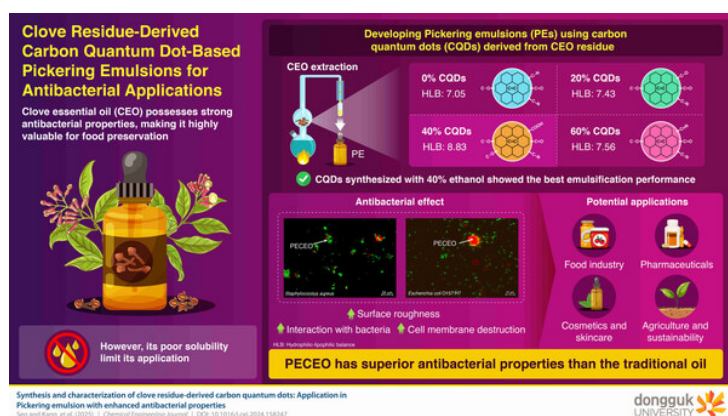


Dongguk University researchers create clove-essential-oil-based Pickering emulsions

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In a groundbreaking discovery, a team of scientists led by Jun-Won Kang, Assistant Professor in the Department of Food Science and Biotechnology at Dongguk University, has developed a novel Pickering emulsion formulation using clove essential oil with remarkable antibacterial efficacy. Their findings were published in the Chemical Engineering Journal's January 2025 issue following their online release on December 3, 2024.

Clove essential oil is widely known for its strong antibacterial properties. However, its low water solubility has limited its broader applications in food safety and preservation. To address this issue, Dr Kang's team explored oil-based Pickering emulsions, stabilising the oil droplets with solid particles instead of traditional surfactants.

The researchers developed a sustainable emulsion using carbon quantum dots (CQDs), innovative solid particles derived from clove essential oil residue. By synthesising four different types of CQDs with ultrapure distilled water and ethanol, they discovered that CQDs produced with 40% ethanol demonstrated the highest emulsifying efficiency. These CQDs increase the surface roughness of the emulsion, promoting bacterial adhesion and resulting in stronger antibacterial activity compared to conventional emulsions.

"This approach not only enhances the antibacterial efficiency of emulsions but also offers a green and eco-friendly alternative to traditional chemical surfactants like Polysorbate 80," said Dr Kang. "Moreover, by upcycling essential oil extraction byproducts into valuable nanomaterials, our method contributes to sustainable material development and waste valorization."

The innovative formulation presents a promising solution for combating foodborne diseases, a significant obstacle to achieving the United Nations Sustainable Development Goal of Good Health and Well-Being. Bacterial contamination during food production, processing, transportation, and storage remains a major concern worldwide. Current chemical preservatives,

such as benzoate and nitrate, are often criticized for safety and effectiveness, driving the need for natural antibacterial alternatives.

With this pioneering emulsion technology, the food industry gains a powerful and sustainable tool to prevent microbial contamination and ensure food safety. As natural essential oils gain traction for their potential health benefits, this development marks a major step forward in creating safer, greener preservation solutions.