Chapter 11

Sericulture 4.0: Sustainable Silk through Modern Technology

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Devendra Singh[1] and Kailash Bisht[2]

Abstract

This chapter investigates silk fibroin's (SF's) structural characteristics and capacity to produce composites with natural materials including curcumin, keratin, alginate, hydroxyapatite, hyaluronic acid, and cellulose. The study emphasizes silk's compatibility with natural additives due to its high number of polar functional moieties. The combination of silk and natural additives produces synergistic interactions, increasing material application while reducing individual unit restrictions. It also examines the present state and problems of commercializing silk-based biomedical devices. This section discusses current biomedical research on silk nano-biomaterials, with an emphasis on their applications in bio-cargo immobilization, chemo-biosensing, bioimaging, tissue engineering (TE), and regenerative medicine. It also explores the nanoscale attributes of silk, like nano-fluidics for specific blood types. The chapter also covers the limitations and opportunities for transforming silk nano-biomaterial research into affordable, off-the-shelf biomedical alternatives. This article examines at the complicated structure and characteristics of natural silk fibers, as well as their applications in biomedicine and smart fiber technologies. It highlights the application of silk fibers in multifunctional materials due to its mechanical strength, biocompatibility, and biodegradability. The study also discusses their biological applications, which include surgical sutures, TE, and drug delivery systems, as well as current advances in smart fiber applications such as sensing, optical technologies, and energy storage. This article looks at an eco-friendly process of making mulberry spun silk fabric that reduces environmental impact and waste. The silk business pollutes the natural environment by emitting dust, smells, and gasses, resulting in high production costs and material waste. The novel method employs silk waste to minimize carbon emissions, material waste, and energy use. The article examines silk and cotton fibers to see which is more successful in atmospheric deterioration.

Keywords

Silk Fibroin (SF), Biomaterial Engineering, Fiber Bioengineering, Regenerated SF (RSF), Piezopolymer, Piezoelectric, Sericin

[1]Uttaranchal Institute of Technology, Uttaranchal University, Dehradun-248007, Uttarakhand, India, devendra0503@gmail.com
[2]UIM, Uttaranchal University, kailash.bisht1911@gmail.com

Corresponding Author:
Email-id: kailash.bisht1911@gmail.com

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