Formulation of a sustained release docetaxel loaded cockle shell-derived calcium carbonate nanoparticles against breast cancer

ABSTRACT

Purpose: Here, we explored the formulation of a calcium carbonate nanoparticle delivery system aimed at enhancing docetaxel (DTX) release in breast cancer. Methods: The designed nano- anticancer formulation was characterized thorough X-ray diffraction (XRD), Fourier transformed infrared (FTIR), transmission electron microscopy (TEM) and field emission scanning electron microscopy (FESEM) and Brunauer-Emmett-Teller (BET) methods. The nano- anticancer formulation (DTX- $CaCO_3$NP) was evaluated for drug delivery properties thorough in vitro release study in human body simulated solution at pH 7.4 and intracellular lysosomal pH 4.8. Results: Characterization revealed the successful synthesis of DTX- $CaCO_3$NP, which had a sustained release at pH 7.4. TEM showed uniformly distributed pleomorphic shaped pure aragonite particles. The highest entrapment efficiency (96%) and loading content (11.5%) were obtained at docetaxel to nanoparticles ratio of 1:4. The XRD patterns revealed strong crystallizations in all the nanoparticles formulation, while FTIR showed chemical interactions between the drug and nanoparticles with negligible positional shift in the peaks before and after DTX loading. BET analysis showed similar isotherms before and after DTX loading. The designed DTX- $CaCO_3$NP had lower ($p < 0.05$) cytotoxity against MCF-7 cells than DTX at 24 h but comparable ($p > 0.05$) effects at 48 h and 72 h. However, the DTX- $CaCO_3$NP released less than 80% of bond DTX at 48 and 72 h but showed comparable effects with free DTX. Conclusions: The results showed that the developed DTX- $CaCO_3$NP released DTX slower at pH 7.4 and had comparable cytotoxicity with free DTX at 48 and 72 h in MCF-7 cells.

Keyword: Breast cancer; Cancer therapy; Cockle shell- derived calcium carbonate nanoparticles; Drug delivery; Nano- anticancer