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Abstract

Formulation and Characterization of a Methacrylated Chitosan Topical Treatment with Dispersed Magnetite Nanoparticles Functionalized with Hydrophobic Drugs Encapsulated in Liposomes †

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Abstract: Cutaneous administration has advantages over the oral or intravenous route, such as convenience for the patient, avoiding hepatic metabolism, and providing sustained administration of the active component over long periods of time. A major challenge in this route is the administration of drugs that are difficult to penetrate. For these, it is necessary to design delivery vehicles that help increase the stability of the active components and facilitate transport across the skin barrier. In this work, magnetoliposomes (MLPs) immobilizing magnetite nanoparticles (MNPs) have been realized. MNPs act as a nanocarrier for hydrophobic drugs, such as doxorubicin (DOX). To facilitate topical application, MLPs were dispersed in photoresponsive methacrylated chitosan hydrogels. For this purpose, the MLPs were synthesized by coprecipitation of $FeCl_3$ and $FeCl_2$. Subsequently, they were silanized and functionalized by a PEG spacer to bind DOX. The success of each functionalization step was evaluated by Fourier transform infrared spectroscopy (FTIR) and thermogravimetric analysis (TGA). The size and morphology of the PEG-DOX-MNPs were analyzed by DLS and TEM. Then, the MNPs-PEG-DOX MNPs were encapsulated in liposomes synthesized by the layer hydration method. Dispersion of MLPs in the hydrogel, followed by crosslinking with visible blue light, was performed. Preliminary FTIR results indicate a correct synthesis and functionalization of the MNPs, as indicated by the presence of bands corresponding to the Si-O stretching vibration at 1029 cm^{-1} and Fe-O absorption bands around 560 cm^{-1}. TGA results showed a weight loss of 3.5% for MNPs from 200 to 400 °C, which was attributed to silane ligands. The hydrodynamic diameter of the MNPs was 140 nm with polydispersity indices of 0.16. In a future work, DOX will be conjugated to MNPs and MLPs will be synthesized for dispersion in the hydrogel. Subsequently, drug release kinetics tests will be performed under relevant conditions.

Keywords: magnetoliposomes; nanoparticles; magnetite; skin drug delivery; ChiMa hydrogels

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