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New extracting process of silk sericin and its potential valorizations

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PURPOSE OF THE ABSTRACT

In recent years, the recovery of molecules from waste or by-products raw materials shows great interest. Thus, the development of products from biomass, which does not compete with food, constitutes a significant challenge. Silk is a non-food protein polymer produced by silkworms. The silk cocoons are composed of a unique thread of two joined filaments produced by the Bombyx mori silkworms. The composition of silk contains fibroin (70 %) and sericin (30 %) proteins [1] [2].
Silk fibers are composed of fibroin microfibrils. Fibroin is a hydrophobic protein that gives to silk its mechanical property. Both filaments are covered by sericin, a hydrophilic protein, which ensures the structural unit. The sericin is a globular protein made up of several layers and composed mainly of serine (32 %), aspartic acid (18 %) and glycine (16 %) [3]. The molecular mass of sericin is between 10 and 300 kDa. Three major fractions of molecular weights at 150, 250, 400 kDa were reported [4].

Used in the textile industry, fibroin is separated from sericin (degumming process) to obtain a lustrous, soft, and resistant fiber. The degumming process is done in a water solution made of sodium carbonate or Marseille soap [2]. Sericin that constitutes the by-product of the textile industry is released in wastewater (up to 50 000 tons per year) and is responsible for environmental contamination. Recycling this protein could represent a serious economic and environmental challenge. However, the separation of sericin from soap solution is a hard task. Hence, a new extraction methodology is needed to recover sericin and further recycle it. Recycling the sericin presents several interests. As an antioxidant, antibacterial, UV resistant, and with good moisture retaining capacity, sericin has large potential features in food, cosmetic, or pharmaceutical product development [5]. It is also used in tissue engineering in the synthesis of biomaterials [6].

The objectives of this study are first to find an extraction method that recovers the sericin from silk cocoons, by avoiding the presence of residual reactants in order to bypass the actual processing steps (degumming). It is essential to develop a method, which has at least, similar or higher extraction yields than the traditional method and can produce exploitable sericin. Several extraction methods from the literature have been compared with the traditional alkaline method: boiling water, autoclave, and microwave. Here we compare the various methodologies and propose a new degumming method to recover sericin: the microwave treatment. This latest protocol allows for an enhancement of the extraction efficiency (29.9 ± 0.8 %), which corresponds to nearly all the amount of the

sericin present in the cocoon. Otherwise, autoclave extraction, allowing sericin production at a larger scale, gives a good extraction yield of 24.3 ± 0.4 %. Sericin obtained by the different extraction methods was analyzed by UV, IR spectroscopy and SDS-PAGE. The results show that the composition is similar for each method used and it is similar as well to a commercial sericin.

The second objective of the study is to propose new ways to use silk sericin. Here our goal is to exploit the characteristic of this protein (high concentration of hydrophilic amino acids and great conservation of the structure with numerous repetitive units) for potential cosmetic, food and pharmaceutical applications. Surface adsorption properties and emulsifying capacity of silk sericin have been studied. Then the properties of sericin peptides, obtained after an enzymatic hydrolysis treatment, have been also evaluated. Finally, sericin peptides can be reacted with fatty chains to produce lipopeptide with expected good amphiphilic properties and biological activities.

FIGURES

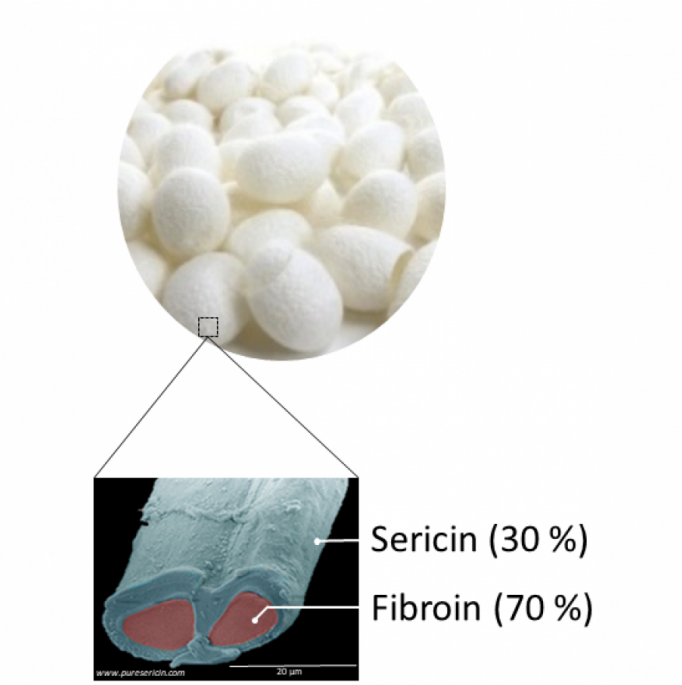

FIGURE 1

Silk cocoons of Bombyx mori

SEM image of silk fiber composing Bombyx mori's silk cocoons showing sericin surrounding fibroin filaments

FIGURE 2

KEYWORDS

sericin | extraction | valorization

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