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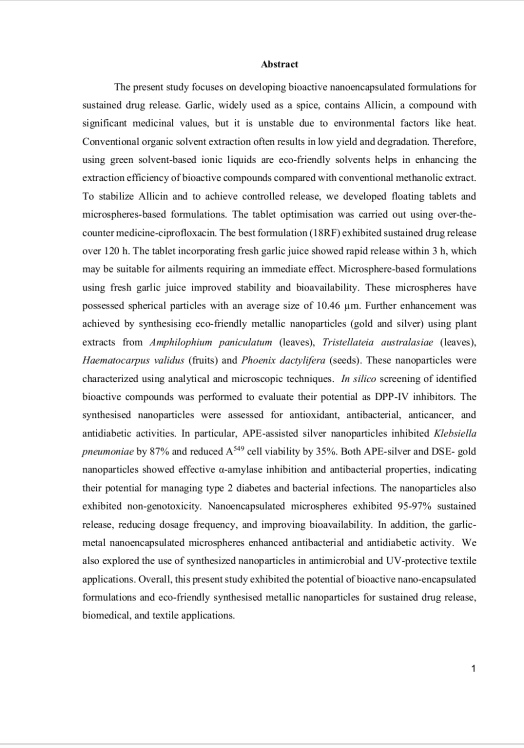

Abstract

The present study focuses on developing bioactive nanoencapsulated formulations for sustained drug release. Garlic, widely used as a spice, contains Allicin, a compound with significant medicinal values, but it is unstable due to environmental factors like heat. Conventional organic solvent extraction often results in low yield and degradation. Therefore, using green solvent-based ionic liquids are eco-friendly solvents helps in enhancing the extraction efficiency of bioactive compounds compared with conventional methanolic extract. To stabilize Allicin and to achieve controlled release, we developed floating tablets and microspheres-based formulations. The tablet optimisation was carried out using over-the-counter medicine-ciprofloxacin. The best formulation (18RF) exhibited sustained drug release over 120 h. The tablet incorporating fresh garlic juice showed rapid release within 3 h, which may be suitable for ailments requiring an immediate effect. Microsphere-based formulations using fresh garlic juice improved stability and bioavailability. These microspheres have possessed spherical particles with an average size of 10.46 µm. Further enhancement was achieved by synthesising eco-friendly metallic nanoparticles (gold and silver) using plant extracts from *Amphilophium paniculatum* (leaves), *Tristellateia australasiae* (leaves), *Haematocarpus validus* (fruits) and *Phoenix dactylifera* (seeds). These nanoparticles were characterized using analytical and microscopic techniques. *In silico* screening of identified bioactive compounds was performed to evaluate their potential as DPP-IV inhibitors. The synthesised nanoparticles were assessed for antioxidant, antibacterial, anticancer, and antidiabetic activities. In particular, APE-assisted silver nanoparticles inhibited *Klebsiella pneumoniae* by 87% and reduced A^{549} cell viability by 35%. Both APE-silver and DSE- gold nanoparticles showed effective α-amylase inhibition and antibacterial properties, indicating their potential for managing type 2 diabetes and bacterial infections. The nanoparticles also exhibited non-genotoxicity. Nanoencapsulated microspheres exhibited 95-97% sustained release, reducing dosage frequency, and improving bioavailability. In addition, the garlic-metal nanoencapsulated microspheres enhanced antibacterial and antidiabetic activity. We also explored the use of synthesized nanoparticles in antimicrobial and UV-protective textile applications. Overall, this present study exhibited the potential of bioactive nano-encapsulated formulations and eco-friendly synthesised metallic nanoparticles for sustained drug release, biomedical, and textile applications.

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Development of Bioactive Drug Formulations Using Eco-friendly Metallic Nanoparticles for Sustained Drug Release Systems and Selected In vitro Biomedical Applications

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