Functionalizing the surface of hydroxyapatite drug carrier with carboxylic acid groups to modulate the loading and release of curcumin nanoparticles

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Keywords

Hydroxyapatite; Breast cancer; Curcumin; Nanoparticle; Carboxylic acid

Abstract

This study has evaluated the effect of functionalizing surface charges of hydroxyapatite on the modulation of loading and release of curcumin nanoparticles. The increase in loading and release of curcumin nanoparticles indirectly translates to enhanced anti-cancer effect. Owing to the hydrophobic characteristics of curcumin which have resulted in low bioavailability in cancer cells, the engineering curcumin into nanoparticles is therefore a viable solution to overcomes its limitation. In order to maintain a sustained release profile of curcumin nanoparticles, curcumin nanoparticles were loaded (Cur-NPs) onto hydroxyapatite (HA) via physical adsorption. To regulate the adsorption capacity of Cur-NPs onto HA, we functionalized HA with different carboxylic acids (lactic acid, tartaric acid and citric acid). The presence of carboxylic groups on HA significantly affected the binding and the release profile of Cur-NPs. The effects of Cur-NPs loaded HA were evaluated on breast cancer cell line (MCF-7), which included cell proliferation, cellular uptake of Cur-NPs, apoptosis and cell cycle analysis. The results showed that carboxylic acid-functionalized HA demonstrated higher anti-proliferating activity and time dependent cytoplasmic uptake of Cur-NPs in MCF-7 cells compared to unmodified HA. In addition, Cur-NPs loaded on functionalized HA induced higher apoptosis and cell cycle arrest in MCF-7 cells compared to unmodified HA. The present study indicates that the delivery of Cur-NPs to breast cancer using carboxylic acid-functionalized HA carrier could improve their anti-cancer activities.