Eugenol Pickering emulsion stabilized by chitosan self-assembled nanoparticles: fabrication, emulsion stability, antioxidant and antimicrobial activity

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Abstract

Background: Eugenol, an important active ingredient in essential oils, effectively inhibits food-borne pathogens but is hindered by its high volatility. Pickering emulsion provides a suitable method to encapsulate, protect and enhance the absorption of these biologically active food components. This study investigated the encapsulation of different concentrations of eugenol Pickering emulsion

stabilized with self-assembled chitosan nanoparticles by ultrasound-assisted emulsification. The effects of varying eugenol concentrations on Pickering emulsions' physical, stability, antioxidant and antimicrobial properties were analyzed. Results: The integration of eugenol at different concentrations increased the droplet size of Pickering emulsion, and the value ranged from 20 to 142 nm during a 60-day storage. Eugenol (5%) significantly improved the antioxidant activity of the Pickering emulsion with a DPPH (2,2-diphenyl-1-picrylhydrazyl) value of 78%. In addition, eugenol effectively increased the antimicrobial activity of the Pickering emulsion against Staphylococcus aureus (S. aureus) and Escherichia coli (E. coli) with inhibition zones of 14.1 and 17 mm, respectively. The stability of the Pickering emulsion increased with the increase in eugenol concentration throughout the storage period. Conclusion: Pickering emulsions stabilized with self-assembled chitosan nanoparticles effectively enhanced the stability, antioxidant, and antimicrobial performance of eugenol. These results highlight the potential of such systems as natural and efficient delivery platforms for food and pharmaceutical applications. © 2025 Society of Chemical Industry (SCI).

Author keywords

antimicrobial; antioxidant; eugenol; Pickering emulsion; stability

Indexed keywords

Engineering controlled terms

Acetobacter; Aerobic bacteria; Emulsification; Escherichia coli; Listeria

EMTREE drug terms

1,1 diphenyl 2 picrylhydrazyl; chitosan nanoparticle; eugenol; self assembled nanoparticle

Engineering uncontrolled terms

Active ingredients; Anti-microbial activity; Antimicrobial; Antioxidant activities; Chitosan nanoparticles; Emulsion stability; Eugenol; Food-borne pathogens; Pickering emulsions; Self assembled nanoparticles

EMTREE medical terms

absorption; antimicrobial activity; antioxidant activity; Article; controlled study; dispersity; emulsion; encapsulation; Escherichia coli; food preservation; food storage; foodborne pathogen; nanofabrication; pickering emulsion; Staphylococcus aureus; ultrasound; volatilization; zeta potential; zone of inhibition

Engineering main heading

Chemical industry

Chemicals and CAS Registry Numbers

Unique identifiers assigned by the Chemical Abstracts Service (CAS) to ensure accurate identification and tracking of chemicals across scientific literature.

1,1 diphenyl 2 picrylhydrazyl	1898-66-4
eugenol	97-53-0

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