COLLAGEN, SILK FIBROIN AND CHITOSAN BASED MATERIALS FOR BIOMEDICAL AND COSMETIC APPLICATIONS

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Introduction

Collagen is widely used for production of 3D sponges, wound dressings and scaffolds for biomedical applications [1]. It is also widely used in cosmetic preparations [2]. Due to high price of selected types of natural collagens there is a need to modify collagen to decrease the price, however, in the same time, to maintain the properties of this biopolymer. The blending of collagen with other water soluble polymers can lead to preparation of new materials suitable for biomedical applications [1,3]. In this work ternary blends based on collagen, chitosan and silk fibroin were prepared. The miscibility study was performed by viscometric measurements and calculation of parameters of interaction between polymers [4]. The miscibility can be estimated by determining the experimental parameters of the mixture and comparing them with the ideal parameters (calculated ones) [1,4]. The miscibility is the key for creating an ideal, homogeneous mixture. It gives the possibility to obtain a homogeneous material characterized by good mechanical properties. New materials based on the blends were turned into thin films and 3D sponges. The properties of the materials were studied.

Materials and Methods

Collagen (Coll) was obtained in our laboratory from tail tendons of young rats. Chitosan (CTS) was supplied by the company Sigma-Aldrich (Poznan, Poland). The deacetylation degree (DD, %) of CTS was 78%, and the viscosity average molecular weight was 0.59×10^6.
Silk fibroin (SF) was obtained from *Bombyxmori* cocoons in our laboratory following the method described by Kim et al. with slight modifications [5].
Collagen, silk fibroin and collagen were mixed together in appropriate weight ratio. All mixtures of polymers were placed in polystyrene container and frozen. 3D scaffolds were obtained during the lyophilisation process for 2 days. The structure of the blends was evaluated by attenuated total reflection infrared spectroscopy. The size of pores and their distribution were analyzed based on Scanning Electron Microscope (SEM) pictures. Surface properties of thin films were analyzed by AFM and contact angle measurements.

Results and Discussion

Viscosity measurements and IR spectroscopy showed that between components of the blend there are interactions. Strong interactions between the polymer blend components and the solvent were found by viscometric method. Depending on the weight ratio the ternary mixtures were classified as miscible and immiscible systems. According the structure of single biopolymers the interactions are due to hydrogen bonds formed between chemical moieties of polymers. After solvent evaporation from the polymer mixture thin films were obtained. The films show hydrophilic character. After lyophilisation process the 3D porous sponges can be obtained (FIG. 1).

FIG. 1. Scaffolds made from the blend of Coll and SF.

The cross-section of example of 3D sponge is shown in FIG. 2. As one can see the size of pores is irregular.

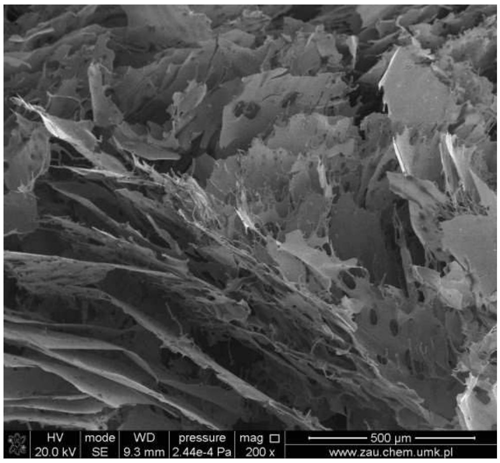

FIG. 2. The cross-section of collagen/silk fibroin blend liopilized into 3D sponge.

Film-forming properties of the blend are suitable for cosmetic applications. Mechanical properties and surface properties of new materials after covering the hair were studied. The adhesion of polymeric blend to the hair was very good.

Conclusions

Strong interactions between three components in polymer blend can lead to new material. The modification of biopolymer properties is a consequence of the strong interaction between the polymeric components. Biological properties of new materials should be studied

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