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Synthesis and Characterization of Phosphated Konjac Glucomannan Hydrogels

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Abstract: Konjac glucomannan (KGM) was crosslinked with sodium tripolyphosphate (STPP) to synthesize hydrogels. The crosslinking reaction was confirmed by FT-IR. The results of degradation test show that the hydrogels retain the enzymatic degradation character of KGM and can be degraded for 74.45% in 5 days by cellulase E0240.

Keywords: Konjac glucomannan, sodium tripolyphosphate, hydrogels.

Konjac glucomannan (KGM) can not be hydrolyzed by digestive enzymes in upper gastrointestinal tract of human beings, but it could be hydrolyzed by β-glycosidases to oligosaccharides[1]. KGM could form strong, elastic, heat-stable gels, when it was heated with mild alkali[2]. It has also been used as drug carriers[3]. In our previous work, we found that the graft copolymers of KGM and acrylic acid retain the enzymatic degradation specificity[4]. Phosphated guar crosslinked with trisodium trimetaphosphates for colon-specific drug delivery was studied by Irit *et al.*[5, 6]. In this letter, we report the synthesis and characterization of a novel degradable hydrogel crosslinked by sodium tripolyphosphate. In order to exploit the obtained hydrogels for colon-specific drug delivery, *in vitro* degradability of the hydrogels was also tested.

Experimental

Phosphated konjac glucomannan hydrogel has been synthesized, which is illustrated in **Scheme 1**. Sodium tripolyphosphates (0.947 g) was dissolved in 30 mL NaOH solution (pH=12) at room temperature for 4 hours, then konjac glucomannan (0.648 g) was added into the solution under continuous stirring. The dispersion was mixed for 6 hours to allow maximum swelling of KGM. The mixture was heated to 60ºC and incubated for 24 hours. After reaction, the hydrogels were washed several times with double distilled water to remove the unreacted STPP, KGM and other soluble agents. Then the hydrogels were dried under 60ºC to constant weight.

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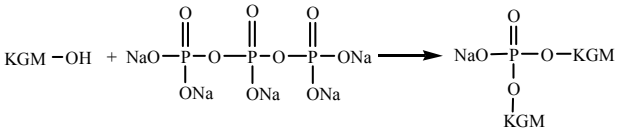
Scheme 1 Synthesis of phosphated konjac glucomannan hydrogel



Results and Discussion

The phosphated hydrogel was characterized by FT-IR spectroscopy (Perking-Elmer-2 spectrometer). As compared with the spectrum of KGM, the peak at 1734 cm^{-1} disappeared, and the peaks at 1157, 1091, 881, 715, 536 and 507 cm^{-1} appeared, which were assigned as absorption bands of phosphates. The results showed that the crosslinking occurred between KGM and STPP.

The enzymatic hydrolysis experiment was carried out in pH 7.4 buffer solution at 37ºC with cellulase E0240 at the concentration of 0.4 mg/mL. To test the specificity to

Figure 1 FTIR spectra of KGM and hydrogel

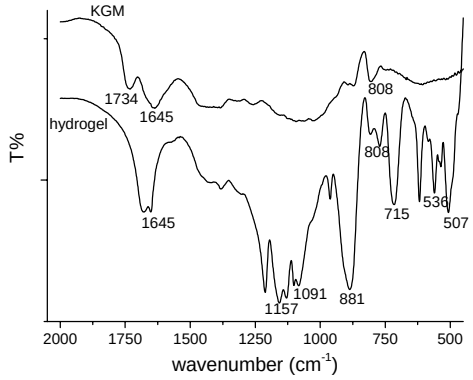
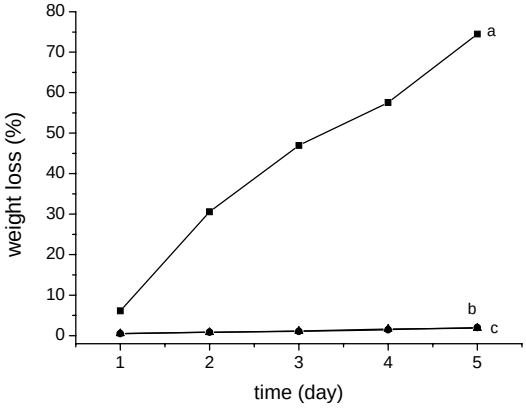


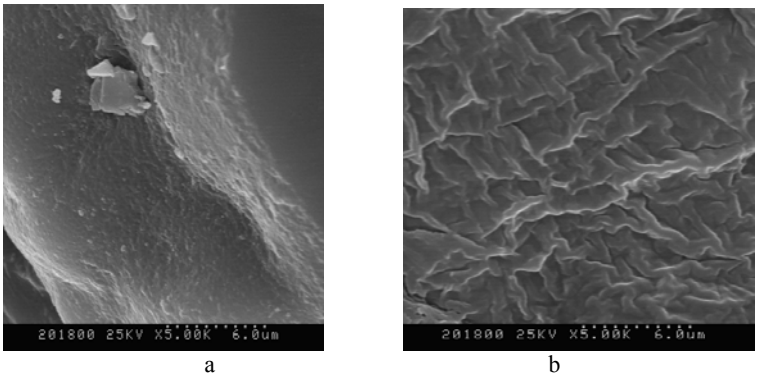
Figure 2 Degradation of hydrogel in buffer solution of pH 7.4 with cellulase E0240 (a), with pancreatin (b) or without enzymes(c) at 37ºC



enzymatic degradation, pancreatin (0.8 mg/mL) was used as positive control and buffer solution without enzymes was used as negative control. The results (see **Figure 2**) indicated that hydrogel could not be degraded in phosphate buffer solution at pH 7.4, or by pancreatin, but it could be degraded by cellulase E0240, which contains β-glycosidases, and the weight loss was 74.45% for 5 days. The results suggested that the phosphated KGM can be degraded by the enzymes which can degrade KGM itself[1], *i.e.* phosphated KGM hydrogels retain the biodegradability characters of KGM.

The biodegradation of the hydrogels was further confirmed by SEM micrographs of the hydrogels before and after enzymatic degradation. Before degradation, the surface of hydrogel was smooth and compact (**Figure 3a**). After degradation, caves and holes in the surface of the hydrogel were observed (**Figure 3b**). The results indicated that the hydrogel was degraded by cellulase E0240.

Figure 3 SEM photographs of surface of hydrogels before (a) and after (b) degradation by cellulase E0240



a b

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