Radiation cross-linked carboxymethyl sago pulp hydrogels loaded with ciprofloxacin: influence of irradiation on gel fraction, entrapped drug and in vitro release

ABSTRACT

Carboxymethyl sago pulp (CMSP) with 0.4 DS, viscosity 184 dl/g and molecular weight 76,000 g/mol was synthesized from sago waste. 10 and 20% w/v solutions of CMSP were irradiated at 10–30 kGy to form hydrogels and were characterized by % gel fraction (GF). Irradiation of 20% CMSP using 25 kGy has produced stable hydrogels with the highest % GF and hence loaded with ciprofloxacin HCl. Drug-loaded hydrogels were produced by irradiating the mixture of drug and 20% CMSP solution at 25 kGy. After irradiation, the hydrogels were cut into circular discs with a diameter of 671 mm and evaluated for physicochemical properties as well as drug release kinetics. The ciprofloxacin loading in the disc was 14.7%71 w/w with an entrapment efficiency of 73.5% w/w. The low standard deviation of drug-loaded discs indicated uniform thickness (1.570.3 mm). The unloaded discs were thinner (170.4 mm) and more brittle than the drug-loaded discs. FESEM, FT-IR, XRD, DSC and TGA analysis revealed the absence of polymer–drug interaction and transformation of crystalline to amorphous form of ciprofloxacin in the discs. The disc sustained the drug release in phosphate buffer pH 7.4 over 36 h in a first-order manner. The mechanism of the drug release was found to be swelling controlled diffusion and matrix erosion. The anti-bacterial effect of ciprofloxacin was retained after irradiation and CMSP disc could be a promising device for ocular drug delivery.

Keyword: Carboxymethyl sago pulp; Ocular drug delivery; Ciprofloxacin hydrochloride; Radiation cross-linking; Release kinetic