Silk sericin (SS) has been fabricated into beads using a 1 M LiCl/DMSO solvent and utilized as a heavy metal adsorbent. Among the various heavy metals, we targeted Cr(VI) for adsorption using SS beads and found that its adsorption depended on the coagulant used for the fabrication of the SS beads. When methanol was used as a coagulant, the beads had a better adsorption capacity than when ethanol was used except at pH 1. The adsorption behavior of Cr(VI) on the SS beads followed the BET isotherm. The maximum adsorption capacity was 33.76 mg/g at pH 2. The adsorption of Cr(VI) was confirmed by FT-IR and EDS analyses. Finally, the desorption was carried out using NaOH solution, and it was found that 73.19% of the adsorbed Cr(VI) could be detached.

Introduction

The recovery and utilization of silk sericin (SS) have attracted much interest among scientists in the field of sericulture, since they can provide an additional benefit to the sericulture industry. SS can be recovered from degumming waste using membrane techniques (Capar et al., 2004). However, without an appropriate application of the recovered SS, this technique will not be applied in the industry. Therefore, there has been much research on new applications of SS besides in cosmetics, where SS has been used widely for a long time. We have previously reported that SS can be fabricated into beads (Oh et al., 2007) and microspheres (Oh et al., 2011) using a 1 M LiCl/DMSO solvent. As one potential application, the SS beads and microspheres were used as drug carriers. However, there has been some debate on the safety of SS biomaterials, and there have been several reports questioning the biocompatibility of SS (Liu et al., 2006; B. Panilaitis et al., 2003). Although the use of SS in the biomedical field is attractive and many studies have been reported on such applications (Kundu et al., 2008; Kim et al., 2012; Seo et al., 2011), they cannot be realized in the near future unless these safety concerns are solved. Outside the

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In this study, we have prepared SS macrobeads using a previously reported method (Oh et al., 2007) and investigated their Cr(VI) adsorption ability. The removal of Cr(VI) was measured using colorimetric methods, and the adsorption of Cr(VI) was confirmed by FT-IR and EDS analyses. In addition, we predicted the mechanism of adsorption of Cr(VI) onto SS using isothermal models.

Materials and Methods

Materials

Silkworm cocoons were kindly provided by Heung Jin Co. Ltd. All chemicals were purchased from Sigma-Aldrich (USA).

Extraction of silk sericin

SS was extracted by boiling 25 g of Bombyx mori silkworm cocoons with 1 L of distilled water using an autoclave for 1 h at 120°C. The extracted solution was filtered with a nonwoven filter in order to remove the remaining cocoons. The SS solution was frozen at -70°C for 4 h and lyophilized.

Preparation of silk sericin beads

The lyophilized SS was dissolved in 1M LiCl/DMSO solution for 2 h at 50°C to prepare a dope solution of 25% (w/v). The dope solution was dropped into alcohol coagulants through a 26G syringe using a syringe pump (KD scientific, USA). Methanol and ethanol were used as coagulants, and the obtained beads are designated as SS-M and SS-E, respectively. The SS beads were left in the coagulant bath for another 1 h. They were then filtered with a nonwoven filter and washed with the same coagulant to remove the residual LiCl and DMSO. To enhance the water stability and mechanical strength of the SS beads, the beads were immersed in a crosslinking reagent. The crosslinking was performed with 2%