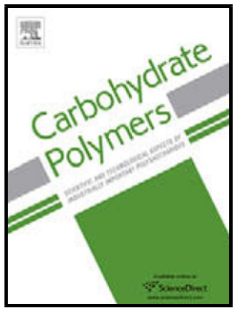

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Enhancement of anticancer activity and drug delivery of chitosan-curcumin nanoparticle via molecular docking and simulation analysis

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Highlights:

- Biopolymer, for nanoparticle building, is selected by molecular docking
- BBD-RSM method used for the NPs formulation & optimization
- NPs stability in aqueous medium is checked using MD simulation
- *In-vitro* and *in-vivo* experiments of formulated NPs shows increased efficiency for drug delivery

Abstract

Computational analyses followed by traditional wet-bench experiments have become a method of choice due to successful results. To enhance the solubility and bioavailability of curcumin within chitosan nanoparticle, we have exploited computational methodologies *i.e.* docking, BBD-RSM and MD simulation for the polymer selection, NPs' formulation, optimization and their stability confirmation in an aqueous medium, respectively. Formulated CSCur NPs were assessed for *in-vitro* release, which exhibited a sustained release pattern and four-fold higher cytotoxic activity in a nanoparticulated system. Enhanced uptake, apoptotic effect of CSCur NPs were established by morphological changes in cells as observed by fluorescence microscopy and FE-SEM. DNA damage, cell-cycle blockage and elevated ROS levels further confirm the anticancer activity of the CSCur NPs following apoptotic pathways. *In-vivo* study on *Danio rerio*, for uptake and toxicity reveal the particle's biocompatibility and nontoxicity. Therefore, CSCur NPs could be the potential formulation for a safe chemotherapeutic drug for cancer.

Keywords: Chitosan-curcumin nanoparticle, Anti-cancer, Box-Behnken design, Molecular docking, Molecular dynamic simulation, Zebrafish.

1. Introduction

Extraction of the elixir from carbohydrate polymers' as targeted functional biomolecule is hard Extraction of the elixir from carbohydrate polymers' as targeted functional biomolecule is hard to achieve as all functionality cocooned within the physico-chemical property of the polymer. Use of polymer as an adjuvant in an immunological purpose had been extensively studied (Petrovsky & Aguilar, 2004). After blooming of nanobiotechnological research, nanocarrier technology for delivery of bioactive component had have become a choice since last decade. Nanocarriers have been found effective for site-specific drug delivery, and also for the