IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, March 2026
Impact Factor: 8.2

Design, Development, and Characterization of Bael Fruit Polysaccharide-Based Nanoparticles for Targeted Anti-Cancer Drug Delivery: in Vitro Evaluation and Antioxidant Activity

Mr. Shaikh Akbar Mohd Altaf[1] and Dr. K Sarvanan[2]
Research Scholar, Bhagwant Global University, Kotdwar, Uttarakhand[1]
Research Guide, Bhagwant Global University, Kotdwar, Uttarakhand[2]

Abstract: *The present study focuses on the design, development, and characterization of Bael (Aegle marmelos) fruit polysaccharide-based nanoparticles for targeted anti-cancer drug delivery. Nanoparticles (NP1–NP9) were formulated using ionotropic gelation with varying polymer (50–100 mg) and crosslinker (0.05–0.2% w/v $CaCl_2$) concentrations. Physicochemical characterization revealed particle sizes ranging from 180 ± 5 to 220 ± 10 nm, PDI values of 0.22–0.30, and zeta potentials of −25.3 ± 1.2 to −34.5 ± 1.9 mV, indicating stable colloidal dispersions. Entrapment efficiency and drug loading improved with increased polymer content, reaching 95.5 ± 2.5% and 17.0 ± 0.9%, respectively. In vitro release studies demonstrated sustained drug release, with slower release observed at higher polymer and crosslinker concentrations. Antioxidant potential was evaluated via DPPH, ABTS, and total antioxidant capacity assays, indicating enhanced radical scavenging activity with higher polymer content. Cytotoxicity against MCF-7 breast cancer cells was assessed using MTT assay, revealing a concentration- and formulation-dependent inhibitory effect, with NP9 achieving 67.0 ± 1.8% inhibition at 100 µg/mL. The study highlights the potential of Bael polysaccharide nanoparticles as a biocompatible carrier for anti-cancer drugs, providing controlled release and antioxidant benefits. These findings support further in vivo studies for targeted cancer therapy.*

Keywords: Bael fruit polysaccharide, Nanoparticles, Anti-cancer drug delivery, Ionotropic gelation, Doxorubicin, MCF-7 cells, Antioxidant activity, Sustained release.

DOI: 10.48175/IJARSCT-31570