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Molecules of medical, agricultural, environmental, and industrial interest derived from insects: isolation, characterization, and biotechnological applications

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INTRODUCTION

Insects are an important source of biomolecules of biotechnological and industrial interest, including silk, a natural protein biopolymer relevant not only in textiles but also in biomaterials, owing to its biocompatibility, biodegradability, mechanical strength, and processing versatility[1,2]. In silk fibers, fibroin is the main structural component, whereas sericin plays an adhesive role and contributes to fiber organization[3,4]. Silk extraction is therefore crucial, since conventional degumming methods, particularly alkaline ones, may affect fibroin integrity, structure, crystallinity, and mechanical performance[5,6,7]. *Galleria mellonella* (Lepidoptera: Pyralidae) is of particular interest because its silk shows a distinctive and highly organized fibroin architecture, associated with resistance and elasticity, and differs from that of other Lepidoptera species[8,9]. Accordingly, silk extraction from *G. mellonella* is relevant for both improving knowledge of this fiber and assessing its biotechnological potential.

METHODS

Silk was collected from *G. mellonella* larvae (Fig. 1) and subsequently processed through an alkaline degumming procedure to separate fibroin, the main structural protein fraction, from sericin, the water-soluble adhesive component. Following degumming, the two fractions were separately recovered, purified by dialysis to remove residual salts and reagents, and freeze-dried to obtain stable samples for subsequent morphological and spectroscopic analyses (Fig. 2)

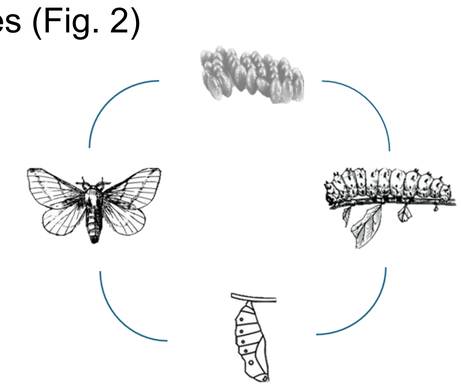

Fig. 1 Life cycle of *G. mellonella*: eggs, larvae, pupae, and adults

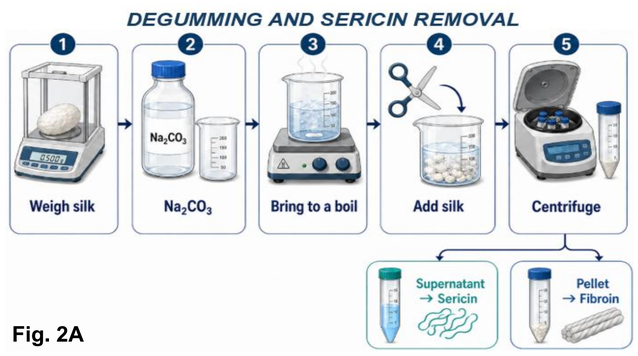

Fig. 2A

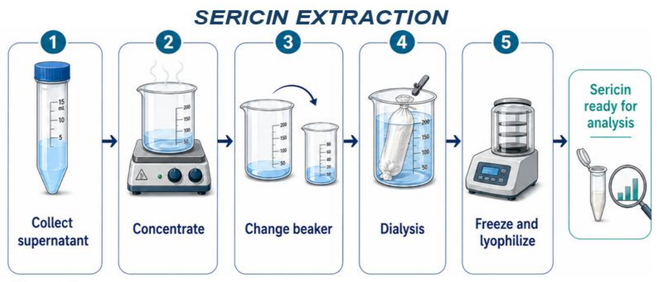

Fig. 2B

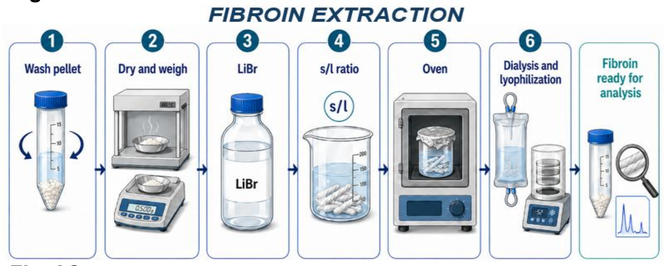

Fig. 2C

Fig 2. Process of separation of sericin and fibroin from silk
Fig. 2A Degumming.
Fig. 2B Sericin extraction.
Fig. 2C Fibroin extraction.

RESULTS

Preliminary extraction allowed the separate recovery of fibroin and sericin from *G. mellonella* silk. SDS-PAGE showed only partially defined protein bands, suggesting the need for further optimization of sample concentration and gel conditions. SEM analysis revealed distinct morphologies among cocoon silk, single filament, sericin (Fig. 3A) and fibroin film (Fig. 3B), while FTIR was used to further characterize the recovered protein fractions (Fig 4).

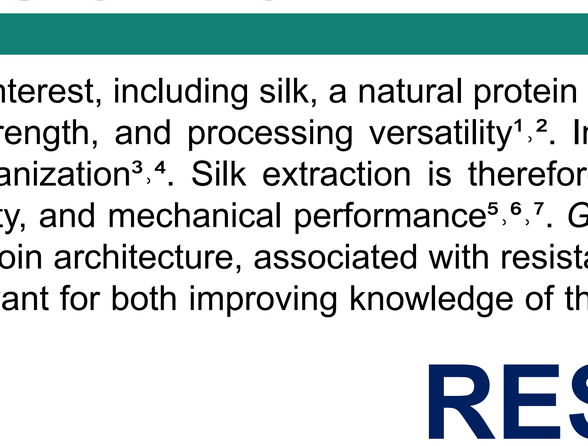

Fig. 3A

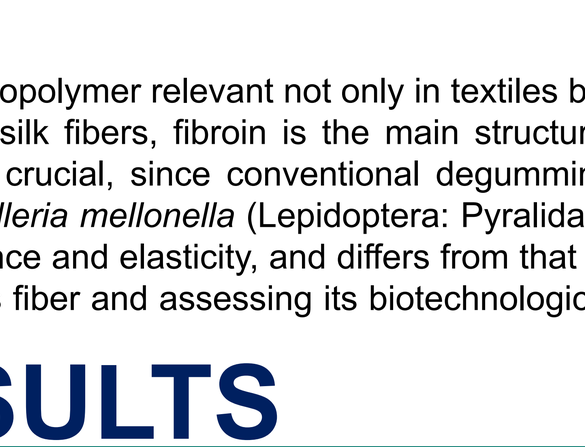

Fig. 3B

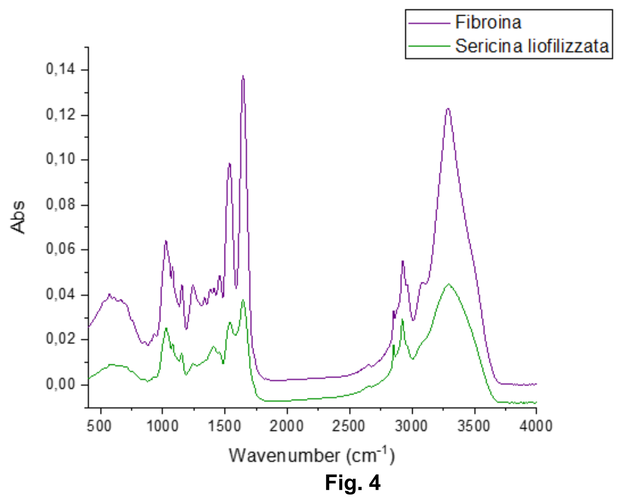

Fig. 4

Fig. 3A SEM micrograph of lyophilized sericin.
Fig. 3B SEM micrograph of fibroin film.
Fig. 4 Comparative FTIR spectra of fibroin and lyophilized sericin.

CONCLUSIONS

These preliminary results confirm the feasibility of separating fibroin and sericin from *G. mellonella* silk and highlight clear morphological differences between the recovered fractions. Although the electrophoretic profiles were only partially resolved, the combined analytical approach, including SDS-PAGE, silver staining, and SEM observations, proved useful for obtaining an initial characterization of the samples. In particular, the distinct surface and structural features observed among cocoon silk, single filament, sericin, and fibroin film support the effectiveness of the extraction procedure. Overall, this work provides a solid starting point for future studies aimed at optimizing extraction and purification protocols and at further exploring the biotechnological potential of *G. mellonella* silk.

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