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Swelling and Drug Release Kinetics of Polyacrylamide/Sodium Alginate Copolymer Hydrogels Synthesized by Gamma Irradiation

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Hydrophilic hydrogels based on different ratios of polyacrylamide (PAAm) and sodium alginate (AG) were synthesized by gamma irradiation in aqueous solutions. The pH-sensitive character of PAAm/AG hydrogels was investigated in a wide range of buffer solutions of different pH values (2-8). The pH-sensitive character of PAAm/AG hydrogels was utilized for the possible use in drug delivery; the release profiles of chlortetracycline and ketoprofen, as drug models, was investigated. The swelling and release were further analyzed by Ficks power law equation, and the possible mechanisms of the water diffusion and release were suggested. The hydrogels were characterized by different techniques; FT-IR spectroscopic analysis, swelling, drug release measurements and kinetics of drugs Release
Results and discussion
Release of tetracycline
The drug release from loaded PAAm/AG hydrogel films, in different buffer solutions of pH 2.0, 5 and 8 was studied. Clearly, it can be seen that the drug release from loaded films is very sensitive to the pH of the medium. The release was increased by increasing the pH values depending on hydrogel composition. The high the ratio of AG in the hydrogel composition, the lower was the release. The results were in consistent with the water swelling ratio of non-loaded PAAm/AG hydrogel films in different pH values. As the amount of COO– on alginate is almost equivalent to the amount of NH3+ on PAAm, in the blank matrix film at pH 2.0, the macromolecular chains in the film matrix attract each other inducing a shrink in this system. So, the value of water swelling ratio of blank matrix film was the lowest at pH 2.0. When the equilibrium between the amount of COO– and NH3+ was broken at high pH, the chains macromolecules of the film matrix toke each other apart, increasing the water swelling ratio of the film and accelerating the drug release.
Release of Ketoprofen
Ketoprofen is a non-steroidal anti-inflammatory drug and it has a pKa of 4.94. The chemical name for ketoprofen is 2-(3-benzoylphenyl)-propionic acid. When this drug is loaded onto the networks of PAAm/AG hydrogels, it will be reacted through hydrogen bonding inside the network structure of hydrogels. These hydrogen bondings are through the COO- of AG molecules and those on chemical structure of ketoprofen.. For both hydrogel compositions, ketoprofen released rapidly at first and then gradually reached equilibrium release at ~ 3 h depending on the pH of medium. The equilibrium release of ketoprofen from PAAm/AG hydrogel (50/50%) is much higher than the release from PAAm/AG hydrogel (80/20%) and 50/50%, irrespective of the pH value. Opposite trends were found in the case of the release of tetracycline drug at similar conditions.
Conclusion
In this study, films of a new pH-sensitive copolymer hydrogel based on polyacrylamide (PAAm) and sodium alginate (AG) was successfully prepared by gamma radiation in the form of interpenetrating polymer networks (IPN). The pH-sensitivity of hydrogels affects the drug release

Country/Organization invited to participate

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