New hydrogel biomaterial for the treatment of diabetic ulcers

Sara Baptista-Silva[1], Sandra Borges[1], Paulo Alves[2], Ana L. Oliveira[1]

[1] - Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina, Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal
[2] - Universidade Católica Portuguesa, Instituto de Ciências da Saúde (ICS), Porto, Portugal

Introduction/Resume

Lower extremity diseases are twice common in diabetic compared with nondiabetic persons, affecting 30% of diabetics, probably caused by impaired production or utilization of insulin (1). Ulcers frequently become infected, cause great morbidity, and are the first step to lower extremity amputation.

Enzyme-mediated crosslinking hydrogels are capable of gelling *in situ* by crosslinking polymer hydroxyphenyl groups. In our studies, it was possible for the first time, a new enzyme-triggered crosslinked hydrogel using horseradish peroxidase (HRP). This hydrogel is composed of silk sericin protein and able for fast gelation at physiological temperature (Patent Application (2)).

Objectives

This project suggests a simple and practical strategy to rebuild the function of tissues in diabetic ulcers by an in situ formed hybrid sericin hydrogel, for healing and tissue regeneration, enabling cell recruitment and proliferation. Since diabetes is a disease caused by impaired production or utilization of insulin, this work may also help to explain the connection between diabetes and poor healing.

Besides tackling one of today's major public health issues, the project promotes, the re-use and valorization of a textile industrial by-product by its integration in the Biomedical arena.

Methods

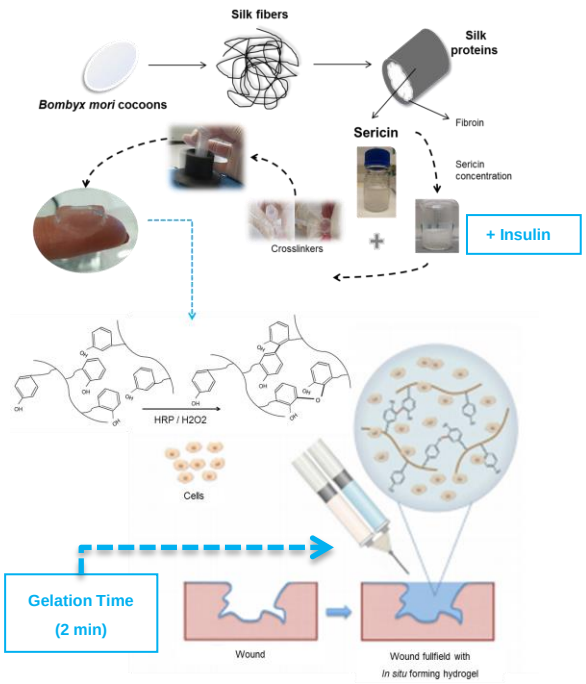

Figure 1. Schematic illustration of *in siu* enzimatic-mediated crosslinking silk sericin hydrogels.

Results

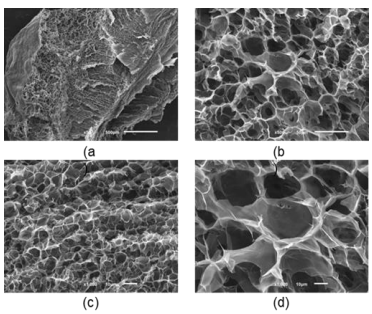

Figure 2. SEM micrographs of lyophilized sericin-based hydrogels at different resolutions (a) and (b) at 500x; (c) and (d) at 1000x.

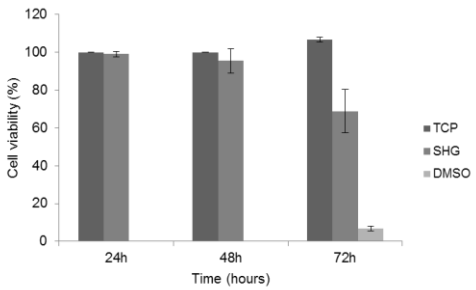

Figure 3. Effect of SHG on viability of L929 cell lines after 24 h, 48 h and 72 h. Tissue culture polystyrene (TCP) and DMSO were used as positive and negative controls respectively. The results were the mean of 4 replicates, bars represent standard deviation

Discussion/Conclusions

In this study, silk sericin from *Bombyx mori* cocoons was extracted, purified and concentrated by a procedure previously developed/optimized in the group (Figure 1). The enzyme mediated crosslinked sericin hydrogels was developed by the addition of different concentrations of HRP and hydrogen peroxide until achieving the ideal gelation time of 2 min. Formulations with this gelation time and better mechanical properties were selected for subsequent studies. The morphology and microstructure of the sericin-based hydrogel were examined by SEM at different resolutions (Figure 2). From the obtained images, sericin hydrogel showed to be also homogeneously and highly porous in randomly SEM micrographs, pores were noted with approximately 50 µm. The pores diameter suggest that the sericin hydrogel may be broadly applicable for repair of different types of tissues (3). The hydrogels were also biocompatible supporting cell viability after 3 days (Figure 3). This study provides new insights on the production of a bio-based hydrogel as an innovative wound treatment, by using an industrial by-product which creates a current environmental damage and has a neglected biomedical potential.

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