Fabrication of highly porous biodegradable biomimetic nanocomposite based on silk fibroin and hydroxyapatite nanoparticles as advanced bone tissue engineering scaffold

Abstract

The development of biomimetic materials is currently a challenge in the field of tissue regeneration. Natural biomaterials such as chitosan, collagen and silk fibroin, and synthetic biopolymers such aspolycaprolactone, polyglycolic acid, polylactic acid, and their copolymers are being used as scaffold for tissue engineering applications. Silk fibroin has attracted great interest in tissue engineering because of its outstanding biocompatibility, minimal inflammatory reaction and biodegradability. In this study, silk fibroin/nano-hydroxyapatite (SF-nHA) nanobiocomposites are fabricated by freeze dryingt processes. The freeze-drying process causes the formation of micro-scale pores in the scaffold, which can be confirmed by field emission scanning electron microscopy (FE-SEM). A new tissue engineering scaffold material based on freeze-dried SF-nHA biocomposites was prepared using sonicate method. nHA (1, 3 and 5 %w-w) is successfully produced in a solution of synthesized silk fibroin in minutes without any pretreatment. Pure SF and SF-nHA scaffolds scaffolds were evaluated for their characteristics by a Fourier transform infrared spectroscope (FTIR), X-ray diffraction (XRD) and EDX analyses. As well as, In this study, the effects of pure SF and SF-nHA on the rate of water uptake and biodegradation of scaffolds are investigated. The water uptake of pure SF scaffolds was equal to 68% and SF/nHA scaffolds were 76, 82 and 89%, respectively, with an increase in the percentage of nanoparticles in phosphate buffer saline. All these results indicate that this silk fibroin/nano-hydroxyapatite (nHA) nanobiocomposites scaffold may be a promising biomaterial for bone tissue engineering.

Keyword: Biomimetic nanocomposite, porous sponge scaffold, silk fibroin, hydroxyapatite nanoparticles, bone tissue engineering