HYDROGELS FROM GLYCOSAMINOGLYCANS FOR CARTILAGE RENEWAL

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Introduction

Osteoarthritis is a common and increasing problem in modern life. Since physical and pharmacological therapy is ineffective the development of injectable hydrogels for the treatment of cartilage defects is highly demanded. Functional polysaccharides derived from extracellular matrix (ECM) like hyaluronan or chondroitin sulfate are of particular interest, not only due to their injectable potential, but also the expression of multiple biological effects, like growth factor binding and cellular activity control, which is suitable for cell survival and growth and finally forming functional tissues

Methods

We have synthesized succinylated chitosan (s-Chi) and oxidized glycosaminoglycans (ox-GAGs) which were crosslinked to hydrogels via Schiff base reaction. The chemical structures of polysaccharide derivatives and hydrogel were identified by FT-IR and NMR. The morphologies of hydrogels without/with cells after freeze-drying were investigated by Environmental Scanning Electron Microscopy (ESEM). Physical properties of hydrogels were characterized by swelling measurements and rheological tests. The cytotoxicity of the hydrogels was determined by XTT assay. The cell viability was stained by FDA and visualized by fluorescence microscopy.

Results

Infrared spectroscopy and NMR confirmed the introduction of succinyl groups to chitosan making it soluble at pH 7,4. The presence of free aldehydes in ox-GAGs was quantified by Schiff`s reagent. The freeze-dried hydrogels show a porous well-interconnected structure in ESEM images. The equilibrium swelling ratio (ESR) was found to be between 60 and 95% after 24h. According to quantitative XTT assay and FDA vital staining the hydrogels and their products show no toxic behavior towards cells.

Discussion

These new hydrogels were formed from different functionalized GAGs without employing any exogenous crosslinker. The gelation time can be controlled by the ratio of the components and is also dependent on the amount of free aldehyde groups within the applied GAG. They can be applied as injectable scaffold for the regeneration of human cartilage which was proven by the encapsulation of fibroblast cells in vitro. This can be used as an alternative route to renew damaged cartilage tissue where clinical surgery is difficult to perform.

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