Antibacterial silk fibroin e-gel scaffolds for tissue engineering applications

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Silk is a natural protein which has been used for centuries as suture material. Silk has two components, double strand fibroin and its surrounded gummy substance called sericin[1]. Silk has popularity in wide range biomedical applications because of environmental stability, mechanical properties, biocompatibility and the ability for surface modifications[2]. In literature, various formed silk scaffolds have been prepared such as films, sponges, hydrogels, electrospun mats and tubes to use in diverse tissue engineering applications[3]. Soft biomaterials, i.e. hydrogels which provide extracellular matrix functionalization and appropriate mechanical properties are needed frequently for tissue engineering and regeneration. The hydrogelation of silk fibroin can be induced through conditions such as low pH, high temperature or alternatively, ultrasonication and vortexing[4]. Recently, silk fibroin gel systems (e-gel), formed with weak electric fields have been prepared for the various tissue engineering applications such as neural, cartilage and bone. In this study, curcumin loaded silk fibroin e-gel scaffolds were prepared and biocompatibility of these novel silk fibroin e-gel scaffolds was evaluated.

Firstly, Bombxy mori silk cocoons were degummed using 0.05 M Na_2HCO_3 at 80 °C for 2 hours and were washed with distilled water to remove the sericin shell from the surface of silk fibers as per established protocols[5]. The obtained silk fibroin fibers were then dissolved in a 9.3 M LiBr solution, followed by dialysis against distilled water for 5 days. An aqueous silk solutions were stored at 4–7 °C before use. Silk solution was sterile filtered through a 0.22 μm membrane. Prior to the onset of gelation, the silk solution was mixed with curcumin solutions of two different concentrations dissolved in ethanol and electrodes were immersed in the concentrated aqueous solution of silk fibroin (8 %wt) and 25 V_{DC} was applied over a 4 minute period. The obtained pure and curcumin-loaded silk fibroin e-gels were freeze-dried at -70 C. The surface morphology, water uptake, antibacterial properties and cytotoxicity of fabricated hydrogels were comparatively investigated against pure silk fibroin e-gel scaffolds. For cell studies, mouse fibroblast cell line (L929) was used and an MTT assay was used to assess cell density on these surfaces.

1. Vepari C, Kaplan DL. Prog Polym Sci. 32 (8-9) (2007) 991-1007.
2. Panilaitis B, Altman GH, Chen JS, Jin HJ, Karageorgiou V, Kaplan DL. Biomaterials 24 (2003) 3079.
3. Schneider A, Wang XY, Kaplan DL, Garlick JA, Egles C. Acta Biomat. 5 (2009) 2570.
4. Lu Q, Huang Y, Li M, Zuo B, Lu S, Wang J, Zhu H, Kaplan DL. Acta Biomater 7(6) (2011) 2394-400.
5. Rockwood DN, Preda RC, Yücel T, Wang X, Lovett ML, Kaplan D. Nat Protoc. 6(10) (2011) 1612-31.

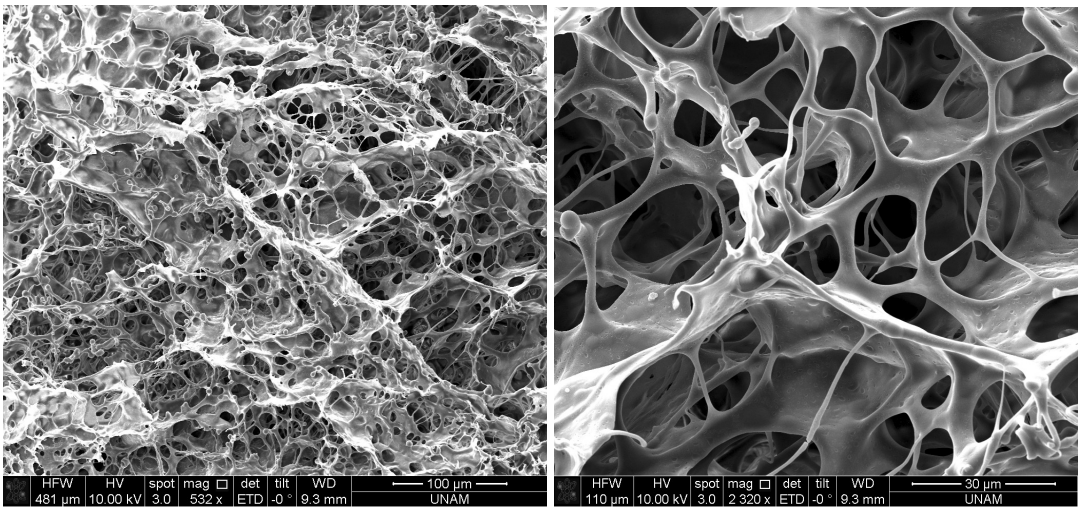

Fig 1. SEM images of silk fibroin e-gel scaffolds