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Camellia Japonica flower mediated green synthesis of silver nanoparticles and its combination therapy with antimicrobial polymer against multi-drug-resistant bacteria

Abstract:

Multidrug-resistant (MDR) bacteria are a growing global threat, diminishing the efficacy of conventional antibiotics. This study presents a novel combination therapy involving green-synthesized silver nanoparticles (AgNPs), mediated by Camellia japonica flower extract, and the cationic polymer PONI-C11-TMA. Camellia genus, belonging to the Theaceae family, exhibits significant potential as biogenic reducing and stabilizing agents for synthesis of metallic nanoparticle. AgNPs, renowned for their broad-spectrum antimicrobial activity, were characterized by UV–Vis spectroscopy (single peak at 400 nm), dynamic light scattering (DLS), and transmission electron microscopy (TEM), confirming a uniform spherical morphology (20–30 nm). The molecular weight of polymer with poly(oxanoborneneimide) (PONI) backbone with a C11 alkyl chain and trimethylamine-TMA functional group, was determined via gel permeation chromatography (GPC). Minimum inhibitory concentrations (MICs) were tested against two gram-negative strains: Acinetobacter baumannii (CD-575) and Escherichia coli (CD-2), with MICs of 10 µg/mL for AgNPs and 2.5 µg/mL for the polymer. Cytotoxicity assessment using Alamar Blue on NIH 3T3 fibroblasts showed >90% cell viability at antimicrobial-effective doses, indicating strong biocompatibility. Synergistic potential was evaluated through checkerboard assays, revealing increased MICs under combination treatment, 2–4 fold for A. baumannii and 4–8 fold for E. coli. The calculated fractional inhibitory concentration (FIC) index of 0.75 indicated an additive interaction. Overall, this phytochemically capped nanoplatform combined with cationic polymer assemblies demonstrates enhanced antimicrobial activity, and additive therapeutic effect, suggesting a promising approach to combat MDR infections while minimizing resistance development.

Biography

Humaira Khan is currently pursuing her PhD in Technologies for Resilient Living Environments at the University of Campania, Italy, with a research focus on plant-extract-functionalized nanomaterials. She recently completed a visiting research fellowship at the University of Massachusetts, USA, where she explored polymeric nanomaterials for antimicrobial applications. Her interdisciplinary background in chemistry and nanotechnology spans Pakistan, Turkey, Italy, and the United States, and she has received multiple government-funded scholarships and awards for academic excellence and international research collaboration.