Decellularized cardiac tissue for the development of non-immunogenic EPSs-rich biofabricated patches for cardiac regeneration

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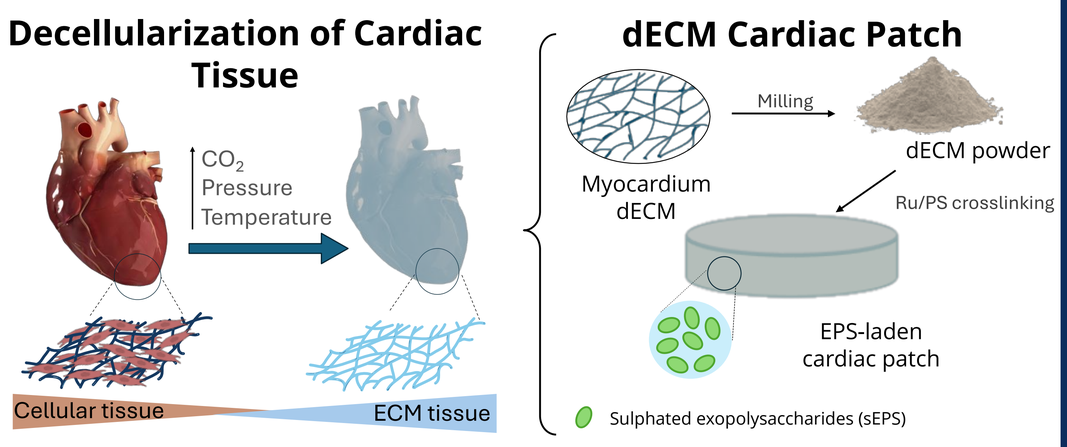
Introduction

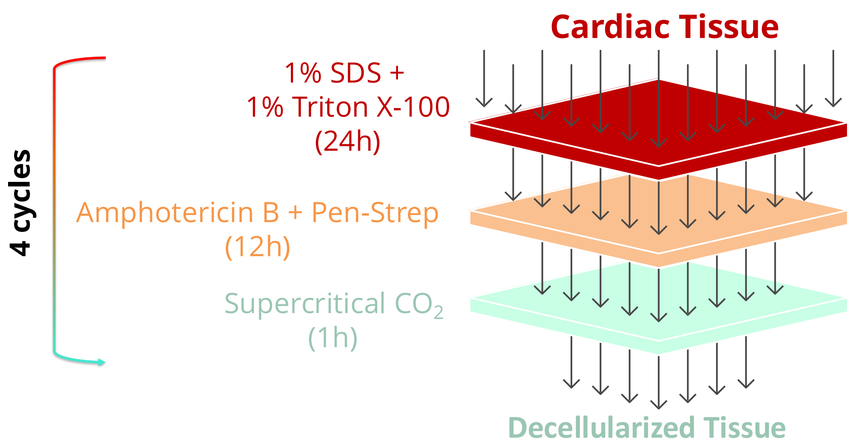
Cardiovascular diseases account for 32% of the global deaths, comprising different pathologies related to heart failure. [1] The heart self-regeneration is limited, which is associated to the highest mortality and morbidity rates of cardiovascular diseases. To bridge this gap, we developed a decellularized extracellular matrix (dECM)-based cardiac patch functionalized with sulfated exopolysaccharides (EPSs) to synergistically mimic native myocardial architecture and improve cardiomyocyte electrophysiological function. In fact, the sulfated groups in EPSs have the potential to influence the conductive properties of cardiomyocytes, enhancing ion exchange and electrical coupling between cells, thus improving the propagation of electrical signals. [2]

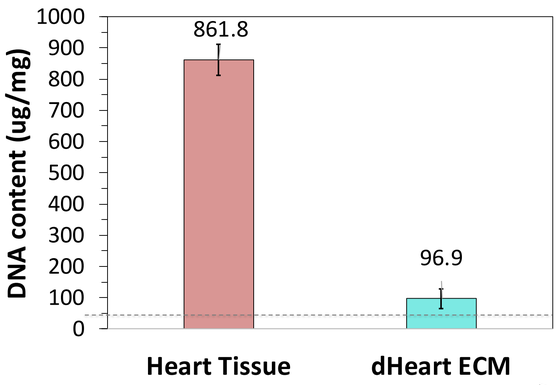
Objectives



Methods and Results

Cardiac Tissue Decellularization



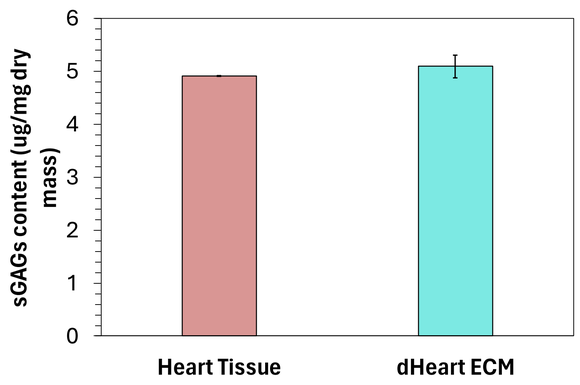


Residual DNA quantification

Reduced DNA content in porcine heart tissue after four cycles of decelullarization, resulting in a reduction of 89% of DNA content.

ECM components (sGAGs)

The sulphated glycosaminoglycans (sGAGs) were preserved, after 4 cycles of decellularization.



Sulphated exopolyssacharide (EPS) extraction

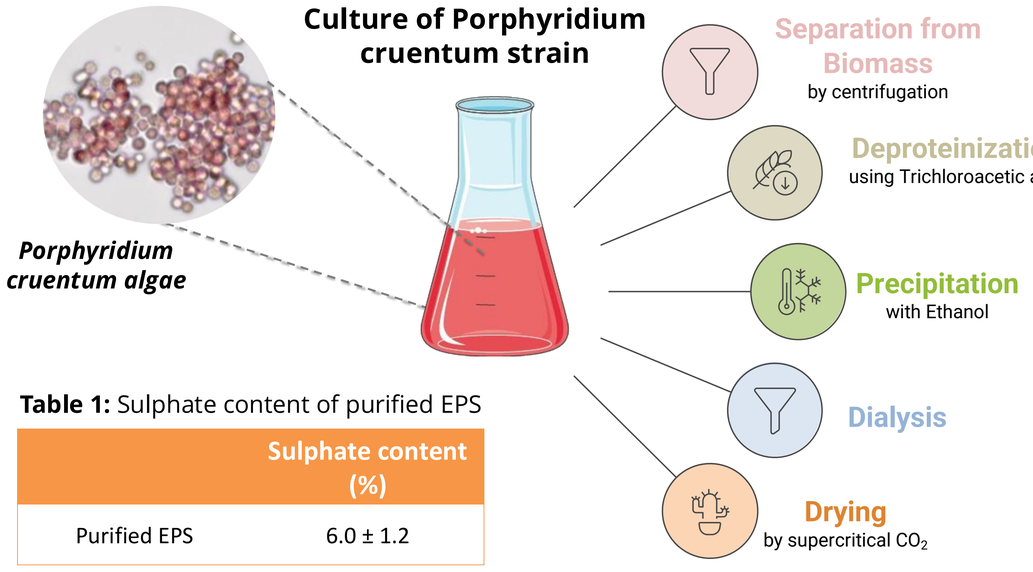
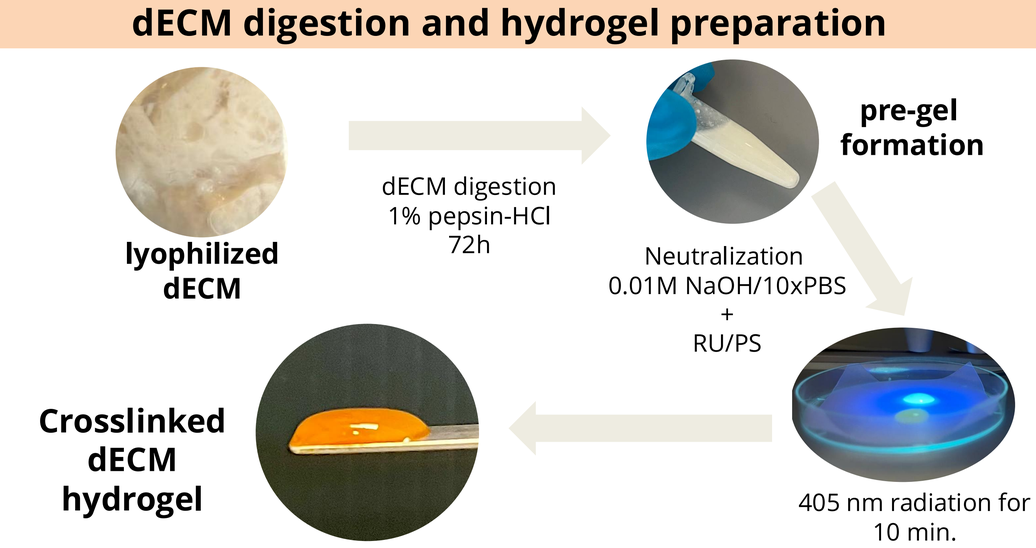


Table 1: Sulphate content of purified EPS

	Sulphate content (%)
Purified EPS	6.0 ± 1.2

dECM digestion and hydrogel preparation



Conclusions

The decellularization protocol using solvents and supercritical CO_2 effectively removed cellular components but requires optimization to meet the recommended DNA threshold (≤50 µg/mg tissue). Quantitative analysis confirmed the retention of key ECM components, particularly sulfated glycosaminoglycans (sGAGs), essential for preserving myocardial structural and biochemical properties. Exopolysaccharides (EPS) from *Porphyridium cruentum* were successfully extracted and purified, showing a sulfate content of 6%. Future work will focus on integrating EPS with hydrogels to develop bioengineered cardiac patches supporting cardiomyocyte culture and myocardial repair.

References

1. Ghoneim, M.A., et al. Stem Cell Res Ther, 2024. 15(1): p. 23.
2. Alam, M.M., et al. Naseem. Arch Biochem Biophys, 2015. 584: p. 10-9

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