Iran Polym J (2016) 25:933–943
DOI 10.1007/s13726-016-0480-2

ORIGINAL PAPER

The release of cefazolin from chitosan/polyvinyl alcohol/sepiolite nanocomposite hydrogel films

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Received: 18 May 2016 / Accepted: 17 September 2016 / Published online: 23 September 2016

Abstract Films of chitosan/polyvinyl alcohol (PVA)/sepiolite nanocomposite were prepared by a simple and "green" route through solution mixing; followed by freezing–thawing cycles. The structures of nanocomposites were characterized by transmission electron microscopy (TEM), scanning electron microscopy (SEM), thermogravimetric analysis, X-ray diffractometry, and Fourier transform infrared spectroscopy. The SEM and TEM micrographs confirmed a needle-type dispersion of sepiolite nanoclay in the hydrogel nanocomposites. The effects of sepiolite and chitosan/PVA weight ratio on the swelling of nanocomposites were investigated. The water absorbency of nanocomposites was decreased by introducing sepiolite nanoclay. The nanocomposites with high content of chitosan showed high swelling capacity. The nanocomposite films showed pH-dependent swelling behavior with a maximum water absorbency under acidic pH. The cefazolin with a broad-spectrum activity toward gram-positive and gram-negative bacteria was loaded in hydrogels. The release of cefazolin from nanocomposites was evaluated at pH 7.4. The content of released drug was affected by both sepiolite amount and chitosan/PVA weight ratio. The nanocomposites films released more cefazolin than the neat hydrogel film. Cefazolin-loaded nanocomposites showed the antibacterial activity with a large zone of inhibition against gram-positive *Bacillus cereus* bacterium.

Keywords Chitosan · Polyvinyl alcohol · Nanocomposite · Cefazolin · Antibacterial

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Introduction

Biocompatible polymer materials are the most important aspects in biomedical field. An essential requirement in the biomedical field includes biocompatible polymer materials. In fact, biocompatibility in polymers as biomaterials should be considered as a major important factor [1]. Highly compatible biopolymers are successfully designed as biomaterials in biomedical applications [2]. Chitin, chitosan, alginate, κ-carrageenan, starch, and cellulose are main biopolymers that are applied as new biomaterials with a wide range of functions in biomedical field [3]. Chitosan contains primary amine groups on its backbone and the presence of these pendants makes it unique among the biopolymers. Chitosan exhibits high potential applications in drug delivery and biomedical devices due to its pH sensitivity and antibacterial activity [4, 5]. In last decades, chitosan has been used in the process of wound healing. To develop an improved antibacterial performance, some antibiotic drugs with a broad-spectrum activity against bacteria are combined with chitosan-based materials [6–10].

Although biocompatibility, biodegradability, and non-toxicity are the main features of biopolymers, some properties such as low mechanical strength and thermal stability limit the applicability of these materials in biomedical fields [11]. Also, processing and shaping the biopolymers for various applications cannot be carried out easily. In recent years, polymer blends are suggested as an efficient