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Preparation and Properties of Silk Fibroin/Alginate Blend Sponges and its Application

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Objectives

Silk fibroin (SF) is one of the typical protein polymer produced by silkworm, *Bombyx mori*. SF has been used as textile fiber and surgical suture for thousands of years due to its unique gloss, handle, and mechanical properties. Recently, SF has been intensively studied to diverse usage for biotechnological and biomedical fields because of their reproducibility, environmental compatibility, non-toxicity, and biological compatibility. Based on its biocompatibility, the possible uses of regenerated SF have been proposed including substrate for cell culture[1], enzyme immobilization[2], and matrix for drug release[3]. However, the collective properties especially mechanical properties of SF sponges in the dry state are too weak to handle as wound dressing. To improve collective properties, blending with other polymers is useful. Some researchers reported the physical properties of SF films can be enhanced by blending it with other synthetic or natural polymers. Sodium alginate (SA) is a linear 1,4-linked copolymer of -D-mannuronic acid and -L-guluronic acid residues.

The objective of the present work is to study the structural and mechanical characteristics of SF/SA blend sponges and wound dressing effect.

Materials and Methods

Raw silk was degummed and dissolved in $CaCl_2$ mixture solvent. SF/alginate blend sponges were prepared by mixing the aqueous SF and alginate solutions. Each solution was mixed with the weight ratios of SF to SA. Structural characteristics of SF/SA blend sponges were investigated using Fourier transform infrared spectrometer, X-ray diffractometer. Mechanical properties were examined using a Minimat and morphology of SF/alginate blend sponges was observed through a scanning electron microscope.

Results and Discussion

FT-IR and X-ray diffractograms showed that the blend patterns vary with their compositions, indicating that each material did not affect on the crystalline structure of another material. But DSC showed that thermal properties of blend sponges were affected by blending. With an increase of SA content, the

endothermic peak of SF degradation was much broader than that of SF itself. Moreover, the thermal crystallization temperature of SF decreased and finally disappeared. The compressive modulus of SF and SF blend sponges was calculated from the stress-strain curves. The compressive modulus of SF/SA blend sponges are around 30 kPa, which is much higher that that of SF itself, 7.1 kPa. Wound dressing effect was evaluated by residual wound area from full thickness wound of skin. Silk fibroin/alginate blend sponges showed better wound healing effect than silk fibroin and alginate itself.

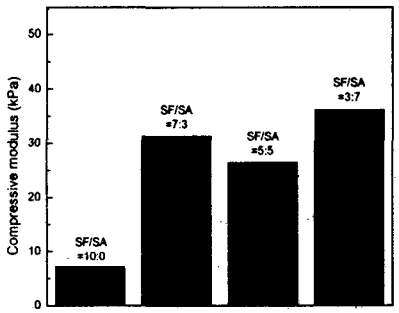

Fig. 1. Compressive modulus of SF/SA blend sponges

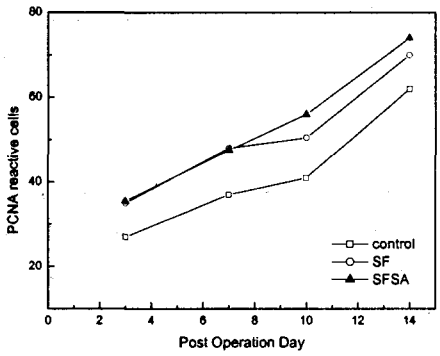

Fig. 2. Expression of PCNA

This study shows that silk fibroin/alginate blend sponges have good mechanical properties and wound healing effect. Therefore, silk fibroin/alginate blend sponges may be promising materials for wound dressing.

References

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