

Inhalable Hydrogel Protects Lungs From SARS-CoV-2, the Virus That Causes COVID

With further development, the gel could provide additional protection against COVID-19 and other respiratory illnesses.

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Mutations in SARS-CoV-2, the virus that causes COVID-19, continue to produce new virus variants. Some of these mutations may confer resistance to the immunity induced by vaccines or prior SARS-CoV-2 infections. Thus, there is a need for strategies that could prevent infection by a range of SARS-CoV-2 variants.

Physical barriers, such as the mucus lining of the airways, provide the first line of defense against infections. A research team led by Dr. Ke Cheng at North Carolina State University set out to develop a way to reinforce this mucus barrier. They described their method, which they dubbed spherical hydrogel inhalation for enhanced lung defense, or SHIELD, in [Nature Materials on February 9, 2023](#).

SHIELD consists of an inhalable powder of fine particles, less than 5 μm across, made from an absorbent polymer. Upon contact with moisture, the particles absorb water, which causes them to swell. Within 10 minutes, they link with each other to form a hydrogel. Electron microscope imaging showed that mucus with SHIELD added formed a denser and stiffer gel, with smaller pores, than mucus alone. Virus-sized particles didn't cross through this denser gel as easily as through ordinary mucus.

The team tested whether SHIELD could protect against virus infection in mice. They administered SHIELD to the mice via a dry powder inhaler and found that SHIELD coated the surfaces of the lower airway. They then exposed the mice to harmless viruses with spike proteins from different SARS-CoV-2 variants. SHIELD reduced the infection rate by 72-75% four hours after SHIELD administration. This declined to 15-18% after 24 hours as the gel was cleared from the mice.

Next, the researchers tested SHIELD in monkeys. The monkeys received a single dose of SHIELD 8 hours before exposure to either the original SARS-CoV-2 strain or the Delta variant. SHIELD-treated monkeys had 50- to 300-fold less virus than untreated animals. Lungs from treated monkeys also had reduced inflammation, viral pneumonia, and signs of damage.

SHIELD was created from food-grade materials, was not toxic to cells in culture, and did not affect normal lung function in mice after two weeks of daily dosing. It could be easily administered daily using a low-cost inhaler.

If shown to be effective in humans, SHIELD could complement existing virus prevention methods. It might be easier and safer to use than masks and other physical barriers.

In addition, the team found that SHIELD also protected mice against pneumonia and H1N1 viruses. So, its usefulness might extend beyond COVID-19 prevention.

“The beauty of SHIELD is that it isn’t necessarily limited to protecting against COVID-19 or flu,” Cheng says. “We’re looking at whether it could also be used to protect against things like allergens or even air pollution – anything that could potentially harm the lungs.”

This [research summary](#) was published by the National Institutes of Health on March 7, 2023.