

Abstract

Subject: Synthesis, physicochemical and antibacterial properties evaluation of polyvinyl alcohol/polylysine hydrogel containing silver nanoparticles modified with tannic acid

Introduction: Wounds and problems related to its treatment are among the challenging cases in healthcare systems. Studies show that in the last decade, new wound dressings such as hydrogels have shown significant results in wound healing. Hydrogels have received attention due to their transparency, ease of exchange of respiratory gases and water, absorption of wound secretions, favorable biological properties and easy use. Along with the use of hydrogels, the use of antibacterial properties of various nanoparticles will strengthen the therapeutic ability of hydrogels. In this study, hydrogel wound dressing based on polyvinyl alcohol was prepared. In order to strengthen the antibacterial properties of the hydrogel, polylysine polymer and silver nanoparticles modified with tannic acid and the antiallergic drug allantoin were added to the polyvinyl alcohol hydrogel. On the other hand, the presence of tannic acid, which is an antibacterial, antioxidant and anti-inflammatory compound, in addition to wound healing through various mechanisms, improves the effects of the resulting hydrogel and at the same time reduces the toxic effects of silver nanoparticles.

Materials and methods: In order to prepare hydrogel, silver nanoparticles modified with tannic acid and highly branched polylysine polymer were prepared separately through thermal polymerization of L-lysine-hydrochloride. The characteristics of particle size and charge of silver nanoparticles were determined. Then three types of hydrogels with different concentrations of silver nanoparticles were made and the properties of initial water content, swelling percentage, water retention capacity and biodegradability percentage were evaluated. After optimizing the amount of silver nanoparticles, the final hydrogel containing the optimal amount of silver nanoparticles, fixed amounts of polylysine and the anti-inflammatory drug allantoin was prepared. The physicochemical properties of the obtained hydrogel were investigated with the tests of transmission infrared spectroscopy (FTIR), thermal gravimetric analysis (TGA) and X-ray diffraction (XRD). Similarly, the antibacterial effects of hydrogel were evaluated by colony counting method.

Results: The findings of this study showed that changing the tested concentration of silver nanoparticles has no significant effect on the physicochemical properties of the hydrogel. Similarly, the results of FTIR, TGA and XRD tests confirmed the formation of hydrogel and drug loading inside the hydrogel. Colony count test results showed that the prepared hydrogel has good antibacterial properties.

Conclusion: The results of this study showed that the prepared hydrogel has good antibacterial properties and can be a suitable treatment option for wound healing.

Keywords: wound, silver nanoparticles/tannic acid, polyvinyl alcohol hydrogel, multi-branched polylysine polymer