

In-situ forming silk sericin-based hydrogel

for chronic wound healing



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PORTO

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Introduction/Resume

Chronic wounds are currently a global epidemic, causing great morbidity, and are the first steps to lower extremity amputation (1). An ideal dressing should respect each stage of the wound, promoting the gradual refurbishment of injured tissue towards anatomic and functional integrity. Hydrogels have been widely exploited when moisture and hydration are required in the wound bed for the normal re-epithelialization (2). *In situ* crosslinking hydrogels in particular are able to effectively fulfill the wound in its full shape and depth. In this study, a new enzyme-triggered crosslinked hydrogel, composed of silk sericin, has been developed for the first time (3). This protein is reported to exhibit several important biological activities such as: biocompatibility, biodegradability, antioxidant behavior, among others.

Methods

Results

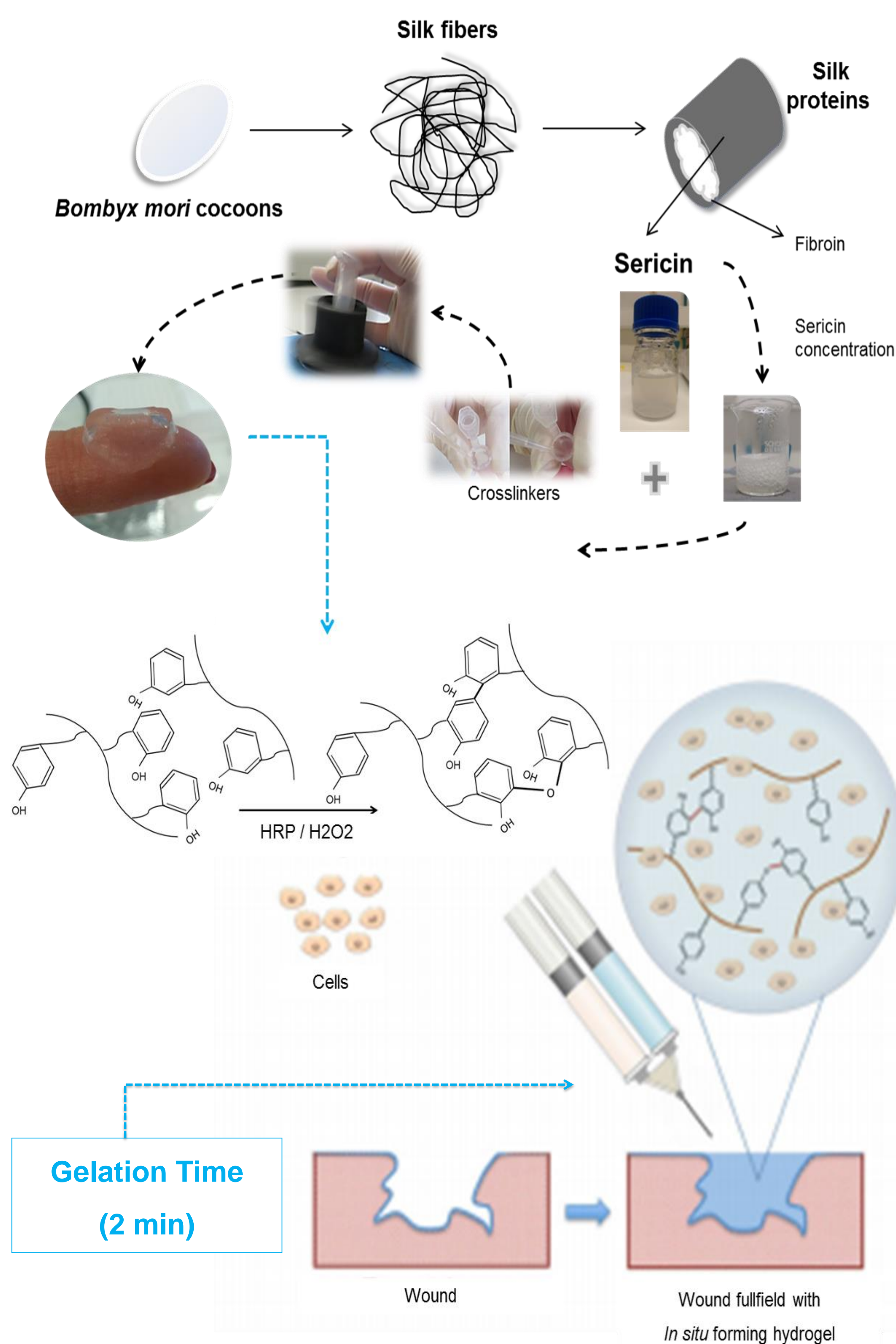


Figure 1. Schematic illustration of *in situ* enzymatic-mediated crosslinking silk sericin hydrogels.

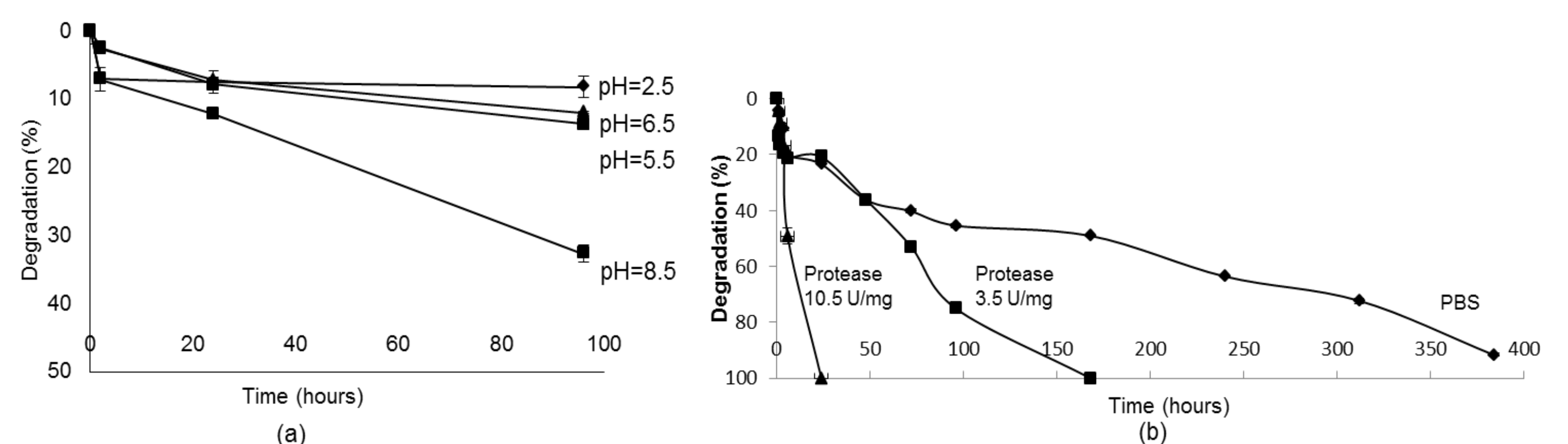


Figure 2. Degradation response of sericin-based hydrogels (a) pH degradation during 96 hours and (b) enzymatic degradation with protease XVI during 400 hours, both at 37 °C.

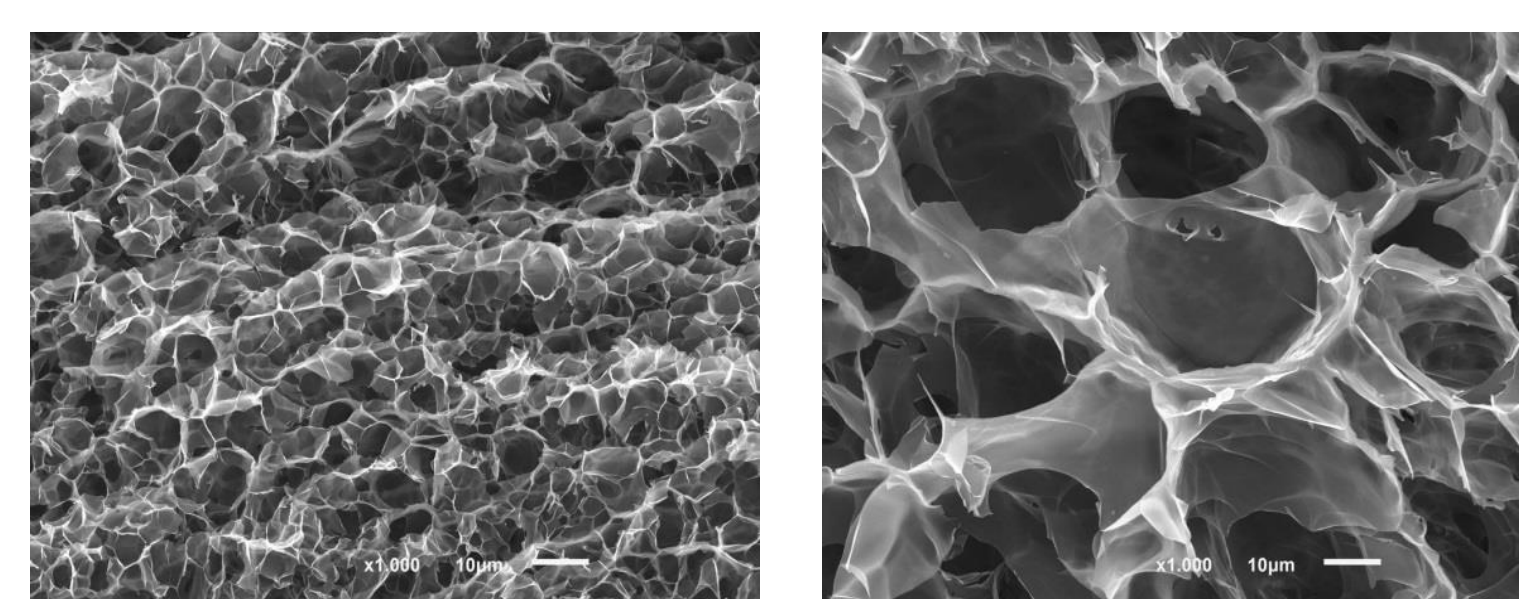


Figure 3. SEM micrographs of lyophilized sericin-based hydrogels at 1000x.

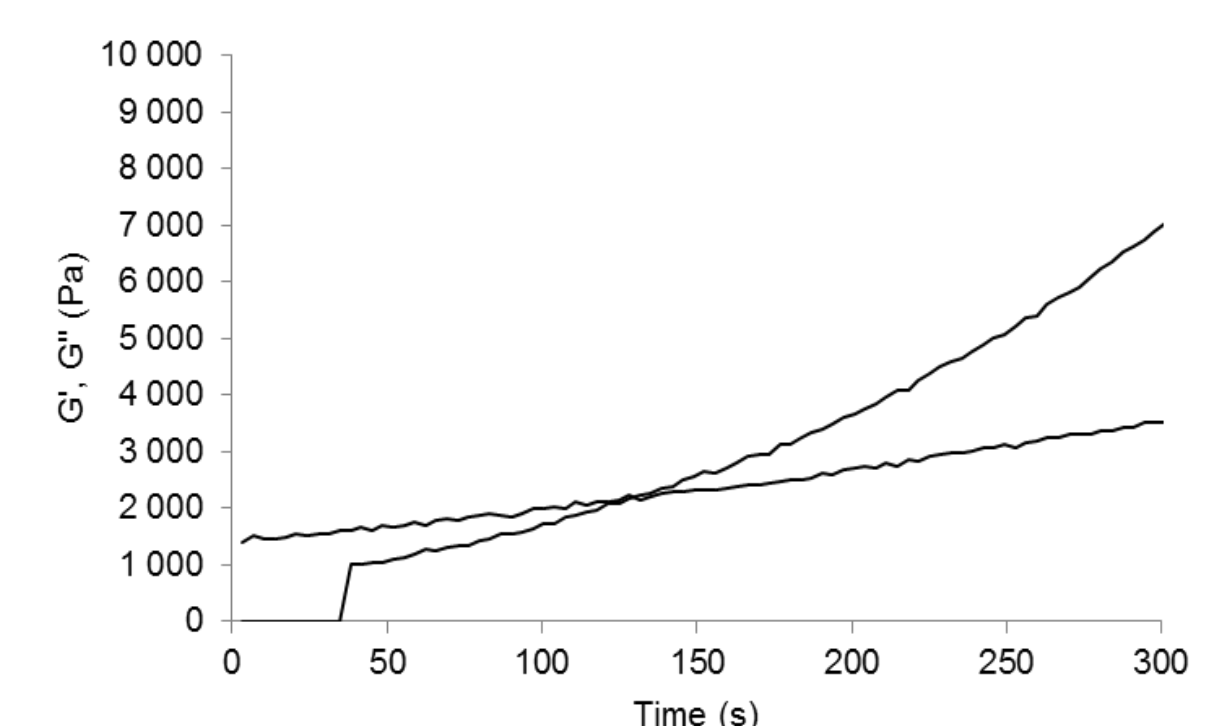


Figure 4. Oscillatory scans displaying both the elastic modulus (G') and viscous modulus (G'') of sericin hydrogel.

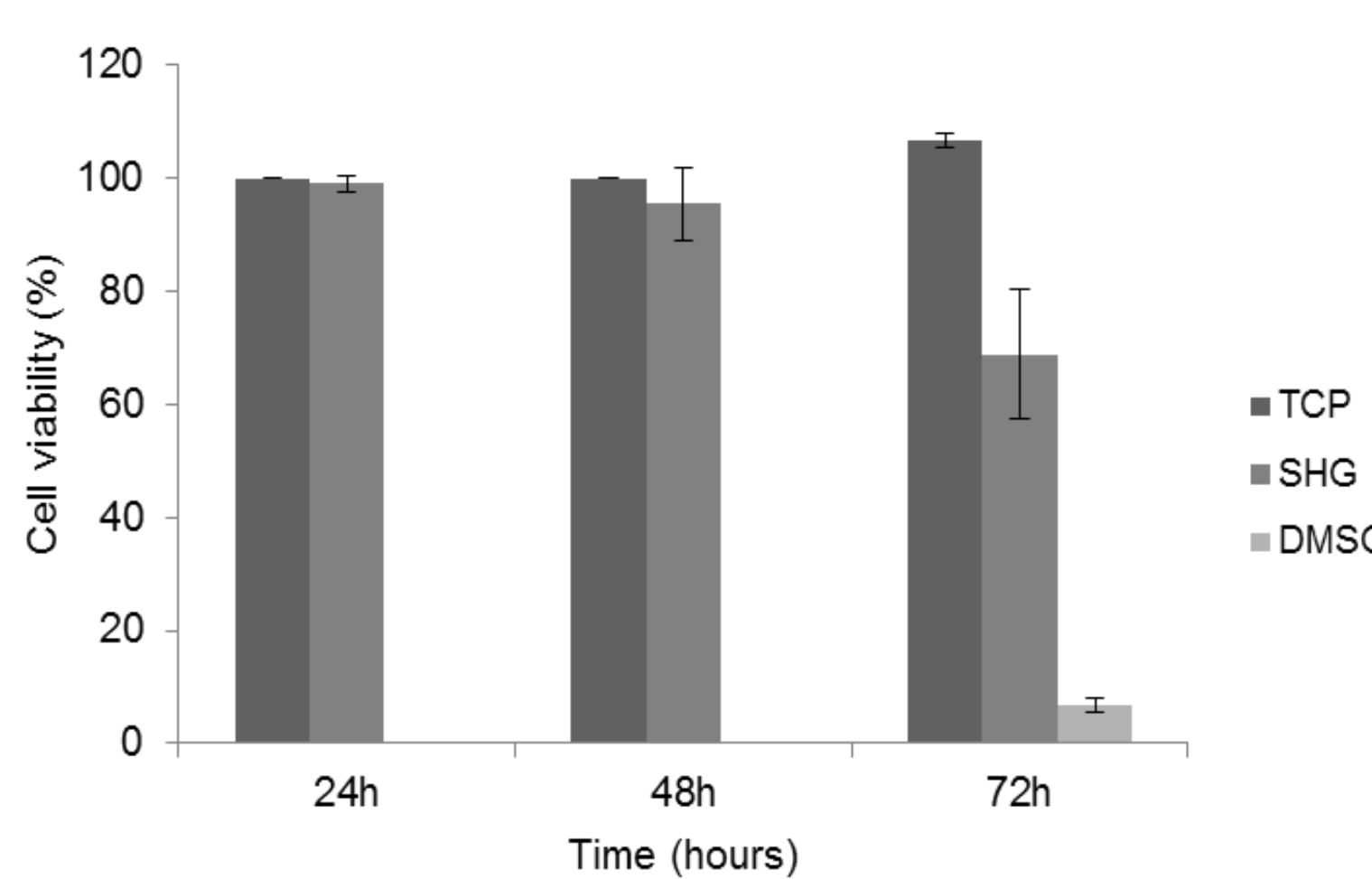


Figure 5. Effect of SHG on viability of L929 cell lines after 24 h, 48 h and 72 h. Tissue culture polystyrene (TCP) and DMSO were used as positive and negative controls respectively. The results were the mean of 4 replicates, bars represent standard deviation.



Figure 6. Sericin-based hydrogel in a clinical wound simulator of a chronic foot ulcer.

Discussion/Conclusions

The present work provides an innovative route to obtain a sericin hydrogel (Fig. 1) within a range of 2-3 minutes under physiological conditions, via peroxidase cross-linking (Fig. 1 and 4). The prepared hydrogels are homogeneously porous, of mainly amorphous conformation and with high degree of transparency (Fig. 3). The hydrogels are stable in PBS (pH 7.4) up to 17 days, including 7 days in the presence of protease (Fig. 2). Additionally, the hydrogels were also able to support cell viability up to 7 days, with cells exhibiting the typical fibroblastic morphology (Fig. 5).

This study suggests a simple, fast and practical *in situ* strategy to produce a sericin-based hydrogel to rebuild the function of tissues in chronic wounds (Fig. 6). Besides tackling one of today's major public health issues, the study herein reported fosters the re-use and valorization of a textile industrial by-product by its integration in the biomedical arena.

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References: 1. WHO. Global report on diabetes. World Health Organization, Geneva. 2016;WHO/NMH/NVI/16.3; 2. Wang Z et al., Sci Rep. 2014;4:7064; 3. Oliveira A, Silva SBd, Borges S, Alves P, inventors - Silk sericin-based hydrogels, methods and uses thereof. EU2016