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Control of Doxorubicin Release Rate from Magnetic PLGA Nanoparticles Using a Non-Permanent Magnetic Field

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Abstract : Inorganic/organic nanocomplexes offer tremendous scope for future biomedical applications, including imaging, disease diagnosis and drug delivery. The combination of Fe3O4 with biocompatible polymers to produce smart drug delivery systems for use in pharmaceutical formulation present a powerful tool to target anti-cancer drugs to specific tumor sites through the application of an external magnetic field. In the present study, we focused on the evaluation of the effect of the magnetic field application time on the rate of drug release from iron oxide polymeric nanoparticles. Doxorubicin, an anticancer drug, was selected as the model drug loaded into the nanoparticles. Nanoparticles composed of poly(d-lactide-co-glycolide (PLGA), a biocompatible polymer already approved by FDA, containing iron oxide nanoparticles (MNP) for magnetic targeting and doxorubicin (DOX) were synthesized by the o/w solvent extraction/evaporation method and characterized by scanning electron microscopy (SEM), by dynamic light scattering (DLS), by inductively coupled plasma-atomic emission spectrometry and by Fourier transformed infrared spectroscopy. The produced particles yielded smooth surfaces and spherical shapes exhibiting a size between 400 and 600 nm. The effect of the magnetic doxorubicin loaded PLGA nanoparticles produced on cell viability was investigated in mammalian CHO cell cultures. The results showed that unloaded magnetic PLGA nanoparticles were nontoxic while the magnetic particles without polymeric coating show a high level of toxicity. Concerning the therapeutic activity doxorubicin loaded magnetic particles cause a remarkable enhancement of the cell inhibition rates compared to their non-magnetic counterpart. In vitro drug release studies performed under a non-permanent magnetic field show that the application time and the on/off cycle duration have a great influence with respect to the final amount and to the rate of drug release. In order to determine the mechanism of drug release, the data obtained from the release curves were fitted to the semi-empirical equation of the the Korsmeyer-Peppas model that may be used to describe the Fickian and non-Fickian release behaviour. Doxorubicin release mechanism has shown to be governed mainly by Fickian diffusion. The results obtained show that the rate of drug release from the produced magnetic nanoparticles can be modulated through the magnetic field time application.

Keywords : drug delivery, magnetic nanoparticles, PLGA nanoparticles,controlled release rate
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