EFFECT OF DEGUMMING PH VALUE ON ELECTROSPINING OF SILK FIBROIN

by

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Short paper
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Regenerated silk fibroin fibers show properties dependent on the molecular weight of fibroin. The cocoon-degumming approaches had great impact on the degradation of silk fibroin. The effect of degumming pH value to electrospining of fibroin was studied in this paper. The viscosity and molecular weight of regenerated silk fibroin were studied using rheometer and gel electrophoresis. The results showed that the weaker the alkalinity of degumming reagent, there was the milder the effect on silk fibroin molecular. The fibroin fibers can be prepared by electrospining with low concentration of regenerated silk fibroin solution.

Key words: *silk fibroin, molecular weight, electrospinning, pH value*

Introduction

Silk fiber has a unique performance such as fineness, strength, elasticity, dye-ability, softness, flexibility, smooth feeling, luster, elegance, grace, and high rating. However, relative to chemical fiber, the price is high. Therefore, the development of man-made silk fiber with appropriate strength and toughness from regenerated solutions becomes critical. Some researchers have done the research of spinning silk fiber from regenerated silk solution [1]. However, it is difficult to spin silk fiber due to the low viscosity regenerated silk solution. Very high concentration of regenerated fibroin solution was used for spinning. The solution will gelled during the process of spin because of the high concentration. So it is important to prepare a high viscosity fibroin solution with low concentration. Although there might be some accidental factors, the low of the protein molecule, which may be due to the silk fibroin was destroyed during regeneration [2], were generally regarded as the main reasons. This article discussed the impact of different silk fibroin degumming pH value and tried to regenerate silk fibers in order to utilize them in industrial and biomedical applications.

Experimental analysis

The different pH value (from 8.5 to 11) degumming solution was used $NaHCO_3$-Na_2CO_3 buffer system. The silk fibers were treated by degumming solution three times with 100 °C for 30 minutes. Then the fiber was dissolved in lithium bromide followed by dialysis with cellulose tubular membranes against distilled water for 3 days. An AR2000 rheometer was used to make the rheological measurements. The result shows that the viscosity decreased with

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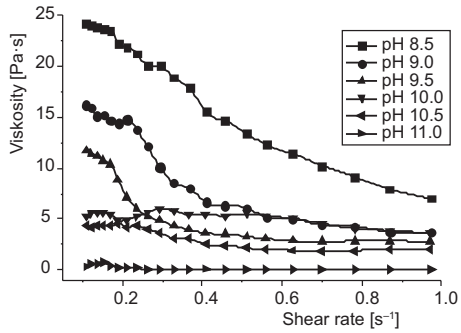

Figure 1. The viscosity of silk fibroin solution degummed by different pH value, the concentration of silk fibroin solution is 10 mg/mL

the pH value increasing (fig. 1), which means the molecular weight decreased with the pH value increasing. In the electrospinning process, a high electric potential was applied to a droplet of silk fibroin (SF) solution at the tip. The electrospun fibers were collected on a target drum which was placed at a distance of 7 cm from the syringe tip. A voltage of 15 kV was applied to the collecting target. The morphology of RSF fibers were observed by SEM. The results show that regenerated silk fibroin (RSF) fibers with diameter of 300-700 nm were prepared by electrospun with low concentration (100 mg/mL) of RSF solution.

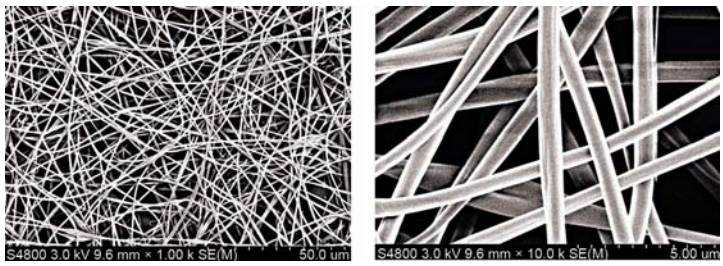

Figure 2. The SEM of silk fibroin electrospinning fibers degummed by pH = 9.5, the concentration of silk fibroin solution is 100 mg/mL

Conclusions

In addition to the study of RSF fiber by electrospining, interest has been growing in high viscosity with high molecular weight of RSF obtained from degumming by different pH value with the aim to produce high-performance RSF fibers. Our study showed that the cocoon-degumming approaches had great impact on the degradation of molecular chain of SF. The weaker the alkalinity of cocoon-degumming reagent, there was the milder the effect on SF molecular chain and the higher viscosity of RSF solution. The RSF fiber can be prepared by electrospining in low concentration with high molecular weight of RSF.

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