Journal of Scientific Agriculture 2025, 9: 66-68
doi: 10.25081/jsa.2025.v9.9502
https://updatepublishing.com/journal/index.php/jsa

Research Article

ISSN: 2184-0261

Quantification of sericin extracted from different seri bio-waste sources

Jasmeena Qadir[1]*, Tajamul Islam[2], Rakesh Kumar Gupta[1,3], Kamlesh Bali[1], Magdeshwar Sharma[3], S. K. Gupta[4], R. K. Samnotra[4]

[1]Division of Sericulture, Sher-e-Kashmir University of Agricultural Science & Technology of Jammu, Jammu-180009, Jammu and Kashmir, India, [2]College of Temperate Sericulture, Mirgund, SKUAST-Kashmir, Kashmir-190025, Jammu and Kashmir, India, [3]Division of Entomology, Sher-e-Kashmir University of Agricultural Science & Technology of Jammu, Jammu-180009, Jammu and Kashmir, India, [4]Division of Vegetable Sciences, Sher-e-Kashmir University of Agricultural Science & Technology of Jammu, Jammu-180009, Jammu and Kashmir, India

Received: February 26, 2025
Revised: May 18, 2025
Accepted: May 21, 2025
Published: May 28, 2025

***Corresponding author:**
Jasmeena Qadir
E-mail: jasmeena.qadir786@gmail.com

ABSTRACT

Apart from good quality cocoons, the cocoon crop generates defective cocoons *viz.*, double cocoons, stained cocoons, deformed cocoons, thin end cocoon, cut cocoon, flimsy cocoon, etc., which are non-reliable. Since many cocoons which do not adhere to quality are wasted in this activity, one of the foremost and convenient options is the extraction of sericin from waste cocoons. Sericin is a globular protein possessing promising attributes such as, antioxidant activity, antimicrobial activity, easy absorption and release of moisture, coagulant activity, chemo-protection and protection of solar ultraviolet (UV) radiations. The deformed cocoons, stained cocoons, undersized cocoons and silk floss were used to extract sericin *via.*, hydrothermal degumming using an autoclave. Significantly, the higher quantity of sericin (18.38%) was obtained from deformed cocoons followed by stained cocoons (17.26%), undersized cocoons (15.04%) and floss (13.84%). Following the protocol developed for the extraction of sericin, it is estimated that in J&K, 22.34 MT of sericin could be extracted annually that can contribute to value addition in sericulture.

KEYWORDS: Sericin extraction, Floss, Deformed cocoons, Hydrothermal processing, Value-addition

INTRODUCTION

Seri bio-waste refers to any material, generated as undesirable in sericulture and intended to discard because of its no utility. Ample quantities of by-products, usually called wastes are generated from each activity of sericulture *viz.*, Mulberry cultivation, Silkworm rearing and post-cocoon sector. Besides the good quality cocoons, the cocoon crop generates defective cocoons *viz.*, double cocoons, stained cocoons, deformed cocoons, thin end cocoon, cut cocoon, flimsy cocoon, etc. which are non-reelable (Qadir *et al.*, 2022). These cocoons are either dumped as waste or sold at minimum prices of ₹ 80-100/kg (Rajput & Singh, 2015). The value addition of waste cocoons is estimated to generate additional income of 25% upon skillful utilization with effective management (Reddy, 2008). In southern states of India, silkworm rearing is conducted round the year and generates hefty income to sericulture farmers. But in the Union Territory of J&K only two crops are raised annually which brings low income to sericulture farmers, due to which the farmers lack interest in the sericulture industry. However, sericulture ventures can be lifted through value addition. Since many cocoons which do not adhere to quality are wasted in this activity, one of the foremost and convenient options is the extraction of sericin from waste cocoons. Sericin is a globular protein possessing promising attributes such as, antioxidant activity, antimicrobial activity, easy absorption and release of moisture, coagulant activity, chemo-protection and protection of solar ultraviolet (UV) radiations (Ghosh *et al.*, 2017). It is non-toxic, hydrophilic and possesses a similar amino acid composition as found in humans and has strong affinities for other proteins as well. But it has been overlooked in the field of sericulture and is discarded as waste. It is estimated that about 1 million tons (fresh weight) of cocoons are produced worldwide per year. Among them, approximately 400000 tons of dry cocoons are generated, that have 50000 (12.5%) tons of recoverable sericin. India produces approximately 1600 tons of silk every year, leaving behind approximately 250-300 tons of sericin (Rajput & Singh, 2015). Traditionally, sericin is removed from fibroin *via.*, chemical treatment by the degumming process. Methods employed to extract sericin affect the different attributes of sericin *viz.*, color, ash content, protein content and molecular weight range. During the degumming process, it may be completely or incompletely hydrolyzed and solubilized in the medium. This process may lead to chemical discharge and can cause damage to sericin. Hence, the development of an energy efficient method is a major requisite for the extraction of sericin (Gupta *et al.*, 2014). The sericin extracted by the degumming process aided with acid, alkali or enzyme leads to environmental pollution. Saha *et al.* (2019) investigated an eco-friendly technique by extracting the sericin from waste silk cocoons without utilizing any chemicals. Cherdchom *et al.* (2021) extracted sericin *via.*, high temperature high pressure (HTHP), urea, acid and alkali degradation and reported the maximum extraction yield by the HTHP method followed by urea degradation, acid degradation and alkali degradation methods respectively. Extraction by the autoclaving method at 105 °C furnishes an ample yield with good gelling properties. The sericin yield is determined by the sericin source as well as by the extraction method used. Sericin extracted from tasar silk fibre waste reveals found to be the potential source of anti-elastase, anti-tyrosinase and anti-oxidant compounds and can be regarded as a promising ingredient in cosmetics (Jena *et al.*, 2018). The retrieval and recycling of discarded cocoons which constitute sericin protein would be a facile choice and will contribute towards significant social and economic benefits. In this study, an attempt was made to isolate sericin from different seri bio-waste sources to ascertain the sericin yield present in different sources and its value addition for the economic benefit of the sericulture industry.

MATERIALS AND METHODS

Collection of the Cocoons

Different types of defective cocoons *viz.*, stained cocoons, undersized cocoons, deformed Cocoons and silk floss was collected from Sericulture Research Laboratory, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu.

Preparation of the Cocoons for Extraction of Sericin

The cocoon shells were chopped into small pieces as illustrated in Figure 1. The chopped cocoon shells (200 g) were dispersed in ultra-pure water (10 L) in the ratio of 1:50 (W/W) and were autoclaved for 1 hrs in autoclave according to the method followed by Capar and Aygun (2015).

Extraction and Quantification of Sericin

After autoclaving, the sericin solutions were filtered through a Whatman filter (1.6 μm filter media) to isolate the cocoon shells from the sericin solution. The cold ethanol was added to the filtered sericin solution carefully, until a final ethanol concentration of 75% (v/v) was obtained. The supernatant was discarded and the settled pellet was kept in the refrigerator until lyophilization. The sericin pellet was frozen in a lyophilizer and sericin powder was recovered after 48 hours of freeze drying. The recovered sericin powder was quantified by measuring on the weighing balance.

RESULTS AND DISCUSSION

The perusal of data on quantification (Table 1) revealed variations among the different bio-waste sources (F=50.030; df=11; P=0.000) utilized for sericin extraction. The highest sericin quantity was obtained from deformed cocoons (9.19±0.154) followed by stained cocoons (8.63±0.158), undersized cocoons (7.52±0.174) and was found statistically different from each other while the lowest quantity was obtained from silk floss (6.92±0.07). Although there are various methods to extract sericin from silk cocoons, we preferred hydrothermal degumming *via* autoclave because degumming by autoclaving method at 105 °C furnishes ample yield with good gelling property and reaps much higher yield at 220 °C (Wang *et al.*, 2021). Additionally degumming by the heat and high-pressure method preserves the purity of sericin protein (Aramwit *et al.*, 2010). In the current investigation, different types of defective cocoons and silk floss were used

Figure 1: Protocol followed for extraction of sericin from different bio-wastes

Table 1: Quantification of sericin obtained from different seri bio-waste sources

Bio-waste (50 g each)	Sericin obtained (g)
Deformed cocoons	9.19±0.154[d]
Stained cocoons	8.63±0.158[c]
Undersized cocoons	7.52±0.174[b]
Silk floss	6.92±0.07[a]

Values are Means±SE. Means within a column followed by different letters are significantly different at $P<0.05$

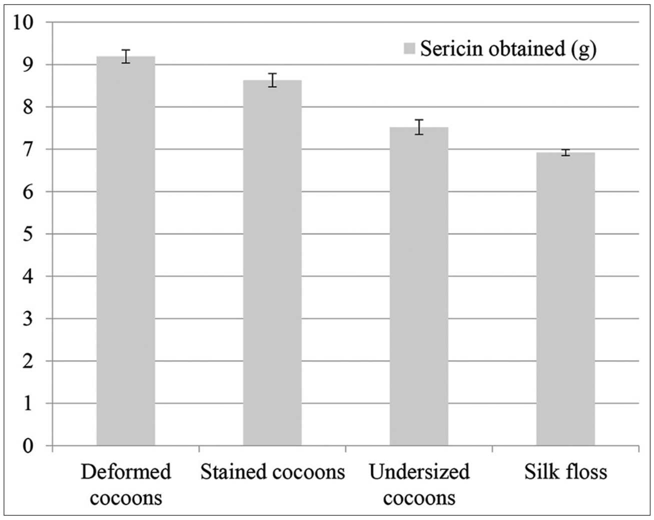

Figure 2: Quantification of sericin obtained from different seri bio-waste sources. Each bar represents mean value±Standard error of three replications. Means within a column followed by different letters are significantly different at P<0.05

for extracting sericin. We found that higher sericin content was obtained from deformed cocoons (9.19 g/50 g) followed by stained cocoons (8.63/50 g), undersized cocoons (7.52 g/50 g) and silk floss (6.92/50 g) by hydrothermal processing using an autoclave (Figure 2). These findings are in line with Bharathi *et al.* (2020) who found significant sericin content from cocoon shells (1.81 g/11 g) and raw silk (1.59 g/11 g) by acid degumming and Capar and Aygun (2015) who found significant sericin content (0.232 g/g of cocoon shell) and Al Masud *et al*. (2021) who recovered sericin content (17% w/w) of cocoons by hydrothermal degumming method.

CONCLUSION

The cocoon crop generates 30% of waste including cut cocoons, stained cocoons, silk floss, etc., besides raw silk production, which are either dumped as waste or sold at minimum prices ₹ 80-100/kg. The value addition of waste cocoons is estimated to generate income ranging from 10 to 25% in total returns. An ample quantity of sericin can be obtained from waste cocoons, particularly deformed cocoons. In the union territory of Jammu and Kashmir, sericin can be recovered to the tune of 22.34 MT which can generate additional revenue of more than 7 crore from the waste cocoons which can directly contribute to the value addition of the silk industry.

ACKNOWLEDGEMENT

All authors are grateful to Sher-e-Kashmir University of Agricultural Sciences & Technology, Chatha, Jammu for providing the facilities to conduct this research.

AUTHORS' CONTRIBUTION

Jasmeena Qadir: Conceptualization, investigation (experimental research), data analysis, writing-original draft, visualization; Tajamul Islam: Conceptualization, writing-review, and editing; Rakesh Kumar Gupta: Conceptualization, writing review and editing; Kamlesh Bali: Conceptualization, resources, writing-review and editing; Magdeshwar Sharma: Data analysis, writing-review and final editing; S.K. Gupta: Data analysis, writing-review and final editing; R.K. Samnotra: Conceptualization and final editing. All authors approved the final version of the manuscript.

REFERENCES

Al Masud, M. A., Shaikh, H., Alam, M. S., Karim, M. M., Momin, M. A., Islam, M. A., & Khan, G. M. A. (2021). Green synthesis of silk sericin-embedded silver nanoparticles and their antibacterial application against multidrug-resistant pathogens. *Journal of Genetic Engineering and Biotechnology, 19*(1), 74. https://doi.org/10.1186/s43141-021-00176-5

Aramwit, P., Kanokpanont, S., Nakpheng, T., & Srichana, T. (2010). The effect of sericin from various extraction methods on cell viability and collagen production. *International Journal of Molecular Sciences, 11*(5), 2200-2211. https://doi.org/10.3390/ijms11052200

Bharathi, M. C., Umakanth, R. S., & Ashoka, K. S. (2020). Extraction of sericin from cocoon shell and raw silk of bivoltine and multivoltine breeds of the Silkworm, *Bombyx mori* L. *Journal of Entomology and Zoology Studies, 8*(4), 869-871.

Capar, G., & Aygun, S. S. (2015). Characterization of sericin protein recovered from silk wastewaters. *Turkish Bulletin of Hygiene and Experimental Biology, 72*(3), 219-234. https://doi.org/10.5505/TurkHijyen.2015.47113

Cherdchom, S., Sereemaspun, A., & Aramwit, P. (2021). Urea-extracted sericin is potentially better than Kojic acid in the inhibition of melanogenesis through increased reactive oxygen species generation. *Journal of Traditional and Complementary Medicine, 11*(6), 570-580. https://doi.org/10.1016/j.jtcme.2021.06.005

Ghosh, S., Rao, R. S., Nambiar, K. S., Haragannavar, V. C., Augustine, D., & Soumya, S. V. (2017). Sericin, a dietary additive: Mini review. *Journal of Medicine, Radiology, Pathology and Surgery, 4*(2), 13-17.

Gupta, D., Agrawal, A., & Rangi, A. (2014). Extraction and characterization of silk sericin. *Indian Journal of Fibre & Textile Research, 39*, 364-372.

Jena, K., Pandey, J. P., Kumari, R., Sinha, A. K., Gupta, V. P., & Singh, G. P. (2018). Tasar silk fiber waste sericin: New source for anti-elastase, anti-tyrosinase and anti-oxidant compounds. *International Journal of Biological Macromolecules, 114*, 1102-1108. https://doi.org/10.1016/j.ijbiomac.2018.03.058

Qadir, J., Gupta, R. K., Bali, K., Sharma, M., & Gupta, S. K. (2022). Impact of sericin fortified leaves on the cocoon traits of Silkworm *Bombyx mori* L. *The Pharma Innovation, 11*(10), 1519-1522.

Rajput, S. K., & Singh, M. K. (2015). Sericin - A Unique Biomaterial. *IOSR Journal of Polymer and Textile Engineering, 2*(3), 29-35.

Reddy, R. M. (2008). Value addition span of silkworm cocoon - Time for utility optimization. *International Journal of Industrial Entomology and Biomaterials, 17*(1), 109-113.

Saha, J., Mondal, M. I. H., Sheikh, M. R. K., & Habib, M. A. (2019). Extraction, structural and functional properties of silk sericin biopolymer from *Bombyx mori* silk cocoon waste. *Journal of Textile Science & Engineering, 9*(1), 1000390. https://doi.org/10.4172/2165-8064.1000390

Wang, W.-H., Lin, W.-S., Shih, C.-H., Chen, C.-Y., Kuo, S.-H., Li, W.-L., & Lin, Y.-S. (2021). Functionality of silk cocoon (*Bombyx mori* L.) sericin extracts obtained through high-temperature hydrothermal method. *Materials, 14*(18), 5314. https://doi.org/10.3390/ma14185314