

**TECHNOLOGIES FOR MANUFACTURING FILAMENTS AND SCAFFOLDS USED
IN MEDICINE USING SILK FIBER WASTES.**

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Annotation: This article reviews the scientific and practical foundations of using silk fiber waste in the production of filaments and scaffolds used in biomedicine. Silk fiber, as a natural biomaterial, has high biocompatibility, biodegradability and mechanical strength. Therefore, economic and ecologically effective solutions are proposed for regenerative medicine, tissue engineering and the creation of implants by recycling silk waste. The article discusses the technologies for processing silk waste, their physicochemical characteristics, as well as the possibilities of creating scaffolds using modern 3D bioprinters.

Keywords: Silk fiber, filament, scaffold, electrospinning, freeze-drying, 3D printing, cell cultures, skin regeneration, bone regeneration, implants and prostheses.

Introduction. In recent years, the use of biomaterials based on natural sources in tissue regeneration, artificial organ development, and regenerative medicine has become a hot topic in the field of biomedicine. Silk fiber is one of the materials widely used in biomedicine due to its natural and ecological aspects. Since silk fiber contains high-quality proteins such as collagen and elastin, it has the potential to be used in medicine, especially in regenerative medicine. However, the industrial production and use of silk fibers often raises problems related to resources and cost-effectiveness. Therefore, the production of filaments and scaffolds used in biomedicine from silk fiber waste opens up new opportunities for the development of environmentally friendly and innovative technologies. [1]

The role of silk fibers in biomedicine

The widespread use of silk fibers in biomedicine is due to their biological properties. Silk fibers are considered a very suitable material for use in biomedicine, due to their high mechanical strength, elasticity, biological stability, biocompatibility and degradability. The molecular structure of silk fibers includes proteins similar to collagen and elastin, which make them ideal materials for supporting cell growth and regeneration. In biomedicine, they are used, in particular, in the regeneration of skin, bone, and other tissues, in the development of implants and prostheses, as well as in the modification of drugs, which ensures their easy processing in the human body. [2]

Use of silk fiber waste

One of the main advantages of converting silk fiber waste into filaments and scaffolds for use in biomedicine is that it is environmentally friendly. Silk waste is usually a material left over from silk production processes or from the production of silk fiber. This is an effective way to recycle waste and transform it into high-tech materials, protecting the environment. [3] That is, it is possible to effectively use the waste generated during the creation of silk fibers, while protecting

them from various factors that can harm the environment, and to produce useful products. In this way, the transformation of waste into high-value biomedical materials helps to save natural resources and prevent their unnecessary loss. [4]

Filament and scaffold production

Several technological processes are required to produce filaments and scaffolds from silk fiber waste. First, the silk fibers in the waste must undergo a cleaning process. These processes can be carried out by biological or chemical methods. The silk fibers are then cut into various sizes and shapes, and their mechanical and biochemical properties are evaluated to verify their quality. [5]

Filaments are continuous or fragmented fibers that can be produced to provide a 3D environment for biological tissues and cells. Filaments have a microscopic structure that helps cells grow.

Scaffolds, on the other hand, are materials that form a 3D structure that creates an ideal growth environment for cells. When silk fibers are used as scaffolds, their structural properties, such as the micropores and spaces necessary for cells, create good conditions for tissue growth. Scaffolds are biocompatible and easy to test and implant in the body. [6]

Several technologies are used to produce filaments and scaffolds from silk fibers, including:

Electrospinning: This technology allows silk fibers to be produced in the form of microfibers using a high-voltage electric field. During the electrospinning process, the silk polymers are rapidly aggregated and transformed into fine fibers, which is useful for their use as scaffolds.

Freeze-drying: Silk fibers can be freeze-dried to create structures while maintaining their biological activity. The freezing process helps to ensure the stability of the scaffolds.

3D printing: Silk fibers can be transformed into scaffolds using 3D printers. This process allows the creation of precise geometric shapes of scaffolds and helps to produce flexible materials for various tissues. [7]

The microfiber structure of silk is used in the production of filaments and scaffolds to maintain their structure, provide support and growth for cells. These materials create a good growth environment for cell cultures and ultimately help regenerate biological tissues.

Potential areas in biomedicine

Filaments and scaffolds made from silk fiber waste have a number of biomedical applications. These include:

1. **Cell culture:** Scaffolds made from silk fiber are used to support the growth and regeneration of cells into various tissues. The microscopic structures of silk create a good growth environment for cells, which helps regenerate new tissues. The high surface area and precise structure of silk fiber create optimal conditions for cell growth.

2. **Skin regeneration:** Due to the good compatibility of silk fiber with skin tissues, it is used in skin regeneration. Materials made from silk fiber are used in wound healing and skin grafting procedures. [8]

3. **Bone and muscle regeneration:** Silk's high mechanical strength and elasticity make it an ideal material for scaffolds used in bone and muscle tissue regeneration.

4. **Drug delivery systems:** Silk is also used to produce microcapsules or nanocapsules for the efficient delivery of biologically active substances to target organs or tissues.

5. **Implants and prostheses:** Materials made from silk fibers are used to develop implants and prostheses for organs and tissues. These materials are harmless, so they are easy to adapt to the body. [9]

Conclusion

The production of filaments and scaffolds from silk fiber waste is an important step in creating innovative materials in biomedicine. This technology is a good way to effectively use waste and protect the environment, allowing the production of environmentally sustainable and effective materials, while creating new opportunities in the field of regenerative medicine and implants. It is also a good example of waste recycling and efficient use of resources, and represents a promising direction for the future of the biomedical industry.

References.

1. Shavkatov Otabek, Yodgorbek Ismoiljonov and Zafar Juraev. "DEFINING MEDICAL DEVICES: A COMPREHENSIVE OVERVIEW." *European Journal of Interdisciplinary Research and Development* 25 (2024): 114-118.
2. Shavkatov O.K. va Tursunboyeva M.A. "ISHLAB CHIQRISHDA TOLANI SIFAT KO'RSATKICHINI ZAMONAVIY USULLAR BILAN ANIQLASH" *Respublika ilmiy-texnik jurnali* (2024): 421-425
3. Kozimbek o'g'li, Shavkatov Otabek. "TECHNOLOGIES OF USING SILK FIBER WASTES IN THE PRODUCTION OF FILAMENTS USED IN BIOMEDICINE." *Web of Medicine: Journal of Medicine, Practice and Nursing* 3.2 (2025): 468-471.
4. Otabek, Shavkatov. "EKG TIBBIYOT TEXNIKASI VOSITASINI EKG SIMULYATORI YORDAMIDA METROLOGIK ANIQLIGINI OSHIRISH." *Journal of new century innovations* 24.3 (2023): 59-64.
5. S.Umarov, E.Bozorov, O.Jabborova "Tibbiy texnika va yangi tibbiyot texnologiyasi" T - 2018.
6. G.J. Jarilkasinova, D.R. Adizova "Amaliy tibbiyotdagi yangi texnologiyalar" Toshkent - 2012. — 208 b.
7. Islomiy, Normatov, Isroilov Asadbek, and Otabek Shavkatov. "ENSURING QUALITY AND SAFETY OF AGRICULTURAL PRODUCTS ON THE BASIS OF INTERNATIONAL STANDARDS." *Next Scientists Conferences*. 2022.
8. Ma, Yue, Yaping Liang, and Wenjuan Bi. "Application of Silk Fibroin in the Field of Oral Clinical Medicine." *International Core Journal of Engineering* 8.7 (2022): 561-564.
9. Raxmonaliyeva, Sodiqova Mahbubaxon. "ADVANCEMENTS IN SILK: DEVELOPMENT OF MANAGEMENT SYSTEMS AND SCIENTIFIC FOUNDATIONS." *International Journal of Advance Scientific Research* 3.06 (2023): 266-271.