Self-Assembling Hydrogels Based on β-Cyclodextrin Polymer and Poly (Ethylene Glycol) Bearing Hydrophobic Moieties for Protein Delivery

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Abstract:

Objective: The development of injectable and stable hydrogels for protein delivery is a major challenge. Therefore, the objective of this study was to evaluate the potential of polymerized β-CD for the formulation of stable hydrogels suitable for loading and release of bioactive agents and to investigate the mechanism of hydrogel formation. Methods: Hydrogels based on the inclusion complexation of polymerized β-cyclodextrin and cholesterol terminated poly(ethylene glycol) polymers were formed by rehydration of a lyophilized mixture of both polymers. The mechanism of hydrogel formation was investigated via isothermal titration calorimetry, fluorescence spectroscopy and dynamic light scattering measurements. The release behavior of bovine serum albumin (BSA) as a model protein from the modified gels was explored. Results: Rheological analysis demonstrated that the prepared hydrogels had a viscoelastic behavior even at elevated temperature (> 37°C). There are two competing mechanisms for hydrogel formation. The first mechanism is the inclusion complexation between cholesterol moieties and β-CD cavities. The second one is the self association of cholesterol modified PEGs. β-CD had the ability to dissociate the PEG-cholesterol associations. The quantitative and complete release of BSA was observed within 4 weeks. Conclusion: The polymerized form of β-CD, rather than native β-CD is essential for the formation of stable hydrogels. These results were supported by the ability of the modified hydrogel system for loading and release of BSA, making such hydrogel systems promising devices in drug delivery applications.

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