becoming news too. Similarly, vegetables are decontaminated by rubbing properly under a running water tap.

iJETRM
International Journal of Engineering Technology Research & Management

Fig.5 BLOCK DIAGRAM



1. AC POWER SUPPLY
2. DC REGULATED POWER SUPPLY
3. BATTERY BACKUP
4. BOOST CONVERTER
5. DC MOTOR AND PUMP
6. MICROCONTROLLER
7. DISPLAY
8. TEMPERATURE SENSOR
9. PROXIMITY SENSOR
10. PIR SENSOR
11. DISINFECTANT STORAGE

IV. PROPOSED METHODOLOGY

AC POWER SUPPLY, DC REGULATED POWER SUPPLY, BATTERY BACKUP-

It consists of regulated DC power with battery backup forming a battery-backed power supply having 12v DC at its output, AC supply from mains is converted into unregulated DC then converted into regulated DC with battery backup which provide the power to the whole circuitry in absence of mains supply and charges it selves when the mains supply is available.

BOOST CONVERTER-

12v DC from DC regulated power supply is boosted to a required voltage of the motor. This boost converter also has shutdown capability. So that turning off boost converter completely stop the motor.

DC MOTOR AND PUMP

DC motor and pump combination is used to spray disinfectant. The pump for disinfectant is so selected that it will provide enough pressure to spray the disinfectant.

MICROCONTROLLER

The microcontroller is used to serve the automation process, and provide a pulse to the boost converter.

DISPLAY,TEMPERATURE SENSOR, PROXIMITY SENSOR, PIR SENSOR

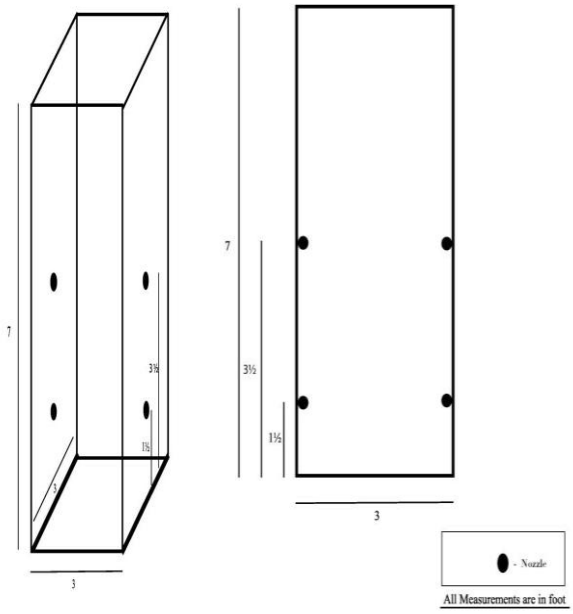
All these sensors are used to measure the temperature of the human body, to detect human occupancy inside the chamber, and display to show temperature.

iJETRM
International Journal of Engineering Technology Research & Management

DISINFECTANT STORAGE

Disinfectant storage stores the disinfectant.

Fig. 6 DEMO MODEL PICTURE



V. CHAMBER DIMENSIONS

Mainly there are 2 types of chamber walkthrough chamber and tunnel type chamber both types are available in the market and both have their advantages and disadvantages.

1) WALKTHROUGH CHAMBER

In the walkthrough chamber, a person has to walk through the chamber. So, several nozzles are attached at a particular distance. So as the human being is detected in the chamber all the nozzles start spraying the disinfectant. The problem with this design is that a large place is required to implement the chamber. And also due to all nozzles spraying at the same time, some amount of disinfectant solution gets wasted. This might increase the operational cost of the chamber. Also, the resources are limited during the period of this pandemic.

2) TUNNEL TYPE CHAMBER

In Tunnel type chamber person has to stand inside the chamber for few seconds and in the tunnel type chamber, unlike walkthrough chamber, few nozzles are attached to the spray disinfectant so there is no wastage of disinfectant and reducing the operational cost and optimum use of disinfectant in scenario of limited resources available during a pandemic. Also, the design of the chamber is more compact Hence the Tunnel type chamber is best suited for the institute level operation.

The height and width of the chamber are decided using the data of humans entering the chamber. Considering this chamber is installed in institute premises so it is necessary to go through the human height data of Indian person. And it comes to be 5 to 5.5 feet on average.

Hence the height and width of the chamber are kept 7 feet tall and 3fite wide.

NOZZLE ARRANGEMENT MOTOR PUMP

There are various guidelines given by WHO directly and indirectly on their official site. As per World Health Organization guidelines for disinfectant spraying the disinfectant solution should not reach the sensitive parts of the face i.e. eyes, nose, ears. Also, natural alcohol-based disinfectants should be used.

iJETRM
International Journal of Engineering Technology Research & Management

Hence the arrangements of the nozzles are so made that the spraying liquid would not reach the face of humans passing from the tunnel.

There are 4 nozzles raised from the ground at 1.5 feet and 3.5 feet for covering the effective area. The diameter of the spraying nozzles is 0.3mm which is best suited for covering the area of spraying. The height and the placement of nozzles are mentioned in the above figure.

The pressure required for the 4 nozzles is about 90psi and it is delivered by a 100gpd pump. The pump used in the arrangement is a diaphragm pump. A diaphragm pump (also known as a Membrane pump) is a positive displacement pump that uses a combination of the reciprocating action of a rubber, thermoplastic, or Teflon diaphragm and suitable valves on either side of the diaphragm to pump a fluid.

BOOKS

"Power Electronics", Ned Mohan, Undeland, Robbins, John Wiley Publication

WEBSITES

1. https://covid19.who.int/
2. https://circuits-diy.com/12v-battery-backup-power-supply/
3. https://www.allaboutcircuits.com
4. https://www.analog.com
5. https://www.edn.com
6.https://electronics.stackexchange.com
7.https://phlipton.com
8.https://arduinodiy.wordpress.com

REFERENCE

1.Zhang Dongyan, Chen Liping, Zhang Ruirui, Xu gang, Lan Yubin, Wesley Clint Hoffmann, Wang Xiu, Xu Min, "Evaluating effective swath width and droplet distribution of aerial spraying systems on M-18B and Thrush 510G airplanes", April 2015, Int J. Agric. & Bio Eng, Vol 8 No.21.

2.Huang, Y. Hoffmann, W.C. Lan, Y. Wu and Fritz, B.K, "Development of a spray system for an unmanned aerial vehicle platform", Dec 2015, Applied Engineering in Agriculture, 25(6):803-809

3, Yallappa D., M. Veerangouda, Devanand Maski, Vijayakumar Palled and M. Bheemanna, "Development and Evaluation of Drone mounted sprayer for Pesticides Applications to crops." Oct. 2017, Research Gate, Conference paper.

4. S.R. Kurkute, B.D. Deore, Payal Kasar, Megha Bhamare, Mayuri Sahane, "Drones for Smart Agriculture: A Technical Report", April 2018, IJRET, ISSN: 2321-9653.

5.Rahul Desale, Ashwin Chougule, Mahesh Choudhari, Vikrant Borhade, S.N. Teli, "Unmanned Aerial Vehicle for Pesticides Spraying" April 2019, IJSART, ISSN: 2395-1052.

6. Prof. B.Balaji, Sai Kowshik Chennupati, Siva Radha Krishna Chilakalapudi, Rakesh Katuri, kowshik Mareedu, "Design of UAV (Drone) for Crops, Weather Monitoring and For Spraying Fertilizers and Pesticides.", Dec 2018, IJRTI, ISSN: 2456-3315.

7.Prof. P. Mone, Chavhan Priyanka Shivaji, Jagtap Komal Tanaji, Nimbalkar Aishwarya Satish, "Agriculture Drone for Spraying Fertilizers and Pesticides", Sept 2017, International Journal of Research Trends and Innovation, ISSN 2456-3315, Volume 2, Issue 6.

8. F. G. Costa, J. Ueyama, T. Braun, G. Pessin, F. S. Osorio, P. A. Vargas, "The Use of Unmanned Aerial Vehicles and Wireless Sensor Network in Agriculture Applications", 2012, IEEE International Geoscience and Remote Sensing Symposium 2012

iJETRM
International Journal of Engineering Technology Research & Management

9.Spoorthi, S., Shadaksharappa, B., Suraj, S., Manasa, V.K.,"Freyr drone: Pesticide/fertilizers spraying drone-an agricultural approach.", 2017, IEEE 2nd International Conference on In Computing and Communications Technologies, pp. 252-255.

10.G. Ristorto, F. Mazzetto, G. Guglieri, and F. Quagliotti, "Monitoring performances and cost estimation of multirotor unmanned aerial systems in precision farming." ,2015, International Conference on Unmanned Aircraft Systems (ICUAS), pp. 502–509

and M. Bheemanna, "Development and Evaluation of Drone mounted
sprayer for Pesticides Applications to crops." Oct. 2017, Research Gate, Conference paper.

11. G. Ristorto, F. Mazzetto, G. Guglieri, and F. Quagliotti, "Monitoring performances and cost estimation of multirotor unmanned aerial .
11.Jessica Hillburn MT(ASCP), CIC, Brian S Hammond, Elanor J Fendler Ph.D., Patricia A Groziak MS, "Use of alcohol hand sanitizer as an infection control strategy in acute care facility", American Journal of infection control Volume 31, Issue 2, April 2003.
12.Satoru Mitsuboshi, Masami Tsugita, "Impact of alcohol-based hand sanitizers, antibiotic consumption, and other measures on detection rates of antibiotic-resistant bacteria in rural Japanes hospitals", Journal of Infection and Chemotherapy, 2018.

13.Golin, A. P., Choi, D., & Ghahary, A. "Hand Sanitizers: A Review of Ingredients, Mechanisms of Action, Modes of Delivery, and Efficacy Against Coronaviruses". American Journal of Infection Control,2020.