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Starch-based biomaterial cross-linked with citric acid for enhanced properties

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Starch-based hydrogel is unsuitable for tissue engineering due to its fast degradation [1], making its application challenging. To overcome this, citric acid (CA) cross-linker is an interesting option. Therefore, this study proposes improving starch-based hydrogel stability using citric acid (CA) cross-linker. Wheat starch (10%, control) was mixed with CA (5%), gelatinizated at 85°C/20 min followed by gelification at 5°C/24h and water removal by freeze-drying. Dried samples were then heated at 180°C for 10, 20, and 30 min and washed with phosphate buffer for 24h to release the unreacted CA. Compared to the control, the CA-starch hydrogels were more stable in the cell culture medium (> 80%, $p<0.05$) and in the presence of amyloglucosidase (>45%, $p<0.05$), suggesting the presence of covalent bonds between CA and hydroxyl groups of starch [2]. Surprisingly, the CA-starch hydrogels had a greater swelling capacity (>40%, $p<0.05$) and a greater blood coagulation index than starch hydrogel. These results suggest the potential application of CA-starch hydrogel as a hemostatic material since its behavior is better than the gelatispon®. In addition to the hemocompatibility (absence of hemolysis), the CA-starch hydrogels did not show a cytotoxic effect on dermal fibroblasts. Finally, when cultured in the presence of macrophages, in contrast to the starch hydrogels, the CA-starch hydrogels did not induce an overproduction of proinflammatory TNF-α and IL-1β. To sum up, CA-starch hydrogel showed good features for tissue healing and subsequently will be evaluated for its osteo-biocompatibility and potential application in bone tissue engineering.

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References:

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