

Science

Sustainable food packaging that keeps harmful microorganisms away

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In the experiment, strawberries in a package developed by NTU-Harvard remained fresh for 7 days before mold developed, while strawberries in mainstream fruit plastic boxes remained fresh for 4 days. was.Credit: Nanyang Technological University

A team of scientists from Nanyang Technological University in Singapore (NTU Singapore) and Harvard TH Chan School of Public Health in the United States have developed a "smart" food packaging material that is biodegradable, sustainable and kills harmful microorganisms to the human body. .. You can also extend the shelf life of fresh fruits by 2-3 days.

Water resistant food packaging is made from a type of corn protein called zein, starch, and other naturally occurring biopolymers, infused with a cocktail of natural antibacterial compounds (see video). These include oil

from thyme, a common herb used in cooking, and citric acid commonly found in citrus fruits.

In laboratory experiments, when exposed to increased humidity or enzymes
Harmful bacteriaThe fiber in the package has been shown to release natural antibacterial compounds and kill common dangerous bacteria and fungi that contaminate foods such as E. coli and Listeria.

The package is designed to release the required trace amounts of antibacterial compounds only in response to additional humidity or the presence of bacteria. This allows the package to withstand several exposures and is guaranteed to last for months.

The compound is not only on the surface of the package, but also on the surface of the package. Food As such, it has the potential to be used in a variety of products, including ready-to-eat foods, raw meat, fruits and vegetables.

In the experiment, the strawberries wrapped in the package remained fresh for 7 days before the mold developed, while the strawberries in the mainstream fruit plastic boxes were only fresh for 4 days.

The invention is the result of collaboration by scientists at the NTU-Harvard TH Chan School (NTU-Harvard SusNano), a public health initiative for sustainable nanotechnology, bringing together researchers from NTU and Harvard Chan School for agriculture. And foods focused on the development of non-toxic and environmentally safe nanomaterials.

The development of this advanced food packaging material is a sustainable food technology solution in line with the NTU 2025 Strategic Plan aimed at developing sustainable solutions to address some of the pressing challenges of mankind. Is part of the university's efforts to promote.

Professor Mary Cheung, director of NTU's Center for Antibacterial Bioengineering, who co-led the project, said: Related bacteria and fungi that can be harmful to humans. The package can be applied to various foods such as fish, meat, vegetables and fruits. It releases antibacterial agents smartly only in the presence of bacteria or high humidity and provides protection only when needed, thus minimizing the use of chemicals and maintaining the natural composition of the packaged food. To do. "

Professor Philippe Democrito, Associate Professor of Environmental Health at Harvard Chan School, Director of the Center for Nanotechnology and Nanotoxicology, and Co-Director of the NTU-Harvard Initiative on Sustainable Nanotechnology, who co-led the study. , Says: It has become a major social challenge of our time with enormous public health and economic implications that compromise food safety. One of the most efficient ways to increase food safety and reduce spoilage and waste is to develop efficient biodegradable, non-toxic food packaging materials. , Biopolymers, non-toxic solvents, naturally inspired antibacterial agents and other naturally derived compounds that can be used not only to improve food safety and quality, but also to eliminate environmental hazards Developed a scalable system for synthesizing antibacterial materials Stem that maintains health, reduces the use of non-biodegradable plastics at the world level, and promotes a sustainable agricultural food system. "

Peter Barber, CEO of ComCrop, a Singaporean company that provided an independent assessment of the work done by the NTU research team and pioneered urban rooftop farming, said: Companies like us who want to reduce plastic usage and adopt more environmentally friendly alternatives are aiming to boost their products to increase Singapore's food production capacity, so the packaging they need. The amount of will increase synchronously and switch to materials such as: This helps us to have a double impact. The antibacterial properties of the packaging, which can extend the shelf life of our vegetables, will help us. Packaging materials are promising in the industry and we may adopt them for packaging and someday our usage. "

The results of the study were published in peer-reviewed academic journals. *ACS Applied Materials & Interfaces* During October.

Reduction of packaging waste

The packaging industry is the largest and growing consumer of synthetic plastics derived from fossil fuels, and food packaging plastics make up the majority of plastic waste that pollutes the environment.

In Singapore, packaging is the main source of waste, and according to data from Singapore's National Environment Agency, one-third of the 1.76 million tons of waste disposed of by domestic sources in 2018 is packaging. It was waste, more than half of which was 55%) was plastic.

Smart food packaging materials, when scaled up, are biodegradable and may serve as an alternative to reducing the amount of plastic waste. Its main component, zein, is also produced from cornstarch and corn gluten meal, a waste by-product of using oil for ethanol production.

Food packaging materials are made by electrospinning zeins, antibacterial compounds with cellulose, the natural high molecular weight starches that make up plant cell walls, and acetic acid commonly found in vinegar.

Professor Mary Cheung said, "Sustainable, biodegradable active food packaging that incorporates technology that keeps bacteria and fungi away is Food industry.. It can serve as an environmentally friendly alternative to petroleum-based polymers used in commercial food packaging such as plastics, which have a significant negative impact on the environment. "

Professor Demokritou said, "Biodegradable, non-toxic, smart / to improve food safety and quality by globalizing food supply and changing attitudes towards healthier lifestyles and environmentally friendly food packaging. You need to develop responsive materials. A scalable synthetic platform for developing food products. Packaging Materials composed of naturally occurring biodegradable biopolymers and naturally inspired antibacterial agents, coupled with a stimulus-induced approach, reduce food waste and enhance food safety and quality in a new society. Meet your needs. "

A team of researchers at NTU and Harvard Chan School hopes to expand their technology with industrial partners with the aim of commercializing it within the next few years.

They are also currently working on other technologies to develop and enhance biopolymer-based smart food package materials. food Safety and quality.

How to extend shelf life and avoid food waste

For more information:

Zeynep Aytac et al, Enzymes and Relative Humidity Responsive Antibacterial Fibers for Active Food Packaging, *ACS Applied Materials & Interfaces* (2021).

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