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Morphological Study of Biodegradable Compound RSS Powder from Silk Cocoons

***Bharathi A and Manikandan K**
P.G & Research Department of Zoology, Sir Theagaraya College, Chennai, Tamilnadu, India – 600021.
*Address for correspondence E-mail: professorbharathi.stc@gmail.com

ABSTRACT
Sericin is a natural, environmentally friendly, proteinous, and biodegradable compound derived as a waste product from the silk industry. To provide raw silk sheen, the sticky sericin substance must be removed during the degumming step. Sericin has a wide range of applications in cosmetics, food, medicine, membranes, bio materials and other sectors. As a result, it is recovered as a by-product. Hence, in this study the SEM images of the RSS powder obtained from liquid dried compounds shows the presence of particles indicates that particle from is a result of the drying procedure. A scanning electron microscope was used to examine the morphology of liquid dried sericin powders at magnifications of 2000X, 3000X, 6000X, 12000X, 15000X, and 40000X. In each SEM image, the particle shape is observed to be quite diverse.
Keywords: *Sericin, liquid dried compounds, RSS powder and SEM images.*

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INTRODUCTION
The extraction efficiency and quality of sericin are known to be affected by extraction factors such as temperature and treatment duration. The yield is critical since it determines the economic worth of the sericin extraction process. Because the silkworm is the only source of sericin, it is obtained from cocoons, silk fabric, and silk waste, as well as the degumming liquid used in the silk business. The global annual cocoon output is roughly 400,000 metric tonnes, and 50,000 metric tonnes of sericin is discarded in effluent every year from the degumming process alone [21]. Now a day's most of the sericin is retrieved from silk degumming process [19, 4]. Huge amount of sericin can be stretched from cocoon waste or silk waste as related to silk degumming liquor[13], though very less reflection was specified toit, but now sericin is fetching the centre of pull to researchers.Insects chiefly belong to two families, viz., Saturnidae and Bombycidae, which turns silk fibre. *Bombyx mori*, a member of the Bombycidae family, creates a thin twin thread of silk fibroin that is protected by a layer of sericin. Silk protein, which includes spongin, collagen, keratin, elastin, and fibroin, is one of the most important components of cocoon filament [8]. Silk gland cells produce the silk fibre protein, which is then kept in the gland's lumen. It is then transformed into silk fibres. During the spinning process, the silkworms secrete liquid silk, which travels via the anterior gland and is discharged by the spinneret hole[17]. The quantity and form of sericin are crucial factors in the cocoon's unique properties [16].Sericin is insoluble in cold water, but it can be easily hydrolyzed, which breaks down the large protein molecules into smaller fragments that can be distributed or dissolved in hot water [6]. Sericin protein is useful because of its unique features, such as resistance to oxidation, antimicrobial activity, UV resistance, and ease of absorption and release of moisture, as well as tyrosine and kinase inhibitory activity. To make silk lustrous, sericin, a significant component of silk fibre, is selectively separated from fibroin during the silk manufacturing process, and the removed sericin is discarded. Seri-waste products and Seri- by-products are now commonly employed as value-added goods. The residue after degumming is fibroin. Silk fibre has a wide range of applications, including textile, medicinal, and industrial. Silk is a long, light, and delicate fibre. Its water absorbency, dyeing affinity, thermos tolerances, insulating characteristics, and shine are well-known. It's used to make precious fabrics, parachutes, type lining materials, artificial blood vessels, and surgical sutures. Ionic liquid could be the key to creating designer silk strands with improved mechanical and optical qualities [11].Silk fibres offer exceptional natural qualities that equal even the most advanced synthetic polymers, but unlike synthetic polymers, silk manufacture does not necessitate severe processing conditions. According to reports, the use of ionic liquids in silk processing provides up a new way to regulate the microstructure and tailor the macroscopic features. It is anticipated that out of

roughly 1 million tonnes (fresh weight) of cocoons produced worldwide, around 4,000 tonnes of dried cocoon are formed, with 50,000 tonnes of sericin recoverable. India's annual silk production of 1,600 tonnes can provide 250 to 300 tonnes of sericin [5]. It would be a tremendous economic and societal gain if this sericin protein could be retrieved and recycled.The silk fibre is almost entirely made up of two types of proteins: sericin and fibroin [6]. Chemically, sericin is a non-filamentous protein. Raw silk also comprises numerous natural layers such as fats and waxes, inorganic salts, and colouring material in accumulation to sericin. The outer layer of silk fibre and discovered that sericin content is higher there [14].During the ending period of larval growth, the silkworm B. mori produces a large number of silk proteins. The silkworm has recently been exploited as a bio factory for the synthesis of valuable protein using the silk gland, which has aided sericulture's technological advancement. As a result, the current study was conducted to acquire sericin from silk cocoons in the form of RSS (Raw Silk Sericin) powder (a biodegradable substance). The main aim of the study is to extract the sericin compound from silk cocoons of *Bombyx mori*.

MATERIAL AND METHODS

Silk cocoons were collected in Velliyanallur village in Thiruvannamalai District's Cheyyar Block. Velliyanallur village is located 86 kilometres east of Thiruvannamalai District Headquarters, 12 kilometres east of Cheyyar, and 98 kilometers east of the State Capital Chennai. Due to the aforementioned limitations, hot-water extraction is the most often used method for sericin extraction. Silk is boiled in hot distilled water without the use of any additional chemicals. Detaching sericin from the fibroin component of silk allows it to be removed. The silk cocoons (1.5g) were chopped into small pieces and degummed in a sodium carbonate solution of 100mL. (0.02 M). To extract RSS powder, the solution was dialyzed against deionized water for three days and then freeze-dried (-40° C). The amount of sericin extracted is influenced by the time and temperature of extraction. Although this approach causes sericin to degrade, the degradation is to such a degree that sericin retains its key qualities. Because of the simplicity of the method, many researchers choose to employ hot-water extraction. Detaching sericin from the fibroin component of silk allows it to be removed. Only fibroin part is needed in the silk industry so elimination of sericin is needed and is done by degumming process which later on is discarded in the effluent. The recovery of sericin from degumming liquor can reduce the load in effluent, minimising the environmental impact and providing a biopolymer with numerousbeneficial qualities.

RESULTS

SEM image of Sericin samples (Liquid Dried):

A scanning electron microscope was used to examine the morphology of liquid dried sericin powders at magnifications of 2000X, 3000X, 6000X, 12000X, 15000X, and 40000X. (Fig 1, Fig 2, Fig 3, Fig 4, Fig 5 and Fig 6). According to recent research, scanning electron microscopy was used to examine the morphology of sericin powders at various magnifications. In each photograph, the particle's form is distinctly different. Each image contains a variety of particle shapes. Another striking finding is that it has strongly aggregated and globules have formed.

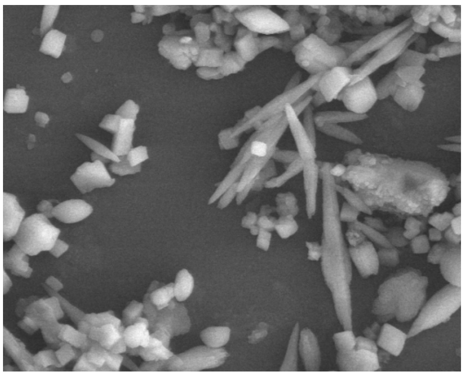

Fig 1: SEM image of sericin samples 2000X magnification

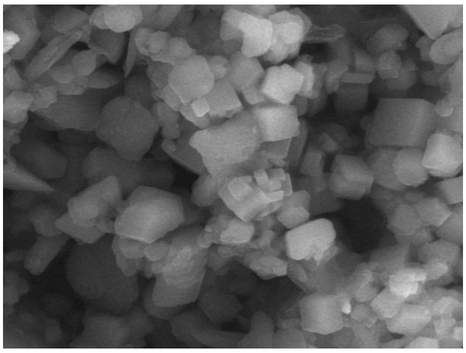
Fig 2: SEM image of sericin samples 3000X magnification

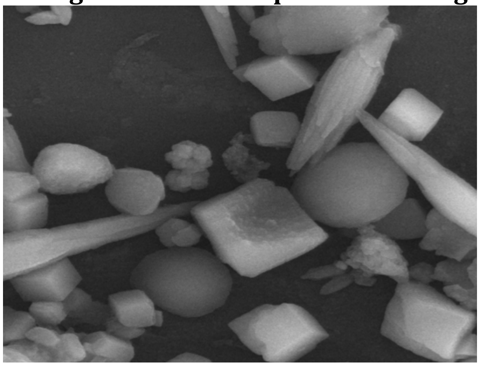
Fig 3: SEM image of sericin samples (Liquid Dried) -6000X magnification

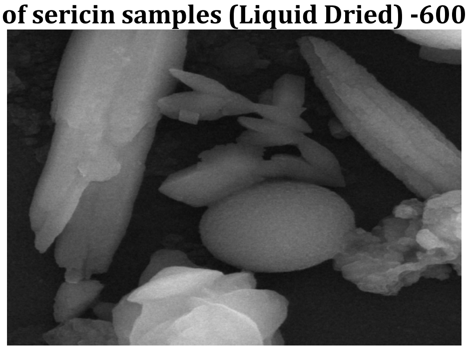
Fig 4: SEM image of sericin samples (Liquid Dried) 12000X magnification

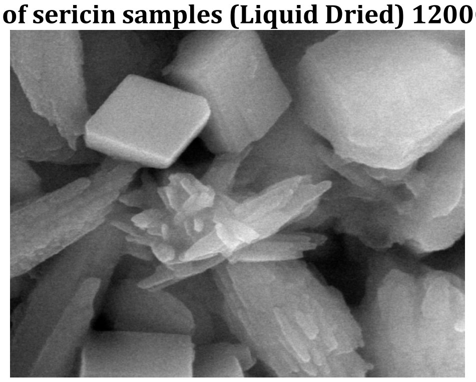
Fig 5: SEM image of sericin samples (Liquid Dried) 15000X magnification

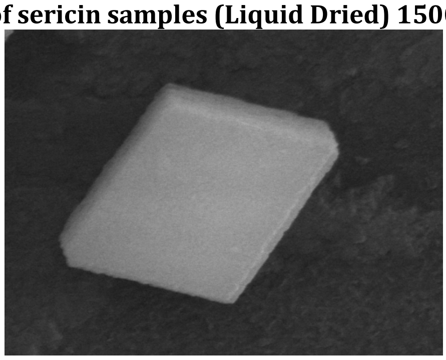
Fig 6: SEM image of sericin samples (Liquid Dried) 40000X magnification

DISCUSSION

Epidermal moisture (epidermal water content) is mainly maintained by natural moisturizing factors (NMF) and the epiderma barrier of the epidermis [3, 7]. As a result of the formation of filaggrin double intermediate (2RI) or filaggrin triple intermediate (3RI), profilaggrin is degraded to monomeric filaggrin, which is then degraded to free AA [12, 18], a multistep process involving various regulators and proteases [1, 22]. A decrease in filaggrin protein expression parallels a decrease in free AA in dry skin disease such as atopic dermatitis (AD) and ichthyosis [15, 23]. Silk protein purified from silkworm (Bombyx mori) cocoons has been reported to have beneficial effects on the protection of dry skin [10, 21, 22]. Silk is made up of two types of proteins, fibroin and sericin. In the processing of silk textiles, sericin, which covers the fibroin in successive sticky layers, is largely removed and the fibroin, a fibrous protein, is purified. Although fibroin has been reported as a beneficial biomaterial in the skin[9], sericin has been reported to specifically prevent skin dryness [10, 20, 22]. Possibly due to its high serine content (30-33% of total AA) and similarity of AA profile to NMF [1]. Human studies have shown that topically applied sericin increases epidermal hydration [10, 20]. Sericin can consequently be a valued source of natural dry skin shield in the cosmetic and food manufacturing [1]. However, the protective effect of sericin on dry skin has been suggested mostly by topical application (in vitro studies) [10] and there is little information on the nutritional effects of sericin. Current research found that the morphology of sericin powders was studied by scanning electron microscopy at different magnifications. The shape of the particle is very different in each image. The shape of the particles in each image is quite diverse. Another remarkable observation is that globules have formed and it is strongly aggregated.

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CONFLICT OF INTEREST

All authors must declare no conflict of interest or any affiliation or involvement in any organization whether it is academic, commercial, financial, personal and professionally relevant to the work under consideration to avoid the potential for bias and accept responsibility for what is said in the manuscript.

Author's Contribution

Each author contribution should be clearly mentioned.

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