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Abstract

The Comparison of Physicochemical Properties of Chitosan/Silk Fibroin/Collagen-Based Materials Cross-Linked with Chemical Agents †

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Interest in biomaterials based on natural polymers has recently surged. The natural polymers are large molecular compounds, which can be obtained from living organisms or are produced by living organisms. Biopolymers typically exhibit properties highly desirable in tissue engineering, including biocompatibility, biodegradability, and minimal immune responses upon introduction into the human body.

Chitosan, collagen, and silk fibroin are biopolymers commonly used in tissue engineering to obtain three-dimensional scaffolds [1]. They can be utilized as fillings for repairing small bone defects. However, materials obtained only from biopolymers or their mixtures may have insufficiently physicochemical properties. Therefore, there is a need to cross-link such materials [1].

The purpose of this work was to obtain and characterize 3D scaffolds based on chitosan, collagen, and silk fibroin modified with various cross-linking agents [2–4]. Collagen was obtained from young rat tail tendons, and silk fibroin was obtained from Bombyx mori cocoons. Materials were obtained using the lyophilization method, and their physicochemical properties, such as porosity, density, moisture content, and mechanical strength, were evaluated. Dialdehyde chitosan, dialdehyde starch, and glyoxal were used as modifiers of the three-component materials.

Based on the results, it can be concluded that the properties of biopolymer materials depend on their weight ratio composition and the cross-linking agent. The study revealed that cross-linked materials exhibited a high swelling rate and sufficient porosity, rendering them suitable for tissue engineering applications. Mechanical properties vary depending on the composition of the blends. Novel biopolymeric composites based on collagen, chitosan, and silk fibroin, chemically cross-linked, hold potential for various biomedical applications, particularly in bone tissue regeneration.

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