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The use and role of silk proteins in the development of biomaterials

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Biomaterials are substances that can mimic biological cells. Biomaterials play a very important role in surgical procedures, diagnostics, treatments or experiments which are a part of developing any biologically significant products. The major properties of a biomaterial or a scaffold include biodegradability, biocompatibility and anti-inflammatory properties. Additionally, it must not interfere with the metabolic pathways. Silk obtained from silkworms is of two types based on the food source of the worm i.e. mulberry and non-mulberry. The silkworm silk consists of eighteen amino acids and is rich in glycine, alanine and serine. The silk obtained from different sources consists of different types of fibroin present in them. Bombyx mori consists of a hexapeptide sequence (glycine-alanine- glycine-alanine-glycine-serine) which dominates the beta-sheet regions. This property helps silk form biocompatible biomaterials and scaffolds. Some of the very few biomedical engineering applications of silk are due to its improved biocompatibility, physical properties, enhanced mechanical strength, nontoxic by-products and good water activity. Silk fibres exhibit good tensile strength and do not easily disintegrate under fluctuating physiological conditions. Hence, these properties make silk a reliable source for tissue growth. In addition, the reproducibility of tissues also increases owing to silk.

The self-degradation of silk might be a result of proteolytic activity. The protease enzyme produced by the cells can contribute to the degradation of early worn-out silk biomaterials. However, if the beta-sheet activity is altered in the silk fibroin, it considerably increases the durability and the mechanical strength of the silk biomaterial. This has helped silk become an efficient vehicle for drug delivery to a target cell or site through a certain pathway. Further, altering or modifying the protein structure or the amino acid sequence can aid in developing efficient silk biomaterials. One of the advantages that silk nanoparticles can provide is bioavailability. They help in improving the efficacy of drug delivery as they have higher stability, comparatively smaller size and high carrier capacity. Moreover, the drugs travel via the root without disintegrating which makes them the most appropriate vehicle for drug delivery. Furthermore, the applications of silk biomaterials include 2D, and 3D cellular substrates which help in mimicking the cellular framework by providing an environment that can regulate cell adhesion, proliferation, migration and differentiation. Implants used for dressing the wound are also made up of silk fibroin as it promotes wound healing and is faster when compared to other wound dressings.

Keywords: Silk, Biomaterials, Implants, Silk fibroin, Wound healing, Drug delivery

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