

2^o Encontro Ibérico de Fluidos Supercríticos Encuentro Ibérico de Fluidos Supercríticos



EIFS2022
Coimbra- Portugal



Book of abstracts

28 Fevereiro - 2 Março
28 Febrero - 2 Marzo



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Self-assembled silk fibroin aerogel particles for wound healing

Beatriz G. Bernardes^{1,2}, Raquel Costa^{*3,4,5}, Carlos A. García-González^{*2}, Ana Leite Oliveira^{*1}

¹ Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal

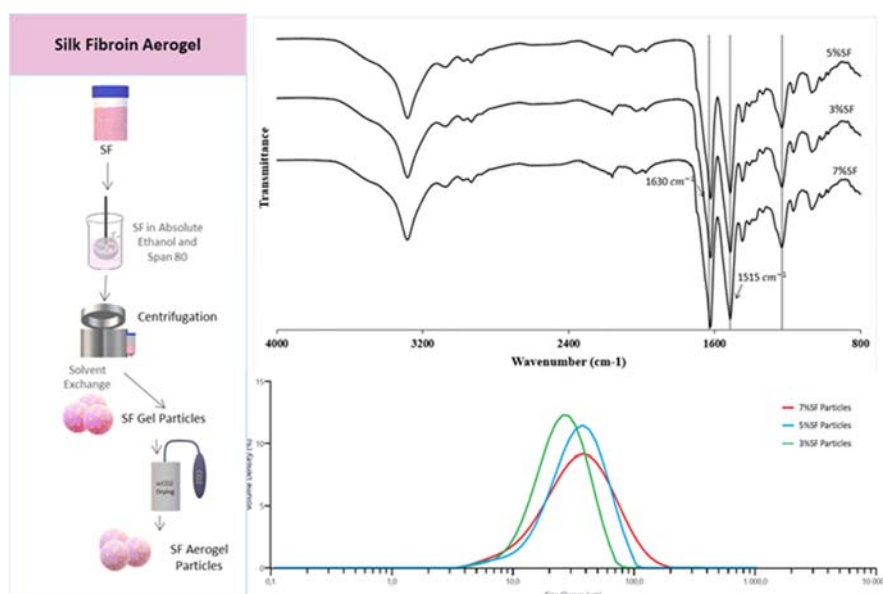
² Department of Pharmacology, Pharmacy and Pharmaceutical Technology, I+D Farma group (GI-1645) and Health Research Institute of Santiago de Compostela (IDIS), Universidade de Santiago de Compostela, E-15782 Santiago de Compostela, Spain

³ Instituto de Investigação e Inovação em Saúde, Universidade do Porto (i3S), Porto, Portugal

⁴ Department of Biomedicine, Biochemistry Unit, Faculdade de Medicina, Universidade do Porto, Porto, Portugal

⁵ Escola Superior de Saúde, Instituto Politécnico do Porto, Porto, Portugal
raquel.costa@i3s.up.pt; carlos.garcia@usc.es; aloliveira@ucp.pt;

GRAPHICAL ABSTRACT



ABSTRACT

Chronic wounds are one of the major therapeutic and healthcare challenges. The design and development of biocompatible, biodegradable and adaptable materials that promote the tissue repair, prevent the infection and inflammation and ensure the control of exudate are a constant need for wound management [1]. Aerogels are nanostructured dry materials which can provide advanced performance for wound healing due to their high porosity, large surface area and water uptake, which can be tailored for a fast and directional fluid transfer of the exudate [2]. Aerogels can also act as carriers for bioactive compounds [1]. Silk fibroin (SF) is a protein that can be obtained from *Bombyx Mori* cocoons and has demonstrated to be an excellent stabilizer of bioactive compounds while supporting cell proliferation, being presently used in wound healing and regeneration [3]. In this work,

SF aerogel particles were developed and their potential as a controlled release system evaluated for wound healing applications.

SF extracted from *B. mori* cocoons was used to prepare SF aerogel particles. For the particles' production SF aqueous solutions at different concentrations (3, 5 and 7%(w/v)) were introduced into an absolute ethanol and Span 80 surfactant (3 wt.% with respect to SF) solution, followed by supercritical CO₂ drying. Ethanol was added at a ratio of 2:1 (v/v) in relation to SF solution. Span 80 was used as surfactant (3 wt.%) in relation to SF solution. The solution with Absolute Ethanol and Span80 was homogenized by mechanical stirring at 600 rpm and further SF solution added dropwise to the ethanol solution with stirring.

For the characterization of the SF particles, particle size distribution was determined by laser diffraction. Fourier Transform Infrared with Attenuated Total Reflectance (FTIR-ATR) spectroscopy was used to investigate the secondary structure formation, conformation and chemical structure. Textural properties have been performed by helium pycnometry and N₂ adsorption-desorption analysis.

The average diameter of the obtained particles varied at different concentrations. Particle diameter and dispersion increase with increasing SF concentration. According to the FTIR-ATR analysis, it was possible to verify the presence of the main characteristic bands of SF assigned to the presence of β -sheet structure, characterized by strong bands on the amide I and II regions. The physicochemical and textural characterization of the aerogels will allow to understand if this method is suitable to produce particles with adequate drug release kinetics. These particles constitute a drug delivery platform to be further loaded with pharmaceutical agents relevant for wound healing applications. *In vitro* tests are presently ongoing to validate the particles biocompatibility and suitability for wound healing.

ACKNOWLEDGEMENTS

This research was funded by MICINN [PID2020-120010RB-I00], Xunta de Galicia [ED431C 2020/17], Agencia Estatal de Investigación [AEI] and FEDER funds. This work was also supported by National Funds from Fundação para a Ciência e a Tecnologia (FCT), through project UID/Multi/50016/2020 and Doctoral Research Grants 2021.05717.BD. Work carried out in the framework of the COST Action CA18125 "Advanced Engineering and Research of aerogels for Environment and Life Sciences" (AERoGELS), funded by the European Commission. This work was supported by project TEX4WOUNDS (POCI-01-0247-FEDER-047029), financed under the Incentive System for Research and Technological Development, R&DT Projects in co-promotion (Notice SI/17/2019). TEX4WOUNDS (POCI-01-0247-FEDER-047029), funded under the Incentive System for Research and Technological Development, R&DT Projects in Co-Promotion (Notice 17/SI/2019)

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