Pegylated and amphiphilic Chitosan coated manganese ferrite nanoparticles for pH-sensitive delivery of methotrexate: Synthesis and characterization

Abstract

Magnetic nanoparticles (MNPs) are the major class of nanoparticles (NPs) with specific functional properties that make them good candidates for biomedical applications. Due to their response to the magnetic field, they can be used in targeted drug delivery systems. In current research, the MNPs were synthesized with the general formula of Fe$_{1-x}$Mn$_x$Fe$_2$O$_4$ by the co-precipitation technique. First, the effect of the Fe$^{2+}$ ions in the system was investigated. Succinic anhydride was used as the first stabilizer to prepare surface for binding two types of polymer, including Polyethylene glycol (PEG) and palmitoylated Polyethylene glycol-grafted Chitosan (Cs-PEG-PA) were introduced as a polymeric shell. The composition, size, structure and magnetic properties of NPs were determined by the particle size analysis (PSA), X-ray diffractometry (XRD), Fourier transform infrared spectroscopy (FTIR) and vibrating sample magnetometer (VSM). Determining the well-defined properties of MNPs, methotrexate (MTX), as a common anticancer drug, was encapsulated into the coated MNPs. The drug encapsulation efficiency was as high as 92.8% with the magnetization value of 19.7 emu/g. The in-vitro release pattern was studied, showing only 6% of the drug release in pH = 7.4 (as a model of the physiological environment) and 25% in pH = 5.4 (as a model of the tumor tissue environment) after 72 h. Based on these results, we may be able to introduce this specific system as a novel pH sensitive MNP system for MTX targeting to tumor tissues in cancer chemotherapy. © 2016 Elsevier B.V.