Thermosensitive porcine myocardial extracellular matrix hydrogel coupled with proanthocyanidins for cardiac tissue engineering

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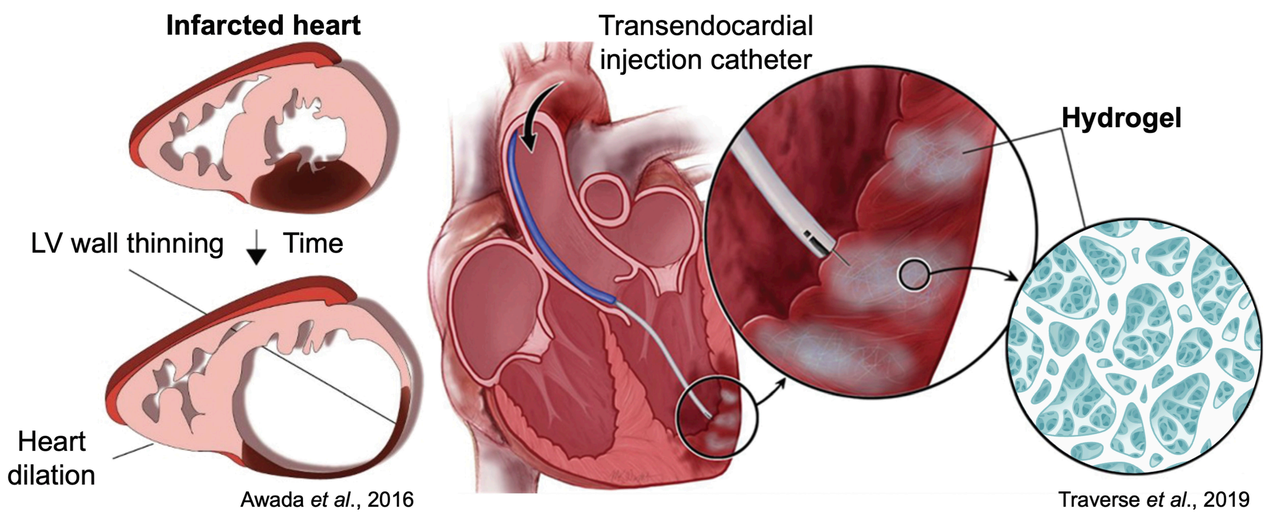
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1. INTRODUCTION

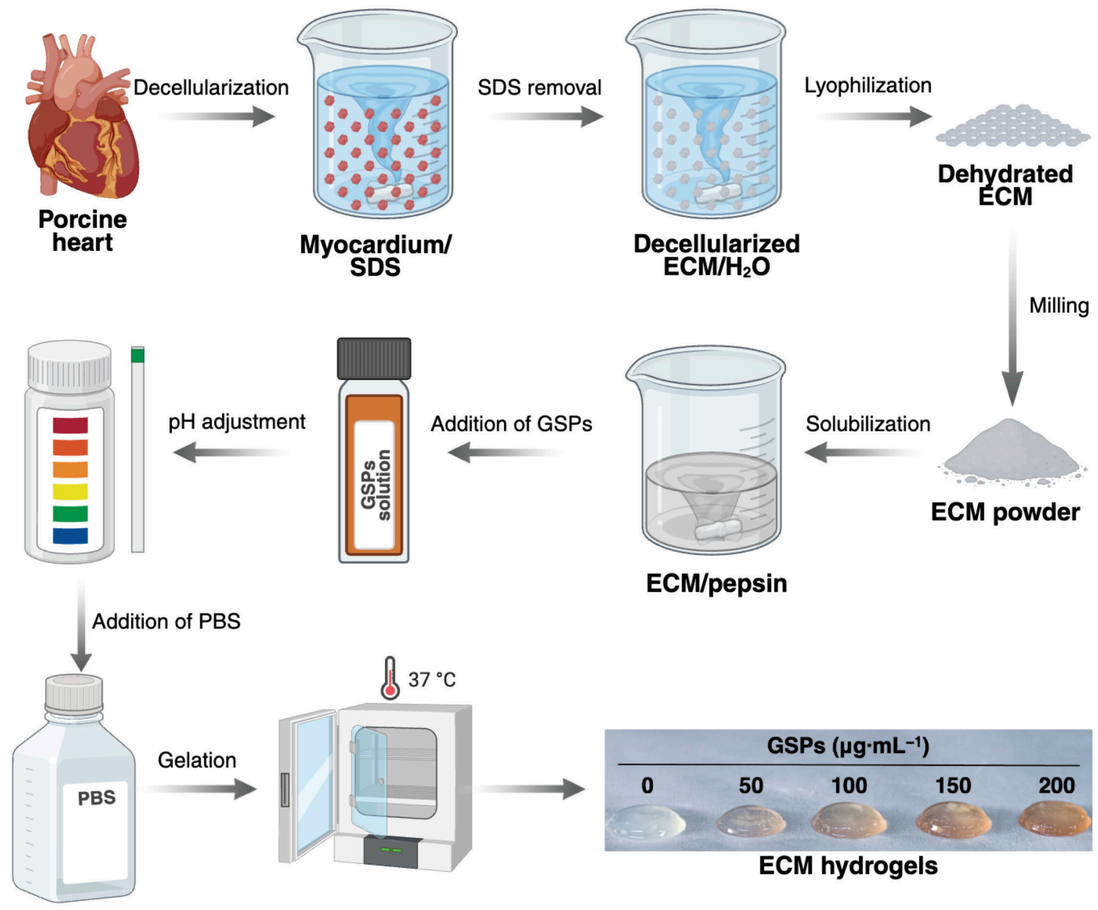
One of the consequences of ischemic heart disease is myocardial infarction, which can lead to heart failure and death. According to the World Health Organization, ischemic heart disease is **the leading cause of death worldwide**[1].

Currently, **there are no therapies** that prevent the negative myocardial remodelling that occurs after a heart attack[2]. **Injectable hydrogels** are a treatment option because they can replace the damaged extracellular matrix (ECM) and can also be administered through a minimally invasive procedure[3].

Reactive oxygen species generated by ischemia-reperfusion injury can limit the therapeutic efficacy of hydrogels[4]. To overcome this limitation, in this study **grape seed proanthocyanidins (GSPs)** were incorporated as antioxidant compounds in a thermosensitive myocardial ECM hydrogel.

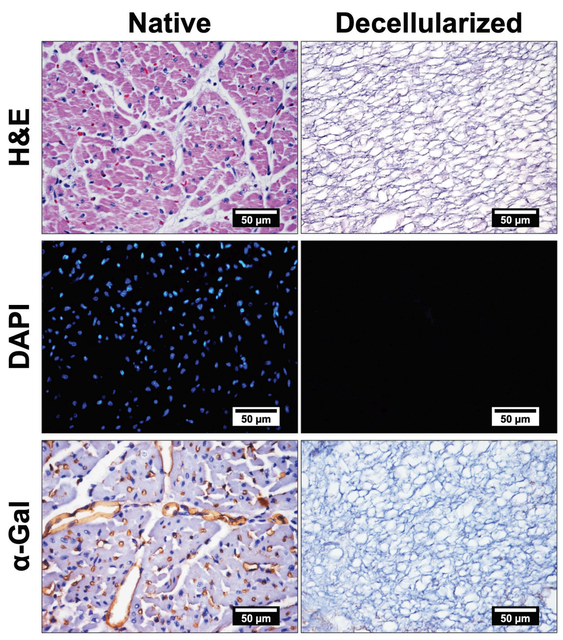


2. METHODOLOGY

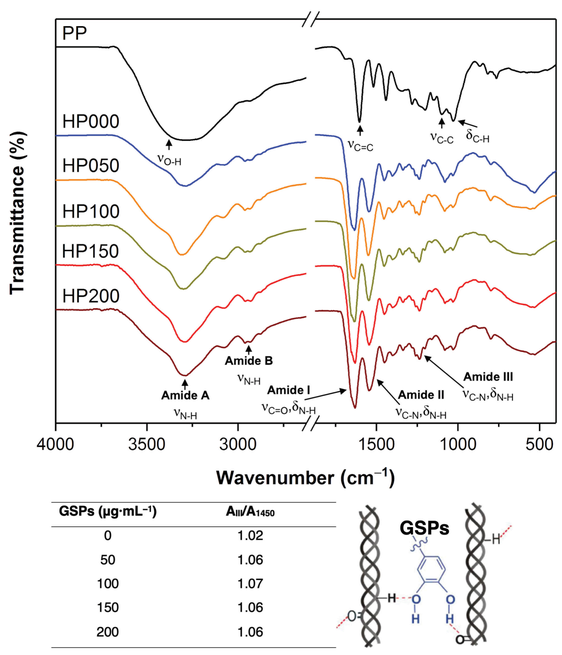


3. RESULTS

Myocardial ECM

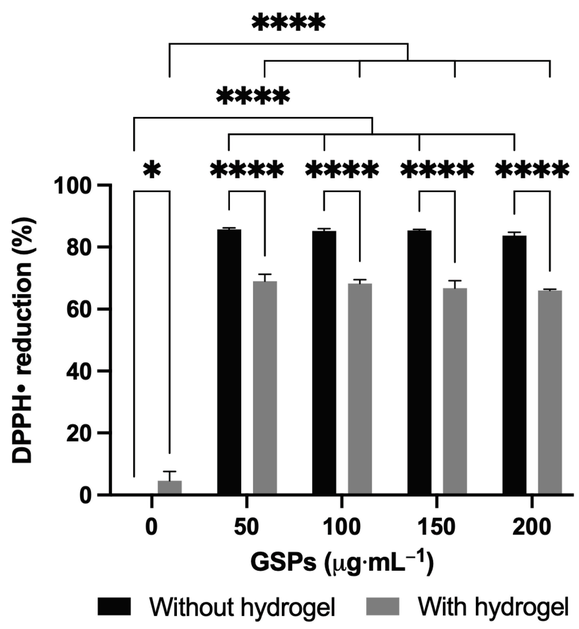


Infrared spectroscopy

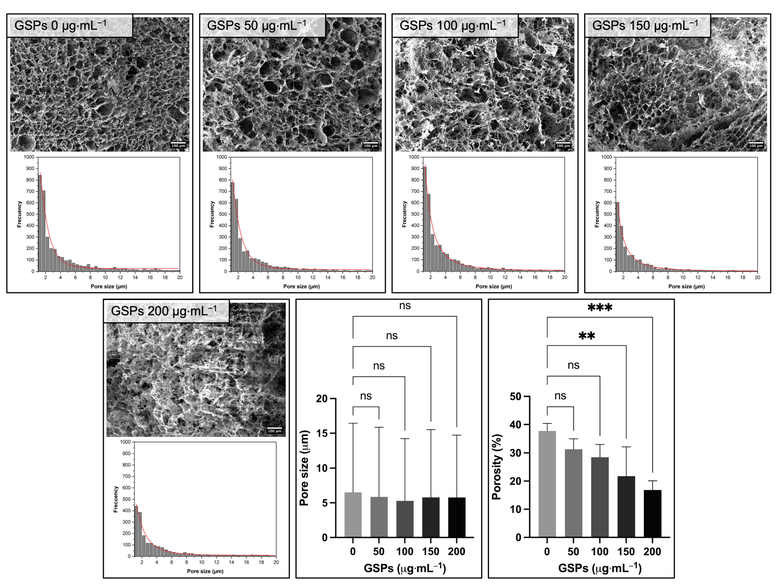


GSPs (μg·mL⁻¹)	A_{III}/A_{1450}
0	1.02
50	1.06
100	1.07
150	1.06
200	1.06

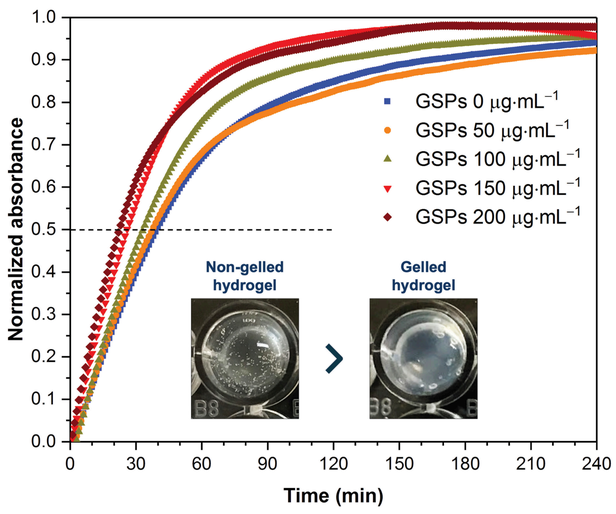
Antioxidant capacity



Morphology

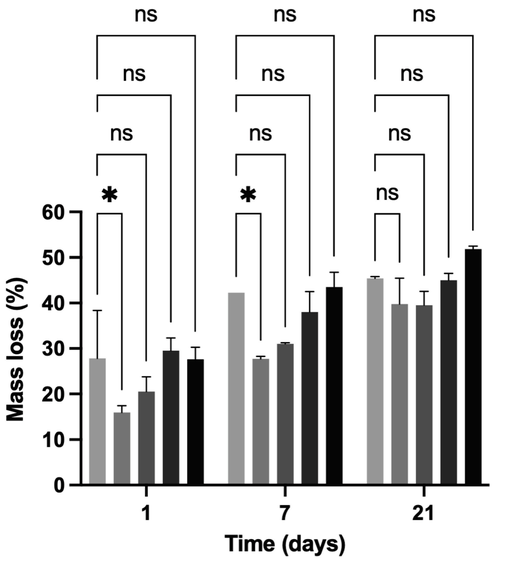


Gelation kinetics

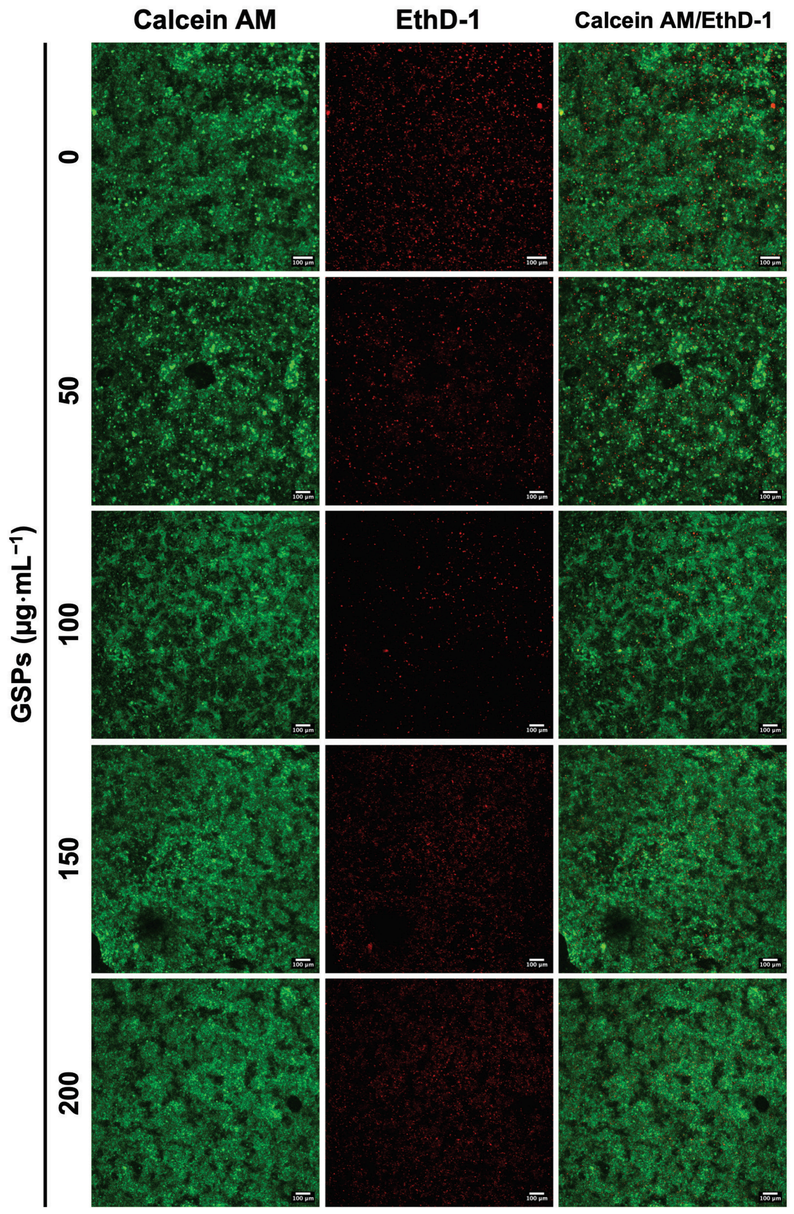


GSPs (μg·mL⁻¹)	*S*	$t_{1/2}$ (min)
0	0.0158 ± 0.0016	33.3 ± 3.0
50	0.0189 ± 0.0002	28.2 ± 0.5
100	0.0202 ± 0.0031	26.9 ± 3.3
150	0.0214 ± 0.0031	24.6 ± 3.2*
200	0.0237 ± 0.0050	18.1 ± 1.6**

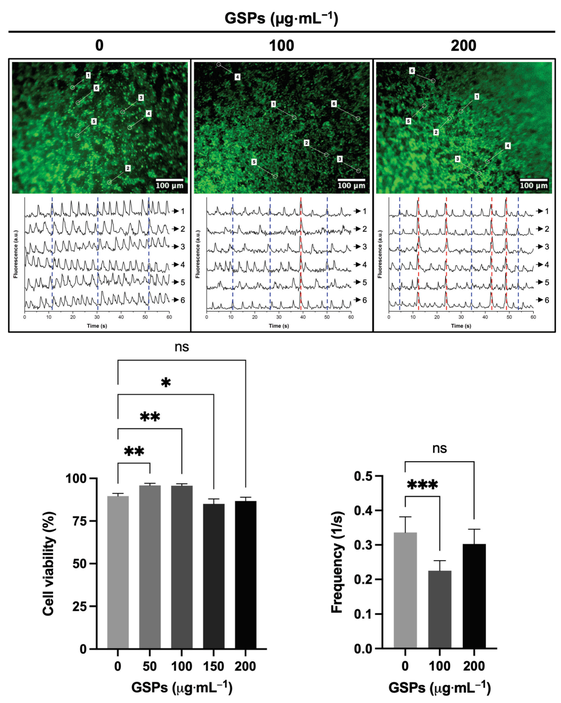
In vitro degradation



Cardiomyocyte viability



Cardiomyocyte functionality



4. CONCLUSIONS

Although the **antioxidant capacity** of the hydrogels coupled with GSPs decreased due to crosslinking interactions, it was still **very high** compared to the hydrogel without GSPs.

The other tests performed on the hydrogels indicated that the **positive effect** of GSPs on the hydrogel properties was dependent on the **GSPs concentration**. For example, a **low concentration** of GSPs in the hydrogels preserved their porosity and increased cardiomyocyte viability; while a **high concentration** of GSPs in the hydrogels increased their gelation rate and improved cardiomyocyte contractile activity. In the case of the *in vitro* degradation assay, the GSPs concentration had no effect on this property of the hydrogels.

Therefore, GSPs not only conferred antioxidant capacity to the hydrogels, but also had a beneficial effect on some properties of the hydrogels, so the **coupling of GSPs** in the thermosensitive porcine myocardial ECM hydrogel can be considered a **promising strategy** in post-infarction myocardial regeneration.

Full article

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Patent application MX/a/2026/000280

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