Revolutionizing Silk Production: A Cutting-Edge, Eco-Friendly Approach to Sericin Synthesis and Sterilization

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Abstract

The growth of acute and chronic illnesses has led to a compelling demand for novel therapeutic agents, prompting the pursuit of sustainable, readily available, and multifunctional materials. In this context, silk-based biomaterials have excellent intrinsic properties such as biocompatibility, biodegradability and mechanical stability. However, there are several key factors to consider when using these natural proteins, such as their origin, extraction and post-processing methods.

Silk has a semi-crystalline core responsible for load-bearing capacity (silk fibroin), while its outer layer comprises silk sericin, a globular protein that acts as a protective agent and adhesive.[1]. Silk sericin represents about 50.000 tons of all raw silk thread processing per year [2]. To valorize this protein and reduce the environmental impact generated, recent studies changed sericin paradigm, showing that sericin can improve biocompatibility *in vitro* and *in vivo*, increase cell adhesion and proliferation of several mammalian cell and also act as a nutritive media for cell growth [3].

Silk protein handling and processing is still a major challenge when it comes to the development of reproductible and functional natural-based materials. Thus, when working with silk driven proteins it is essential to assure quality consistency and batch to batch reproducibility. One way to ensure process standardization is to use these materials in the form of a stable and easy to dissolve powder, so that the quantities used can be better controlled when compared with other techniques such as dialysis, rota-evaporation and evaporation, where it is difficult to obtain solutions with the same protein concentrations, consequently leading to changes in the final properties of the materials produced. Moreover, dry silk samples can be stored for longer without suffering from degradation and are easily transported.

In this project, we propose a simple, eco-friendly, and cost-effective methodology to obtain a ready-to-use silk protein with superior quality to be used as a raw material. This new cryo-lyophilization methodology besides allowing standardization of silk protein materials allows obtaining an off-the-shelf raw material for on-demand use. Moreover, the obtained powders will be sterilized using an eco-friendly technology, supercritical technology ($scCO_2$); and can be produced in high quantities, crucial for the market sector.

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