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Synthesis and Characterization of Methacrylated PEG Hydrogels Responsive to Changes in pH and Temperature †

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Abstract: One of the most important modern classes of materials is stimuli-responsive polymers, which can alter their physical properties in response to external stimuli. Polymers that can be used in such applications are methacrylates bearing functional groups, e.g., poly(ethylene glycol), PEG. These biocompatible materials can be used as injectable hydrogels, biosensors, capsules for controlled drug release, etc. In this investigation, three homopolymers and three copolymers based on PEG methacrylates were synthesized. Specifically, the monomers used were oligo(ethylene glycol), methyl ether-methacrylate, POEGMMA, oligo(ethylene glycol) hydroxyethyl methacrylate, POEGHEMA and poly(hydroxyethyl methacrylate), PHEMA. In addition, three new copolymers were synthesized based on these monomers, namely p[(OEGMMA)-co-(HEMA)], p[(OEGHEMA)-co-(HEMA)] and p[(OEGMMA)-co-(OEGHEMA)]. Bulk free-radical chain polymerization was carried out at 60 °C for the homo-polymers and 80°C for the copolymers, using benzoyl peroxide as the initiator. The successful synthesis of the homopolymers and copolymers was confirmed by the HATR-FTIR spectra, where the peaks at 3400, 1700, and 1250 cm^{-1} were attributed to the characteristic hydroxyl (-OH), ether (C-O-C), and carbonyl (C=O) groups, present in the macromolecules. Moreover, TGA scans reveal that all materials present similar thermal stability, with degradation taking place in one step, starting near 300°C and ending at 420°C. The hydrogels thus prepared were transparent, with a solid structure and elastomeric behavior. Concerning the effect of pH, it was found that PHEMA and copolymers, including this monomer, exhibit higher crosslinking in alkaline solution, whereas the third copolymer in acid solution. The effect of temperature was found to be more intense in the copolymer p[(OEGMMA)-co-(OEGHEMA)].

Keywords: hydrogels; poly(hydroxyethyl methacrylate); simuli responsive polymers.

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Conflicts of Interest

The authors declare no conflict of interest.