Preparation and Wettability Behavior of Thai Silk Sericin/ Polyvinyl Alcohol (PVA) Blending Film

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Abstract

Silk is a natural polymer, produced by silkworm Bombyx mori. Silk fibers are composed of sericin and fibroin proteins. Sericin has unique properties in biomedical applications. In this study, Thai silk sericin/polyvinyl alcohol (PVA) blending films were prepared at various PVA concentrations. The result found that, the prepared films were yellow, transparent and flexible. Time-dependent variations of the contact angles of wetting fluids on surfaces of prepared film have been observed. It was found that contact angles decreased with contact time. For this reason, it can be concluded that the Thai silk sericin/polyvinyl alcohol (PVA) blending films can be a key feature in the development of a drug delivery materials.

Keywords: Sericin; Polyvinyl alcohol, Thai silk, Drug delivery

were prepared and studied wettability behavior.

Introduction

Silk is a natural protein fiber from silkworm cocoon, Bombyx mori. The proteins of silk are composed mainly of fibroin and sericin. Sericin is extracted from silk cocoons during degumming process. Sericin is a waste of textile industry, leading to environmental contamination because chemicals used in the degumming process have a high oxygen demand [1].

Non-textile benefits of sericin have been reported such as skin care, food antioxidant, anticoagulating agent, antiwrinkle and anticancer drugs [2], [3]. In tissue engineering, sericin has been always neglected because it has weak structural properties, high water solubility and difficult to fabricate [3]. However, sericin consists of serine and aspartic acids with strong polar side chain therefore, it can be co-polymerized or blended with other polymers to improve its properties [4, 5].

Polyvinyl alcohol (PVA) was prepared by hydrolyzing polyvinyl acetate in ethanol with potassium hydroxide. PVA shows biocompatibility with human body, thus it is applied for controlled delivery system of drugs, contact lens, artificial skins and biosensor [6].

In this study, the sericin protein was extracted from Thai silk cocoon. Thai silk sericin/ PVA blending films with various concentrations of PVA

The wettability behavior of the films was studied by investigating contact angle of water droplet on surfaces of the film at different time. The wettability behavior can be used to evaluate the potential in drug delivery application of the films.

Materials and Methods

Preparation of silk sericin solution

Silk cocoons were supplied from Nan Thailand. The cocoons were cut into small pieces. The 2 g of cocoons were mixed with 20 ml of deionized water. The sample was boiled at 100°C for 30 min. After that, the sericin solution was characterized by FTIR (Perkin Elmer, 2000) and UV-visible (Jasco, V570) spectroscopy.

Preparation of silk sericin/PVA film

The Thai silk sericin/ PVA blending films were prepared by molding method. In brief, the PVA powders and silk sericin solution were blended together at 80°C with different concentrations (0.15%/w/v - 0.55%/w/v). The silk sericin/PVA blending solutions were poured into the plastic mold and dried in the oven at 37°C for about 2 days. The overall preparation of film is shown in Fig 1.
analyzed in the case of 8µL drop of deionized water on the film surface at room temperature and monitored the drop shape as a function of time. The photographs of water droplet were taken with the web camera. The contact angles were measured by Image J, free software using the contact angle plugin.

**Results and Discussion**

The sericin solution was deep yellow. The functional group of sericin solution was characterized by FTIR spectroscopy. From Fig. 4, there are three different types of distinguishable vibration peaks associated with protein amide: amide I (1650 cm⁻¹) and amide II (1530 cm⁻¹) [3,4].

![Figure 3. The measurement of liquid sessile drop contact angles](image)

![Figure 4. FTIR spectrum of sericin solution](image)

![Figure 5. UV-vis spectrum of sericin solution](image)
Sericin solution shows three distinct absorption bands at 213, 275 and 386 nm. The first and second bands appear due to the presence of peptide bond and aromatic ring, respectively. The last band could be significant for visible radiation [9].

The prepared Thai silk sericin/ PVA blending films were smooth, transparent and flexible. From Fig. 6, it can be observed that the contact angle of each sample was not constant; instead it was initially decreasing over the contact time. In addition, the contact angles of prepared film significantly decreased with the amount of PVA. At PVA concentration of 0.55%w/v, the contact angle is minimal approximately at 67.3 degrees. The reduction of the contact angle is caused by an increase in hydrophilic groups (OH) at the surface of the film [6]. In addition, the contact angle of the films prepared in all conditions is less than 90 degrees typically referring to the wettability behavior of the film surface which is very high.

Figure 7. The evolution of contact angle of deionized water on the film surface at various times

Fig. 7 shows the evolution of contact angle of deionized water on the film surface, which depends on contacting time. It can be seen that, the reduction rate of the contact angle of the films which were prepared in all condition is different. At the PVA concentration of 0.45%w/v, the contact angle is mostly decreased.

Conclusions

Sericin/PVA blending films were successfully prepared. The prepared film showed high wettability. The concentration of PVA affected the reduction rate of the contact angles of the prepared film. The results can be used as a guide in the development of drug delivery materials. For the drug delivery of the prepared films are in the process of research.

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References


