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SYNTHESIS AND INCLUSION STUDY OF β-CYCLODEXTRIN AND POLYETHYLENE GLYCOL BASED BUILDING BLOCKS FOR A DUAL-RESPONSIVE SUPRAMOLECULAR DRUG DELIVERY NETWORK

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Abstract

Supramolecular networks have demonstrated a great potential to use in novel drug delivery applications because of their appealing properties, including the functional diversity and synthetic tunability. The β-cyclodextrin (β-CD) based supramolecular networks offer a great interest in the targeted drug delivery by potentially serving as a novel drug carrier because of its biocompatibility, less-cytotoxicity, stability and the inclusion complex formation ability. This research is focused on the designing, synthesis and supramolecular complex formation study of building blocks, BB1 and BB2 for a β-CD-based dual-responsive supramolecular drug-delivery network. The BB1 and BB2 were designed to be synthesized using the esterification reaction between β-CD and citric acid, and polyethylene glycol 3400 (PEG 3400) and naphthoyl chloride, respectively. Further, the terminal β-CD unit of BB1 can undergo an inclusion with the terminal naphthoyl group of BB2 which leads to a supramolecular network formation. This supramolecular network is designed in a way to exert the dual responsiveness under acidic pHs and high concentration of esterase enzyme by breaking down the non-covalent interactions between β-CD unit of BB1 and naphthoyl group of BB2 as well as hydrolyzing the covalent ester linkage of BB1 and BB2, respectively. The synthesis of BB1 and BB2 were confirmed using Fourier transform infra-red (FTIR) spectroscopy and UV-visible spectroscopy. The absence of –OH stretching vibration of PEG 3400 in the FTIR spectrum of BB2 confirmed the novel diester product formation. The red shift observed in the UV-visible spectra of the mixture of crude BB1 with BB2 confirmed the inclusion complex formation as a result of the formation of the low energy complex. In order to obtain a supramolecular complex in a solid or semi-solid state, optimization of the concentrations of each building block in the final mixture or/and synthetic modifications on the original design need to be carried out.

Keywords: cyclodextrin, polyethylene glycol, dual-responsiveness, supramolecular network, drug delivery