Synopsis of Original Research Paper

A novel biodegradable polyphosphate cross-linker for making biomimetic hydrogel

Yasuhiko Iwasaki

Tokyo Medical and Dental University

Hydrogels are insoluble, cross-linked polymer networks that can absorb significant amounts of water. From a biological viewpoint, hydrogels are as flexible as soft tissues, which minimize their potential irritation to surrounding tissue. More recent trends in hydrogel research are macromolecular drug delivery and cell entrapment for tissue engineering. For these applications, biodegradability and biocompatibility of hydrogels are important.

There has been a great deal of interest in polyphosphates, which are biodegradable through hydrolysis, and possibly enzymatic digestion of phosphate linkages under physiological conditions. These biodegradable polyphosphates appear interesting for biological and pharmaceutical applications because of their biocompatibility and structural similarities to the naturally occurring nucleic and teichoic acid.

To obtain a novel biodegradable cross-linker, polymerizable polyphosphate (PIOP) was synthesized by ring-opening polymerization of 2-i-propyl-2-oxo-1,3,2-dioxaphospholane with 2-(2-oxo-1,3,2-dioxaphosphoroyloxyethyl methacrylate) (OPEMA). The number averaged molecular weight of the PIOP was 1.2x104 and the number of OPEMA units in one PIOP molecules was 2.2. Nonenzymatic degradation of the PIOP was evaluated in various pH aqueous media. The degree of hydrolysis was dependent on the pH, that is, it increased with an increase in the pH of the medium. At pH 11.0, the PIOP completely degraded only 6 days. The poly[2-methacryloyloxyethyl phosphorylcholine (MPC)] cross-linked with the PIOP was prepared by radical polymerization. This polymer could form hydrogel and the free water fraction in the hydrogel was high. The enzymatic activity of trypsin in contact with the hydrogel was similar to that in buffer solution. There is no adverse effect caused by the hydrogel to reduce the function of the trypsin. The cytotoxicity of poly (MPC) and degraded PIOP was evaluated using v79 cells and it was not observed in either case.

In conclusion, PIOP is a hydrolyzable polymer, which can be used as a cross-linker, and novel hydrogels having biodegradability and biocompatibility were prepared from poly (MPC) cross-linked with the PIOP.