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Hydrogels based on poly(methacrylic acid) for controlled release of anti-inflammatory drugs

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Abstract

Everyday struggle of humanity with novel diseases and present once, urge researchers to find novel and improve existing therapies to enhance their efficiency and safety. One of the promising approaches to overcome these challenges is controlled release of drugs. Biomaterials based on poly(methacrylic acid) (PMAA) are excellent drug delivery systems because they can control release rate and released amount of drug. Also, due to their pH sensitivity the PMAA hydrogels can release drug at the site of action. Namely, these nontoxic and biocompatible hydrogels swell in the environment with pH value higher than pKa of PMAA (4.6) and release encapsulated drug during the process. In present study, PMAA hydrogels are synthetized under ambient conditions by simple, cost effective and eco-friendly synthesis. Novel initation system based on hydrogen peroxide, potato peel peroxidase and vitamin C (VC) is used for the first time for free radical polymerization of PMAA hydrogel. In accordance with the principles of circular economy, peroxidase was isolated from potato peel waste by water extraction for 12 h at 4 °C. Four PMAA hydrogels were prepared by using potato peel peroxidase with various enzyme activity (0.4; 0.8; 1.2 and 1.8 IU), whereas the amounts of H2O2 (30 mL) and VC (10 mg) have been kept constant. The composition of the PMAA hydrogels was confirmed by FTIR analysis, whereas their porous structure was revealed by SEM. The swelling of the PMAA hydrogels was monitored in two media: 0.1M HCl (as simulation of human stomach) and phosphate buffer with pH 7.4 (as simulation of human intestines). In order to encapsulate anti-inflammatory drug – dexamethasone into the PMAA hydrogels, the hydrogels were immersed into the dexamethasone aqueous solution (5 mg/ml) and left to swell to the equilibrium, after which they were dried at room temperature. Dexamethasone release from the PMAA hydrogels was monitored in the same environments as was the PMAA swelling. The results showed that around seven times higher amount of dexamethasone was released in the medium with pH 7.4 than in the medium with pH 1. Present study has showed that the PMAA hydrogels, prepared through green and eco-friendly method, have huge potential for encapsulation and controlled release of anti-inflammatory drugs and therefore, for the treatment of rheumatoid arthritis.

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