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ORIGINAL PAPER

Novel metronidazole-loaded hydrogel as a gastroretentive drug delivery system

Parastou Farshforoush[1] · Saeed Ghanbarzadeh[2] · Amir Mohammad Goganian[3] · Hamed Hamishehkar[4]

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Abstract A metronidazole-loaded hydrogel was synthesized by free radical polymerization using dimethylaminoethyl methacrylate (DMAEMA) monomer and triethyleneglycol dimethacrylate (TEGDA) and methylene bisacrylamide (MBA) as cross-linkers. The DMAEMA hydrogels were cross-linked with 5 and 10% MBA or with 0.1, 0.5, 1 and 4% TEGDA as cross-linking agents. Ammonium persulfate and tetramethyl ethylene diamine were used as initiator and catalyst, respectively. The prepared hydrogels were characterized, and the effect of cross-linking agent content on the swelling behavior and in vitro drug release of hydrogels was investigated. The results of X-ray diffractometry, differential scanning calorimetry and Fourier transform infrared spectroscopy studies indicated that the prepared hydrogels possessed an amorphous morphology and there was not any interaction between the hydrogel polymers and metronidazole as drug, which resulted in the dependence of drug release on the physicochemical characteristics of hydrogel such as swelling, polymer erosion, and surface morphology. According to the results, the hydrogel containing 0.5% TEGDA which was prepared by freeze-drying method exhibited a porous structure with a high swelling ratio and displayed a sustained and complete drug release. It could be concluded that the hydrogel developed by this facile method is a good candidate with a potential for use in gastroretentive drug delivery systems.

Keywords Hydrogel · Gastroretentive drug delivery · Metronidazole · Radical polymerization

Introduction

Oral route is the most preferred route of drug delivery because of the ease of administration and patient compliance, low cost of therapy, and flexibility in the formulation process [1, 2]. For the past decades, controlled-release oral dosage forms have been developed due to their important therapeutic advantages in comparison with traditional drug delivery systems [3, 4]. Several approaches are being designed and developed for increasing the residence time of dosage form in the stomach, such as high-density (sinking) systems that are retained in the bottom of the stomach, low-density (floating) systems that cause buoyancy in gastric fluid, mucoadhesive systems, swellable hydrogel systems, magnetic systems, etc. [5, 6]. Hydrogels have received extensive attention in the past 50 years, due to their exceptional promise in wide range of fields such as numerous biomedical and pharmaceutical applications [7–9]. The ability of hydrogels to absorb water arises from their hydrophilic functional groups attached to the polymeric backbone, and their resistance to dissolution which originates from the cross-links between the network chains [10]. Depending on the properties of the used polymer(s), and the nature and density of the cross-linkers, they can absorb various amounts of water. On the other hand, they may also show dramatic volume transitions in response to different physical and chemical stimuli

✉ Hamed Hamishehkar
hamishehkar.hamed@gmail.com

[1] Biotechnology Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

[2] Zanjan Pharmaceutical Nanotechnology Research Center, and Department of Pharmaceutics, Faculty of Pharmacy, Zanjan University of Medical Sciences, Zanjan, Iran

[3] Institute for Stem Cell and Regenerative Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

[4] Drug Applied Research Center, Tabriz University of Medical Sciences, Tabriz, Iran