Abstract

Tissue engineering (TE) is evolving as a promising solution for rehabilitation of diseased and traumatised tissues and organs. Cells, biodegradable scaffolds and growth factors are prerequisites in this endeavour, amongst which scaffolds play a crucial role in directing variety of cellular events by providing suitable microenvironment. In this context, fibrous architecture is preferred because of their structural resemblance to native extracellular matrix (ECM) and provides a range of morphological and geometrical possibilities with interconnected porosity for optimal mass transport.

In the present study, chitosan fibers were spun in sodium tripolyphosphate (STPP) bath through ionotropic gelation. The pH of STPP bath had pronounced effect on mechanism of fiber formation and their physico-chemical properties. Further, the gelation kinetics and gel strength of chitosan-TPP system were evaluated at different pH and correlated with mechanism of fiber formation. Ultrafine chitosan-TPP fibers (~10 μm) were also prepared by wet spinning using novel pressure sensitive spinneret. Non-woven three dimensional chitosan-TPP fibrous scaffolds were fabricated and characterized by different physico-chemical techniques. *In vitro* degradation rate of chitosan-TPP fibers was found to be higher than that of chitosan fibers which may be due to decrease in crystallinity. The scaffolds with interconnected porous structures exhibited considerable cytocompatibility to 3T3 cells. The developed scaffolds also supported *in vitro* biomineralization and allowed significant attachment, proliferation, and differentiation of MG63 cells. Moreover, incorporation of bioactive materials like collagen may further enhance their utility for TE.

Collagen, a major component of ECM, was isolated from fresh water fish scale origin as an economical and safer alternative to commercially available bovine collagen. Promising feature of this collagen was its non-immunogenicity and close denaturation temperature to the mammalian one. Collagen scaffolds having fibrous architectures were prepared by phase separation and subsequently cross-linked for enhanced stability and mechanical property. These scaffolds offered excellent attachment and proliferation to both 3T3 and MG63 cells. Furthermore, to provide adequate mechanical properties and favorable porosity for cell penetration into the core, fibrous collagen-chitosan scaffolds were developed. These scaffolds showed remarkable improvement in terms of cell attachment, viability and can be considered as potential TE scaffolds.

Keywords: Chitosan-tripolyphosphate fiber, ionotropic gelation, fish scale collagen, collagen-chitosan scaffold, tissue engineering