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Authors: Dorsa Dehghan Baniani, Reza Bagheri, Atefeh Solouk



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Preparation and characterization of a composite biomaterial including starch micro/nano particles loaded chitosan gel

Dorsa Dehghan Baniani^{1,a}, Reza Bagheri^{2,a,*}, Atefeh Solouk^{3,b}

¹ dehghanbaniani_d@mehr.sharif.edu

² rezabagh@sharif.edu

³ atefeh.solouk@aut.ac.ir

^a Polymeric Materials Research Group, Department of Materials Science and Engineering, Sharif University of Technology, Tehran, P.O. Box 11155-9466, Iran

^b Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran

* Corresponding author: rezabagh@sharif.edu, Polymeric Materials Research Group, Department of Materials Science and Engineering, Sharif University of Technology, Tehran, P.O. Box 11155-9466, Iran, Tel: +982166165201, Fax: +982166005717

Highlights:

- Synthesis of starch micro/nano particles by W/O mini emulsion technique.
- Particle size relationship prediction with three main factors by statistical model.
- Quadratic model as the most valid particle size predictor within the design space
- Novel injectable thermosensitive composite scaffold for tissue engineering applications
- Improvement of compressive elastic modulus of chitosan hydrogel by about 14 times

Abstract:

Thermosensitive Chitosan hydrogels which can be injected into defects with minimally invasive approach were prepared. Also starch micro/nano particles were synthesized via water-in-oil (W/O) miniemulsion technique. The starch particles were incorporated into the chitosan hydrogel to prepare injectable thermosensitive hydrogel composites. Tube inverting method, compression tests, swelling studies, XRD, SEM, OM, DLS, Uv-vis spectroscopy were used for investigations. Results revealed that increasing crosslinker and surfactant contents and stirring rate leads to particle size reduction. Particle size was modeled using design of experiments (DOE) via the response surface method (RSM). Due to analysis of variance (ANOVA), the particle sizes can be predicted by quadratic model within the design space. Gelation time and compressive modulus measurements showed the particles significant influence on the blend network density and hydrogel mechanical properties. Swelling measurements revealed that incorporation of starch particles in chitosan hydrogel increases its swelling coefficient significantly. The innovative architecture, namely micro/nano particles in gel can be considered as a dual delivery platform or smart scaffold for engineering of certain tissues.

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