Physically Cross-Linked Hydrogels of β-Cyclodextrin Polymer and Poly(ethylene glycol)-cholesterol as Delivery Systems for Macromolecules and Small Drug Molecules

Shaaban K. Osman, Ghareb M. Soliman, Saleh Abd El Rasoul

Abstract:

An injectable hydrogel based on the inclusion complexation of polymerized β-cyclodextrin (pβ-CD) and cholesterol terminated poly(ethylene glycol) (PEG-chol) was developed and used as a delivery system for both macromolecules and small drugs. The hydrogel was characterized by different analyses including X-ray diffraction, differential scanning calorimetry and scanning electron microscopy. The effects of pβ-CD/PEG-chol ratio and PEG-chol architecture on the hydrogel properties were also investigated. Cytotoxicity of the hydrogel was evaluated in NIH 3T3 fibroblasts using MTS assay. The hydrogel had an elastic behavior even at high temperature since the gelation temperature was observed at 69 °C. Highest hydrogel strength and stability were observed for the 8-armed PEG-chol at a pβ-CD/PEG-chol ratio of 1:1, w/w. Hydrogel degradation in phosphate buffered saline occurred by gradual erosion over the course of two months. IgG, a model hydrophilic macromolecule and riluzole, a model hydrophobic small drug were incorporated into the hydrogel and quantitatively released in a sustained fashion. The released IgG maintained its bioactivity confirming the absence of deleterious effects on protein structure during loading and release. The hydrogels showed no toxicity on NIH 3T3 fibroblasts confirming their biocompatibility. These results confirm the potential of pβ-CD/PEG-chol hydrogel as a versatile delivery system for drugs of different molecular weights and nature.

Published In:

Current Drug Delivery, DOI: 10.2174/1567201812666150326113331 , Vol. 12, No. 4 , pp. 415-424