Swelling behavior and controlled drug release from cross-linked k-carrageenan/ NaCMC hydrogel by diffusion mechanism

Abstract

We studied a model system of controlled drug release using beta carotene and k-carrageenan/NaCMC hydrogel as a drug and a device, respectively. Electrostatic interactions between beta carotene and k-carrageenan/NaCMC polymer segments are strong, since beta carotene is positively charged, NaCMC is a weak polyelectrolyte which behaves almost neutrally in pH 7.4 and each disaccharide repeating unit of k-carrageenan chains has one sulfate group.Results have shown that the cross-linked beads possess lower swelling ability in all pH conditions (pH 1.2 and 7.4), and swelling ratio decreases with increasing genipin concentration. Beta-carotene was loaded into the hydrogel by combining into blend solution of kappa-carrageenan/NaCMC. Different concentrations of genipin were then added to the hot solution followed by hardening for about 30 minutes to form cross-linked beta carotene loaded beads by using dripping method. Microstructure study shows that cross-linking has enhanced the stability and structure of the beads network. This phenomenon was well explained by our kinetic model studied. Determination of diffusion coefficient for the release of encapsulated beta-carotene indicates less diffusivity when beads are cross-linked. Swelling models using adaptive neuro fuzzy show that using genipin as a cross-linker in the kC/NaCMC hydrogels affects the transport mechanism. The model shows very good agreement with the experimental data which indicates that applying ANFIS modeling is an accurate, rapid and simple way to model in such a case for controlled release applications.