



PRESS RELEASE (2026/07/06)

Wasted pumpkin peel can keep your food fresh

Kyushu University researchers have turned agricultural by-products into a biodegradable food packaging material, offering a potential approach to both food loss and plastic pollution

Fukuoka, Japan—Researchers at Kyushu University have developed a new food preservation solution. Using pumpkin peel as raw material, they synthesized a nanomaterial for food packaging that slows the deterioration of fruit and other produce while reducing transport damage. The findings were published on 30 April 2026 in [*Food Research International*](#).

An estimated 40 to 50 percent of harvested fruits and vegetables never reach consumers, lost somewhere between farm and market. Proper packaging can prevent much of this loss by protecting them from air exposure, humidity, and physical damage, but the plastics widely used come at an environmental cost.

“Our lab has long focused on extending the shelf life of agricultural produce while reducing reliance on petroleum-based plastics,” says [Fumihiko Tanaka](#), Professor at Kyushu University’s [Faculty of Agriculture](#).

To create functional, eco-friendly packaging that combats food waste, Tanaka’s team turned to agricultural by-products—the very waste from food production itself. This time, they used pumpkin peel, which makes up roughly 10% of the fruit’s weight and contains useful components.

The team heated the peel under high pressure, then cooled and freeze-dried it to produce carbon quantum dots (CQDs), a fine black powder with particles about 10 nanometers in diameter. With antimicrobial and UV-blocking properties, these particles protect food surfaces from browning and degradation caused by excessive light exposure.

They then combined the CQDs with carboxymethyl cellulose and gelatin to form a composite film. Researchers found that adding 3% CQDs increased the film’s tensile strength by 147% and reduced water vapor permeability. This made the packaging more resistant to vibration and impact during transport, while also helping prevent spoilage from moisture loss.

“Conventional antimicrobial packaging typically relies on metal nanoparticles like zinc oxide or silver, which carry a larger environmental footprint than CQDs,” notes [Fumina Tanaka](#), Associate Professor at the same faculty. “Ours are derived from organic matter and show good biocompatibility at effective concentrations, something critical for any food contact material.”

For a real-world test, the team packaged cherry tomatoes, a highly perishable fruit, and compared the results against unpackaged and conventional plastic-wrapped controls. Films containing CQDs suppressed microbial growth and slowed both weight loss and softening,

preserving freshness significantly better than the alternatives.

“We understand safety is a key concern,” comments M.A. Reshaka Kavindi, the study’s first author at Kyushu University’s [Graduate School of Bioresource and Bioenvironmental Sciences](#). “Cell viability tests confirmed the material is non-toxic below 2 mg/mL, and the coating itself uses only a fraction of that amount, at roughly 0.01 millimeters thick. Consumers can further reduce exposure simply by washing or peeling.”

The material can be applied as a packaging film or sprayed directly onto produce. This allows for partial coating only of vulnerable spots, reducing excess packaging and lowering costs. Looking ahead, the team hopes to incorporate natural antifungal agents, like essential oils, to strengthen the material’s defense against more aggressive mold strains.

“Actually, this project began with the idea from a student of ours from Southeast Asia,” recalls Fumihiko Tanaka. “Cold-chain logistics across much of Asia are still underdeveloped, so we hope our technology, which preserves food at ambient temperature, could help in places where that infrastructure is lacking.”

“Beyond the environmental benefits, I’d also love for this material to bring a bit of fun to food packaging,” adds Fumina Tanaka. “Under UV light, the carbon dots fluoresce, and the color shifts with particle size. If we could eventually find a way to render text or illustrations with it, that would be pretty exciting too.”

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For more information about this research, see “Development of active food packaging using carboxymethyl cellulose/gelatin composites reinforced with carbon quantum dots derived from pumpkin peel waste,” M.A. Reshaka Kavindi, Francis Ngwane Nkede, Fanze Meng, Mohammad Hamayoon Wardak, Yan Xirui, Tanvir Ahamed, Fumina Tanaka, K.S.P. Amaratunga, Fumihiko Tanaka, *Food Research International*, <https://doi.org/10.1016/j.foodres.2026.119344>

About Kyushu University

Founded in 1911, [Kyushu University](#) is one of Japan’s leading research-oriented institutions of higher education, consistently ranking as one of the top ten Japanese universities in the Times Higher Education World University Rankings and the QS World Rankings. Located in Fukuoka, on the island of Kyushu—the most southwestern of Japan’s four main islands—Kyushu U sits in a coastal metropolis frequently ranked among the world’s most livable cities and historically known as Japan’s gateway to Asia. Its multiple campuses are home to around 19,000 students and 8,000 faculty and staff. Through its [VISION 2030](#), Kyushu U will “drive social change with integrative knowledge.” By fusing the spectrum of knowledge, from the humanities and arts to engineering and medical sciences, Kyushu U will strengthen its research in the key areas of decarbonization, medicine and health, and environment and food, to tackle society’s most pressing issues.

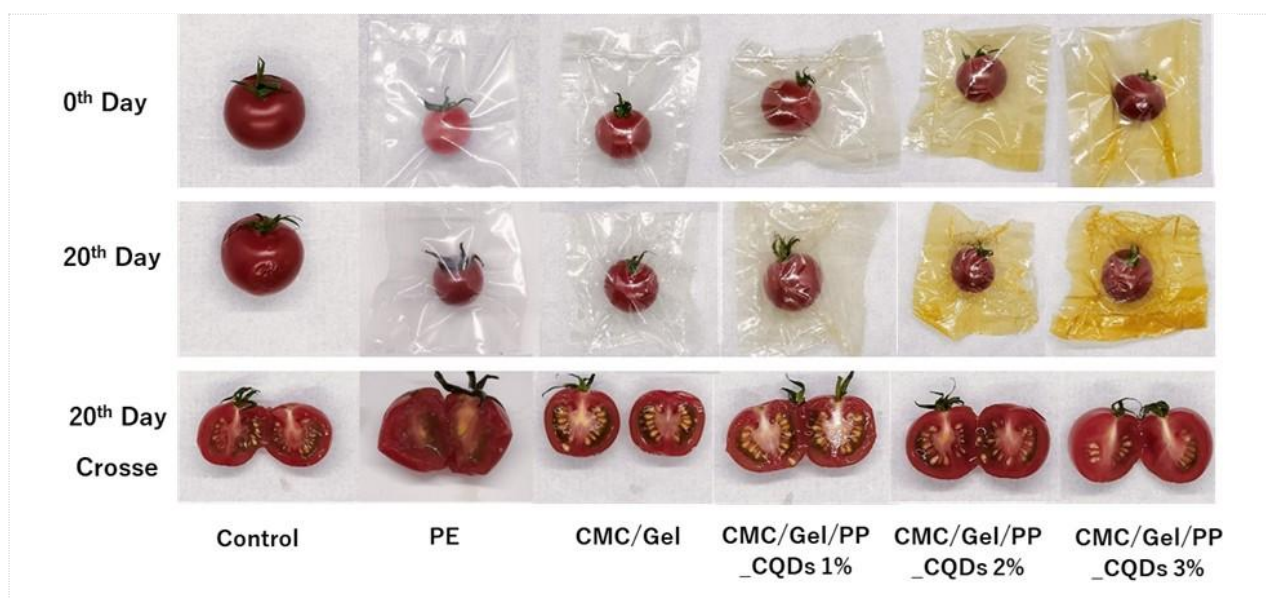


FIG.1 Wasted pumpkin peel can keep your food fresh

Cherry tomatoes packaged in different films over a 20-day storage trial. Films containing carbon quantum dots (CQDs) suppressed microbial growth and slowed weight loss and softening, preserving freshness significantly better than unpackaged or conventionally packaged controls.



FIG.2 Biodegradable film with carbon quantum dots fluoresces under UV light

A cherry tomato sealed in the biodegradable packaging film under normal light (left) and UV light (right), where the embedded carbon dots fluoresce blue. Beyond its environmental benefits, the researchers hope the material could bring a playful dimension to food packaging, with the potential to one day render text or illustrations using fluorescent light.

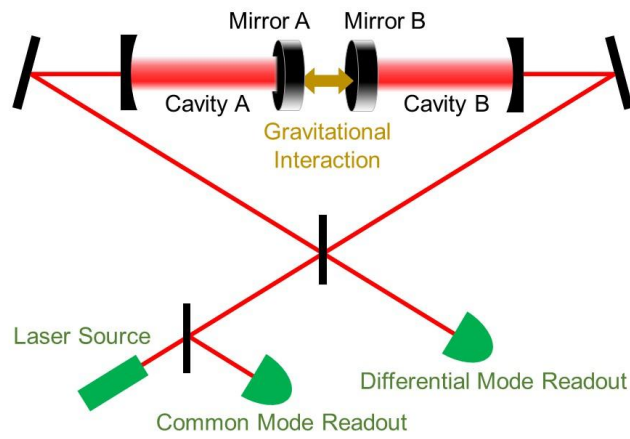


FIG.3 Conceptual diagram of an experiment to test gravity-induced entanglement using optomechanical systems

Two optomechanical systems arranged as shown, where the cylindrical mirrors A and B interact via gravity. The interaction affects only the differential mechanical mode associated with their relative displacement, generating quantum entanglement between the mirrors.

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