Salt-Based Technologies to Help Stop the Spread of the Coronavirus

(Last Updated : June 23, 2020)
Project Line:
Horizon Scan
Project Number:
EN0017-000

Details

Canadian and international researchers are examining whether coating masks, air filters, and high-touch surfaces with sodium chloride (salt) might be an effective option to help prevent the spread of severe acute respiratory syndrome coronavirus 2 and other viruses and bacteria. This article is an update to the CADTH Health Technology Update article "Antimicrobial Compressed Salt for High-Touch Surfaces" published in 2017.[1] The update explores new developments in the use of salt coatings that may help in response to the COVID-19 pandemic.

How It Works

Antimicrobial surfaces work in one of three ways:[2]

- by changing the surface texture, thereby reducing the ability of bacteria to adhere
- by including an antimicrobial additive in the surface that kills or slows the growth of bacteria
- by using a material with natural antimicrobial properties, such as copper, silver, zinc, or, in this case, salt.

Salt is a natural substance that inhibits the growth of bacteria — partly through dehydration, and also by upsetting the enzyme activity of microorganisms, damaging their DNA.[3] Salt is essential to human and animal life, and has a long history of use in food preservation and flavouring, in pharmaceuticals, in home remedies (for example, as a mouthwash and wound cleanser), and in agriculture and industrial products.[4]

The theory behind salt's potential ability to inhibit severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is that when droplets containing virus particles come into contact with a salt-coated surface, the water in the droplets dissolves some of the salt. When the water evaporates, the salt recrystalizes and the jagged salt crystals pierce the virus membrane and kill it.[5] This method has been tested against influenza viruses[6] and bacteria.[7-9] Salt is therefore being investigated as an antimicrobial for use on high-touch surfaces (Outbreaker Solutions technologies),[10] facial masks[6] and air filter[7] materials, as well as a soaking solution for household materials and cloth masks.[9]

Who Might Benefit?

Potentially, these items could be useful to health care providers and anyone working in or visiting environments where they are at an increased risk of exposure to SARS-CoV-2 or other microbial pathogens. Antimicrobial surfaces able to mitigate the spread of the virus could be beneficial in health care and other public spaces. As the population is encouraged to wear masks in public spaces to decrease transmission, increasing the effectiveness of masks to prevent virus transmission could be a positive development in preventive public health interventions.

Availability in Canada

Currently, none of these salt-based and salt-coated technologies for the prevention of infection are commercially available in Canada or elsewhere.

Outbreaker Solutions has created surfaces made out of compressed sodium chloride that can be used in high-touch areas, like door-push plates, bed rails, toilet handles, and taps.[10] Pilot evaluations of Outbreaker products have been carried out at several Alberta facilities.[11] Currently, Outbreaker is using a grant received through the Roche Canada COVID-19 Open Innovation Challenge to continue with its research and test the effectiveness of compressed sodium chloride surfaces specifically against SARS-CoV-2.[12]

A University of Alberta research team is aiming to create face masks using salt-coated filter material and hope the masks will be ready for market in 12 to 18 months.[5] However, their effectiveness against SARS-CoV-2 has yet to be tested.[5,13]

A research team from Boston University examined whether soaking paper towel in saltwater could help increase its ability to filter virus particles.[9] The use of salt-soaked household materials is theoretically possible at any time; however, this method has not been vetted or recommended by any federal or public health authorities.[9]

What Does It Cost?

The potential price of these products in Canada is not yet known, but as the raw material to build or coat the surface (salt) is inexpensive, the price is likely to be accessible.[1]

Current Practice

There are currently no existing surfaces or masks that are known to kill SARS-CoV-2. While there is no evidence of surfaces that can halt or inhibit the growth of SARS-CoV-2, Health Canada has compiled a list of hard-surface disinfectants with evidence against the virus.[14]

What Is the Evidence?

Compressed Salt Surfaces

As reported in the earlier CADTH article,[1] Outbreaker products are made up of over 99% compressed sodium chloride — similar to salt licks manufactured for livestock.[8,11] Laboratory results posted by the manufacturer report that Outbreaker technology reduced levels of surface bacteria by 90% to 100% one minute after contact compared to a stainless steel surface.[15] However, the test method used (contact agar) does not allow for the detection of a 100% decrease in the viable count and the test method's limit of detection was not stated.[1]

A 2016 pilot study assessed the time it took for compressed sodium chloride to inactivate *methicillin-resistant Staphylococcus aureus* (MRSA), relative to a stainless steel control surface and compared to a copper surface inactivation of MRSA, in a laboratory setting.[8] The compressed sodium chloride surface reduced MRSA contamination by 85% in the first 20 seconds, and by 94% within the first 60 seconds compared to 30% to 35% (at 20 seconds) and 71% to 73% (at 60 seconds) for copper surfaces.[8] Outbreaker is currently examining whether the salt surfaces might have a similar impact on SARS-CoV-2.[12]

Salt-Coated Filter Materials

Quan et al.[6] studied the use of salt-coated filter material for surgical masks and tested them against influenza viruses. The results of the study suggested that the salt-coated filters were able to deactivate aerosolized influenza virus.[6] A team from the University of Alberta is hoping to use this type of salt-coated material to develop face masks that can effectively protect against SARS-CoV-2, which has a similar morphology to other tested viruses,[5] and is waiting on a grant to fund its continuing research (Dr. Hyo-Jick Choi, Department of Chemical and Materials Engineering, University of Alberta: personal communication, May 2020

Jeong et al.[7] evaluated the antimicrobial performance of air filters coated by natural sea salt particles against two types of bacterial bioaerosols. The study results indicated that bacterial growth was inhibited by the salt-coated air filters (maximum reduction rate: 98%).[7] The authors found that the filters' ability to kill the bacteria increased with the amount of natural sea salt particles deposited on the filter.[7]

Salt-Soaked Household Materials

Based on the work by Quan et al.,[6] a research team in Boston soaked filter materials in a saltwater solution to determine whether this method of applying salt to materials would also be able to prevent the penetration of virus-sized particles.[9] Household paper towel, laboratory paper towel, and the middle filter layer of a surgical mask were soaked in a saltwater solution for five minutes and mixed to ensure that all surfaces were saturated.[9] The materials were lightly squeezed to remove excess solution and then placed on a flat surface to air dry overnight.[9] Using immunofluorescence images, the researchers determined that the materials were able to filter out particles the size of viruses in droplet testing and found similar results in both the surgical mask and paper towel. They also found that there was a decrease in bacterial growth beneath pieces of salt-soaked materials that were treated with *E. coli*.[9] The authors suggested that saltwater-treated kitchen paper towel could potentially be used as an inexpensive and easily accessible additional layer of protection for people wearing homemade cloth masks or for health care workers who need to extend the life of their personal protective equipment, or PPE.[9]

No mention was made about whether the addition of salt to these surfaces and filters might result in the degradation of the materials over time.

Safety

Sodium chloride is considered to be a chemical of low concern for human risk.[16] However, if exposed to high temperatures, it can produce a vapour that is an eye irritant and high doses of ingested salt can be toxic to humans and animals.[16]

Issues to Consider

As indicated in the previous article,[1] there are a number of particular issues to consider with antimicrobial coatings including:[2]

- which surfaces should be antimicrobial
- whether the coating will be active continuously or only for a period of time and, if the latter, how often the surface or coating will need to be replaced
- what cleaning and disinfecting solutions can be used (some antimicrobial surfaces will not work while covered in cleanser or will be deactivated by the solutions)
- how durable the surface is
- what benefits and disadvantages the surface has (e.g., environmental or safety concerns, or risk for the development of antimicrobial resistance).[2,17]

None of these studies have been done using SARS-CoV-2, as samples are not available to researchers outside of biohazard laboratories.[9] Researchers have made assumptions about the effectiveness of these technologies and techniques based on research done with influenza and other viruses that are of a similar viral size as SARS-CoV-2.[5]

Related Developments

Copper surfaces are another antimicrobial surface option that can reduce bacterial contamination.[18,19] A systematic review found the few studies that measured the impact of copper surfaces on health care-associated infections were flawed (at high risk for bias) and that the reduction in bacterial levels was likely “modest.”[20] Moreover, copper surfaces appear to need a longer period of time to take effect against microorganisms and they are expensive relative to standard fixtures.[8,18,21] The authors of a letter to the editor of *The New England Journal of Medicine* reported they had found no viable SARS-CoV-2 on copper surfaces after four hours of contact.[22]

Various other general antimicrobial surfaces are available or in development, including anti-adhesive surfaces — coatings impregnated with antimicrobial or photosensitive agents, such as titanium dioxide.[23] Researchers are testing a continuously active antimicrobial surface disinfectant technology on a variety of pathogens, including SARS-CoV-2.[24]

Looking Ahead

Research is underway examining the role salt might play in helping to manage the spread of SARS-CoV-2. The virus is still not fully understood, and the evidence is constantly changing and evolving. Information about new technologies and innovations to help manage the current global pandemic are likely to continue to be produced at a rapid pace.

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