Emulsion Containing Zinc Oxide Quantum Dot in Self-Cleaning and Antibiotic Application

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This study introduces a multifunctional emulsion system combining ZnO dots, camellia oil, and CTAC surfactant to provide a safer, eco-friendly alternative for preserving fruits and vegetables. Traditional chemical preservatives pose health and environmental risks, while the developed "3-in-1" system offers antibacterial action, self-cleaning properties, and pesticide residue removal. ZnO nanoparticles were synthesized via two methods: an aqueous route yielding ~500 nm particles, and an ethanol-based method enhanced by Fe2+ doping and tannic acid, producing ~10 nm dots. The modified ZnO showed superior photocatalytic activity, achieving 77% methylene blue decolorization under UV light. Encapsulating the ZnO in camellia oil with CTAC improved dispersion and ensured stability in water for up to 15 days. Antibacterial assays revealed significantly lower inhibitory and bactericidal concentrations. Practical application on grapes demonstrated preserved surface gloss, reduced dehydration, and effective pesticide removal. This emulsion system represents a sustainable solution for food preservation and agricultural surface decontamination.

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