Arginine–chitosan- and arginine–polyethylene glycol-conjugated superparamagnetic nanoparticles: preparation, cytotoxicity and controlled-release

ABSTRACT

Iron oxide magnetic nanoparticles (MNPs) can be used in targeted drug delivery systems for localized cancer treatment. MNPs coated with biocompatible polymers are useful for delivering anticancer drugs. Iron oxide MNPs were synthesized via co-precipitation method then coated with either chitosan (CS) or polyethylene glycol (PEG) to form CS–MNPs and PEG–MNPs, respectively. Arginine (Arg) was loaded onto both coated nanoparticles to form Arg–CS–MNP and Arg–PEG–MNP nanocomposites. The X-ray diffraction results for the MNPs and the Arg–CS–MNP and Arg–PEG–MNPs nanocomposites indicated that the iron oxide contained pure magnetite. The amount of CS and PEG bound to the MNPs were estimated via thermogravimetric analysis and confirmed via Fourier transform infrared spectroscopy analysis. Arg loading was estimated using UV–vis measurements, which yielded values of 5.5% and 11% for the Arg–CS–MNP and Arg–PEG–MNP nanocomposites, respectively. The release profile of Arg from the nanocomposites followed a pseudo-second-order kinetic model. The cytotoxic effects of the MNPs, Arg–CS–MNPs, and Arg–PEG–MNPs were evaluated in human cervical carcinoma cells (HeLa), mouse embryonic fibroblast cells (3T3) and breast adenocarcinoma cells (MCF-7). The results indicate that the MNPs, Arg–CS–MNPs, and Arg–PEG–MNPs do not exhibit cytotoxicity toward 3T3 and HeLa cells. However, treatment of the MCF-7 cells with the Arg–CS–MNP and Arg–PEG–MNP nanocomposites reduced the cancer cell viability with IC50 values of 48.6 and 42.6 μg/mL, respectively, whereas the MNPs and free Arg did not affect the viability of the MCF-7 cells.

Keyword: Arginine; Iron oxide magnetic nanoparticles; Superparamagnetism; cell lines