Sturgeon collagen - new source for fabrication of medical devices

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A promising solution for soft tissue regeneration is tissue engineering, a multidisciplinary field of research which involves the use of biomaterials, growth factors, and stem cells to repair, replace, or regenerate tissues and organs damaged by injury or disease. The success of tissue engineering depends on the composition and microstructure of the used scaffolds. Ideally, scaffolds should be similar to natural tissues. Collagen is the major component of the extracellular matrix of most soft tissues. As a natural molecule, collagen possesses a major advantage, being biodegradable, biocompatible, presenting low antigenicity, easily available and highly versatile. Nowdays, the main source for collagen biomaterials are the bovine, porcine and cadaver skin. Due to religious constrains and bovine spongiform encephalopathy (BSE), the attention for new sources of collagen is absolutely requested. On the other side, a huge amount of wastes (about 50-70%) of original raw materials is generated by fish processing factories, causing serious environment pollution with offensive odour. Therefore, the use of such wastes (skin) in the production of value-added products is a very promising solution from environmental and economical point of view, being part of the circular economy.

Fish skin, scales, and bones have been reported in many studies as source of collagen, used especially in food industry. Collagen extraction from different marine origin skin and its physical, biochemical, structural and biological characteristics were reported so far. Very few studies gained their attention on biomedical applications. The big constrain for using collagen fish in biomedical field is its mechanical strength, thermodynamic stability and high biodegradability.

In the present research, collagen gels from sturgeon skin were obtained and characterized by physical chemical, structural and rheological properties. The collagen sturgeon gels were freeze-dried, and corresponding sponges were evaluated by FT-IR, SEM, water uptake, enzymatic degradation, antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*, proliferation of human fibroblasts on sturgeon collagen sponge at 24, 48 and 72 h, and by *in vivo* tests of sturgeon collagen sponge on Wistar rats with induced burn during 16 days. The results showed sturgeon collagen sponges as a promising biomaterial for wound healing.

Starting from these promising and excelent results, we selected a three factors-two levels factorial design as a first step in fabrication of sturgeon collagen sponges. The independent variables were collagen gel concentrations, crosslinking agent concentrations and freezeing temperatures during freeze-drying process, while the dependent variables were swelling degree, weight loss and pore sizes. Based on the optimization technique, three combinations of formulation and process factors were selected. The human dermal fibroblasts cultivated for 3 weeks evidenced de novo collagen deposition on the scaffolds. The best and final formulation in term of porosity, absorption, biodegradability and biocompatibility was choosen to be the one with 0.6 % collagen, -10^{o}C and 0.5% crosslinking agent. The process of fabrication will follow the Medical Device Regulation – MDR 2017/745, ensuring conformity with medical device standards. There is no any risk for TSE or BSE and the presented biomaterial is ready to be medical device very soon. However, even if the results were excellent, the biomaterials cannot be used by humans until they become medical devices.

Acknowledgement
This work was supported by a grant from the Ministry of Education and Research, Romania, project NUCLEU code 01 01 23 26. The tests were performed in many laboratories such as Innovative Therapeutic Structures Research and Development Center (InnoTher), “Carol Davila” University of Medicine and Pharmacy, Bucharest; Cell and Tissue Engineering Department, “Nicolae Simionescu” Institute of Cellular Biology and Pathology, Bucharest; Advanced Polymer Materials Group, National University of Science and Technology POLITEHNICA Bucharest. Many thanks to be part of this research.