

Plastic film used to protect foods and surfaces inactivates novel coronavirus

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In laboratory tests, the material eliminated 79.9% of SARS-CoV-2 particles in three minutes and 99.99% in up to 15 minutes. Credit: Alpes

Transparent stretchable PVC film for use in packaging meat, fruit, cold cuts, and other foods, and to protect surfaces, can inactivate the novel coronavirus.

Marketed by Brazilian plastics manufacturer Alpes, the material contains silver and silica nanoparticles, a technology developed and licensed by Nanox.

Nanox is a Brazilian company based in São Paulo, Brazil, and supported by FAPESP's Innovative Research in Small Business Program (PIPE).

In tests conducted at the Biosafety Level III (BSL-3) laboratory in the

University of São Paulo's Biomedical Sciences Institute (ICB-USP), the PVC film proved capable of eliminating 79.9% of the particles of SARS-CoV-2 in three minutes and 99.99% in up to 15 minutes.

"Elimination of the virus by the material was extremely effective and fast. It's a very different application from the more than 40 products that attack the novel coronavirus tested by us since the start of the pandemic," said Lucio Freitas Junior, a researcher at ICB-USP.

The film was tested against ISO 21702:2019, the technical standard governing measurement of antiviral activity on plastic and other non-porous surfaces, and requiring demonstration of this capability within four hours.

Samples of the material with and without silver-silica nanoparticles were kept in direct contact with SARS-CoV-2 for varying amounts of time. After the stipulated periods, the viral particles found in the material were removed and placed in contact with Vero cells to measure the infection and replication rate after exposure to the film. Vero cells are derived from the kidney of an African monkey and widely used in microbiological cultures.

The viral genetic material was quantified by PCR, showing a reduction of almost 100% in copies of SARS-CoV-2 after 15 minutes of exposure to the film.

"Considering its use in wrapping for [food products](#) that are exposed and handled in supermarkets, 15 minutes for the film to eliminate the virus completely from the surface of the material is satisfactory," said Nanox CEO Luiz Gustavo Pagotto Simões.

Application in plastic

The stretch-wrap film is the third plastic material containing silver-silica nanoparticles to be marketed by Nanox to provide protection against COVID-19.

In partnership with toymaker Elka, the firm developed a reusable face-covering made of flexible thermoplastic material similar to rubber and coated with the additive as a surface layer. The mask promises to confer a higher level of protection against the novel coronavirus.

An adhesive plastic film containing the additive for protection of surfaces was launched in September by Promaflex and shown in testing to eliminate 99.84% of SARS-CoV-2 particles in two minutes.

The stretch-wrap film differs from the other two products in terms of the concentration of silver-[silica nanoparticles](#) in its composition. Given its use in food packaging, it has to contain a smaller amount of the additive.

"Our silver nanoparticles are registered with the FDA [US Food and Drug Administration] and whitelisted by ANVISA [Brazil's national health surveillance agency], which establish an upper limit on the amount that can be added to materials used as food packaging in order to ensure that the silver doesn't get into the food. So the concentration of the additive in this film has to be slightly lower," Simões explained.

Upgrades made by Nanox in recent years to the process whereby it produces ceramic nanoparticles with silver have enabled film manufacturers to improve the dispersion of the additive. As a result, the amount of silver can be much smaller, according to Simões. At the same time, the antimicrobial efficiency of the additive has been enhanced while maintaining transparency.

"PVC film must be very transparent. If the concentration of silver

particles is high, the film can become yellow or gray. Our technology avoids this problem," he said.

The technology has proved effective to inactivate the novel coronavirus in other applications besides plastic-based products, such as fabric made of a blend of natural and synthetic fibers.

The additive has been used in apparel and fabric made by several Brazilian firms under license of the Nanox brand.

"We've also obtained good responses in studies to appraise the application of the solution in raw materials used by the construction industry, such as MDF in laminate flooring or paints," Simões said.

New markets

Alpes has marketed the plastic film with silver nanoparticles for food packaging to protect products against fungi and bacteria in supermarkets and the home since 2014. With the onset of the COVID-19 pandemic, it decided to see if the material could also eliminate SARS-CoV-2.

"Plastic film is considered a commodity, and the consumer's decision to buy is based mainly on price. By incorporating Nanox's additive, we aimed to offer a superior product with an extra benefit for the consumer," said Alessandra Zambaldi, head of foreign trade and marketing at Alpes.

The firm is one of Brazil's three largest manufacturers of PVC film, currently producing 450 metric tons per month. It is planning a 20% increase in production by mid-2021.

In response to COVID-19, the firm identified new markets for application of the product, including protection of surfaces such as debit

and credit card machines, doorknobs, handrails, keyboards, and touch screens.

The product is also used to cover the skin after tattooing or cosmetic procedures. "When we identified the use of our plastic film for this purpose, we conducted tests to make sure it's hypoallergenic," Zambaldi said.

Provided by FAPESP

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