UNRAVELING THE POTENTIAL OF BIOAEROGELS IN FLUID MANAGEMENT, HEALING AND REGENERATION OF WOUNDS

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Introduction

The healing process of an injury comprises a series of steps (haemostasis, inflammation and proliferation/maturation). During wound healing, a fluid (exudate) is produced as a natural response towards healing, however, its excessive production can be detrimental, delaying the inflammatory phase, resulting in chronic wounds. Chronic wound healing is one of the major therapeutic and economic healthcare services challenges.

Aerogels are nanostructured dry materials with high porosity, large surface and low bulk density. Bio-based aerogels, from natural polymer sources, can provide advanced performance for wound healing due to their high porosity and large surface area, which can be tailored for a fast and directional fluid transfer; also, they can act as carriers for bioactive compounds.

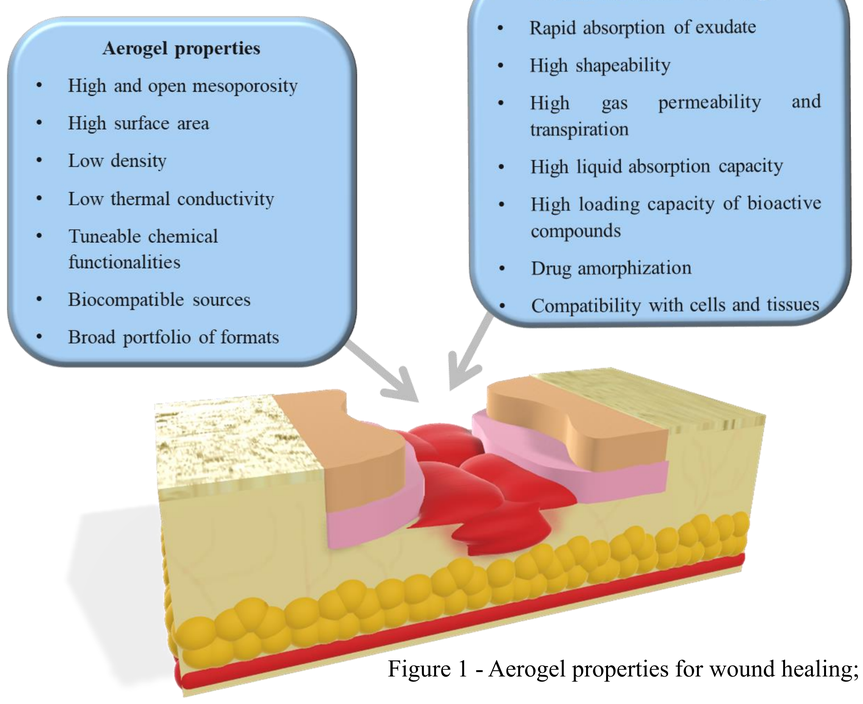

Figure 1 - Aerogel properties for wound healing;

Objectives

The main purpose of this work is the development and characterization of silk-based microparticulate aerogel system formulations for the sequential release of bioactive compounds in medium to high exudative wounds for the treatment of the inflammatory phase of the wound healing process.

Methods

Silk fibroin extracted from Bombyx mori cocoons was used to prepare SF aerogel particles by emulsion-gelation from SF aqueous solutions at different concentrations as aqueous phase in water-in-oil emulsions followed by supercritical CO2 drying (Figure 2). The oil phase was prepared by using paraffin oil with different percentages of Span 80 surfactant.

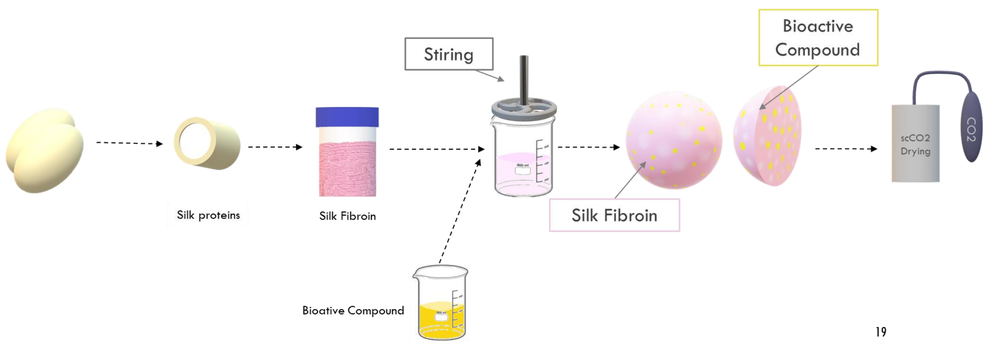

Figure 2 – Silk-based aerogel particles production method.

Chemical and structural characterization

- Fourier transform infrared spectroscopy with attenuated total reflectance (FTIR-ATR)

Morphological characterization

- N2 adsorption-desorption tests
- Helium Pycnometer
- Mastersizer

Results and Discussion

SF gel particles were produced with an emulsion-gelation method using different concentrations of SF (3% and 5% (w/v)), stirring velocity (600 and 1100 rpm) and Span 80.

Table 1 – SF aerogel particles diameter considering the average size of all the methodologies adopted.

SF particles Diameter											
	Dv10		Mean STD	RSD%	Dv50		Mean STD	RSD%	Dv90		Mean STD	RSD%
5%SF	509	µm	3	0,7	856	µm	20	2,2	1073	µm	91	6
3%SF	368	µm	2	0,6	635	µm	5	0,8	1075	µm	22	2

Table 2 – SF aerogel particles Surface Area and Skeletal Density at different methodologies.

Concentration (w/v)	Span80 Percentage	Stirring Velocity (rpm)	Surface Area (m^2/g)	Skeletal Density (µm)
5%	3%	600	515±26	1.36±0.04
3%	3%	600	457 ±23	1.53±0.09
5%	3%	1100	147 ± 7	1.09±0.00
3%	3%	1100	177 ± 9	1.02±0.02
5%	10%	600	160 ± 8	0.81±0.03

According to ATR-FTIR analysis, it was possible to verify the presence of the main characteristic bands of f β-sheet structure (Figure 3). Also, it was detected the presence of Span80. The non-complete removal of Span80 may explain why the surface area of the SF aerogels with 10%Span is lower.

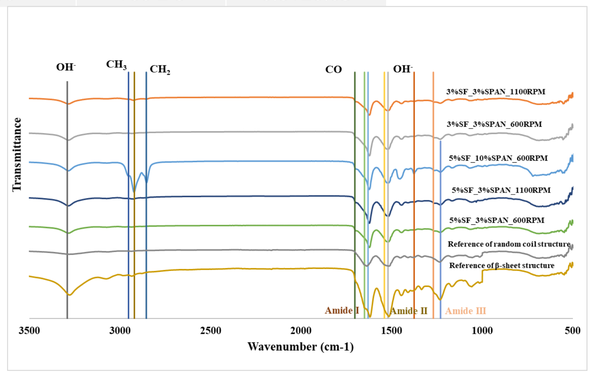

Figure 3 – FTIR-ATR analysis;

Conclusions

✓ SF gel particles were produced with an emulsion-gelation method using different concentrations of SF, stirring velocity (600 and 1100 rpm) and Span 80. Namely, the SF particles with a stirring velocity of 600 rpm were more spherical and homogeneous.

✓ Physicochemical and textural characterization of the SF aerogels showed excellent properties and low particle size deviation, suggesting that the method is suitable for the production of particles for wound healing applications. In the future, we intend to load these particles with pharmaceutical drugs relevant for wound healing applications.

Acknowledgements

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