

Preparation and characterization of 6-mercaptopurine-coated magnetite nanoparticles as a drug delivery system

ABSTRACT

Background: Iron oxide nanoparticles are of considerable interest because of their use in magnetic recording tape, ferrofluid, magnetic resonance imaging, drug delivery, and treatment of cancer. The specific morphology of nanoparticles confers an ability to load, carry, and release different types of drugs. Methods and results: We synthesized superparamagnetic nanoparticles containing pure iron oxide with a cubic inverse spinel structure. Fourier transform infrared spectra confirmed that these Fe₃O₄ nanoparticles could be successfully coated with active drug, and thermogravimetric and differential thermogravimetric analyses showed that the thermal stability of iron oxide nanoparticles coated with chitosan and 6-mercaptopurine (FCMP) was markedly enhanced. The synthesized Fe₃O₄ nanoparticles and the FCMP nanocomposite were generally spherical, with an average diameter of 9 nm and 19 nm, respectively. The release of 6-mercaptopurine from the FCMP nanocomposite was found to be sustained and governed by pseudo-second order kinetics. In order to improve drug loading and release behavior, we prepared a novel nanocomposite (FCMP-D), ie, Fe₃O₄ nanoparticles containing the same amounts of chitosan and 6-mercaptopurine but using a different solvent for the drug. The results for FCMP-D did not demonstrate "burst release" and the maximum percentage release of 6-mercaptopurine from the FCMP-D nanocomposite reached about 97.7% and 55.4% within approximately 2,500 and 6,300 minutes when exposed to pH 4.8 and pH 7.4 solutions, respectively. By MTT assay, the FCMP nanocomposite was shown not to be toxic to a normal mouse fibroblast cell line. Conclusion: Iron oxide coated with chitosan containing 6-mercaptopurine prepared using a coprecipitation method has the potential to be used as a controlled-release formulation. These nanoparticles may serve as an alternative drug delivery system for the treatment of cancer, with the added advantage of sparing healthy surrounding cells and tissue.

Keyword: 6-mercaptopurine; Controlled release; Cytotoxicity; Drug delivery; Superparamagnetic nanoparticles.