PORCINE MYOCARDIAL EXTRACELLULAR MATRIX-DERIVED HYDROGEL CROSSLINKED WITH GENIPIN FOR CARDIAC TISSUE ENGINEERING

Angélica Raquel Rivera-Contreras[1]; José Luis Hidalgo-Vicelis[1]; Andrés Eliú Castell-Rodríguez[1]; Beatriz Hernández-Téllez[1], Gabriela, Piñón-Zárate[1]; Katia Jarquín-Yáñez[1], Gertrudis Hortensia González-Gómez[2]; María Alicia Falcón-Neri [2]

[1] Laboratorio de Inmunoterapia e Ingeniería de Tejidos, Departamento de Biología Celular y Tisular, Facultad de Medicina, UNAM, Ciudad de México, México.

[2] Laboratorio de Biofísica Funcional, Departamento de Física, Facultad de Ciencias, UNAM, Ciudad de México, México.

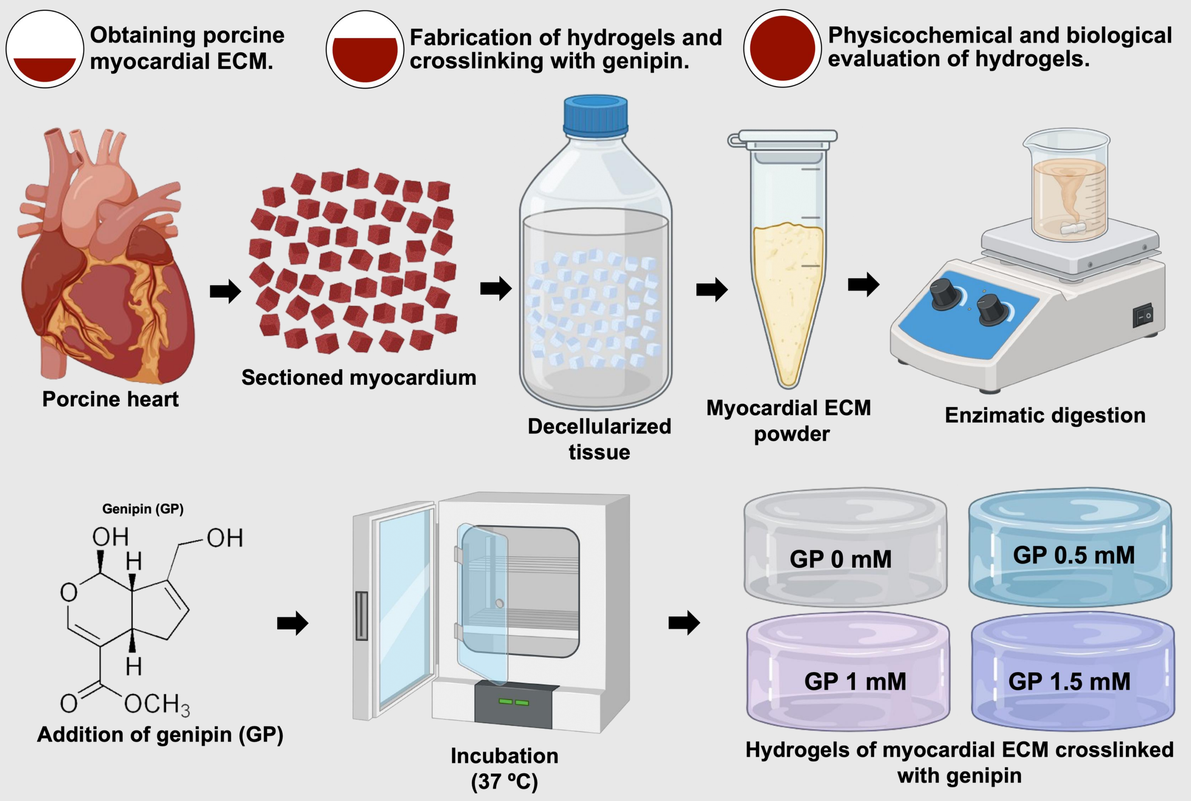
Introduction

Myocardial infarction (MI) is one of the leading death causes, which occurs when the heart undergoes prolonged ischemia, leading to cardiomyocytes (CMs) necrosis [1]. Treatments like cell therapy has been used for post-MI repair, however, the administered cells are hardly retained in the area of interest due to the absence of an environment that favors their adhesion [2].

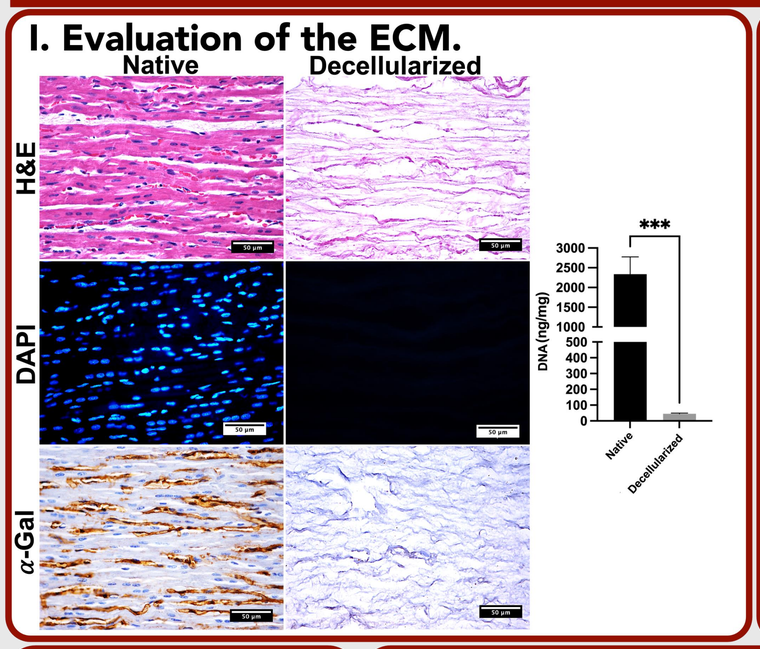
To address this limitation, the use of injectable hydrogels derived from decellularized tissues has been opted because they mimic the function of the extracellular matrix (ECM) and their administration is minimally invasive [4]. Decellularization can affect the degradation rate and mechanical properties of the ECM, so the addition of a crosslinking agent such as genipin would improve them [5]. Genipin (GP), a natural compound, has a high crosslinking capacity and biocompatibility [3].

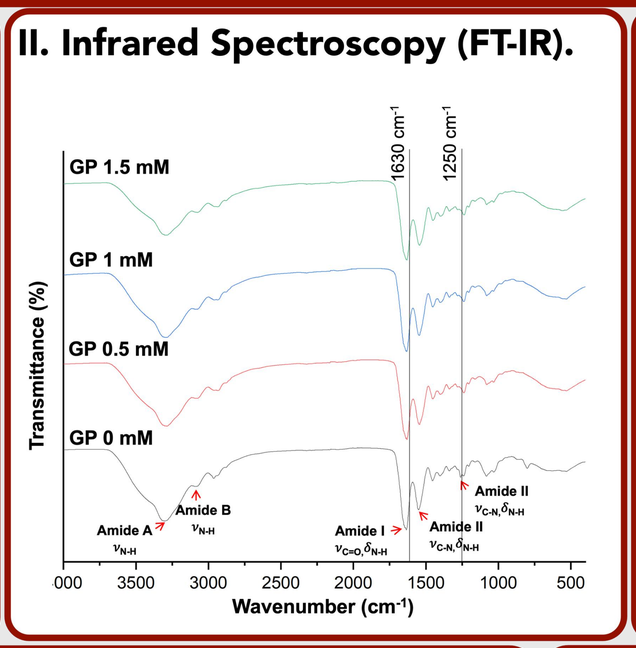
In this regard, a porcine myocardial ECM-derived hydrogel crosslinked with genipin was developed for its possible application in cardiac tissue engineering.

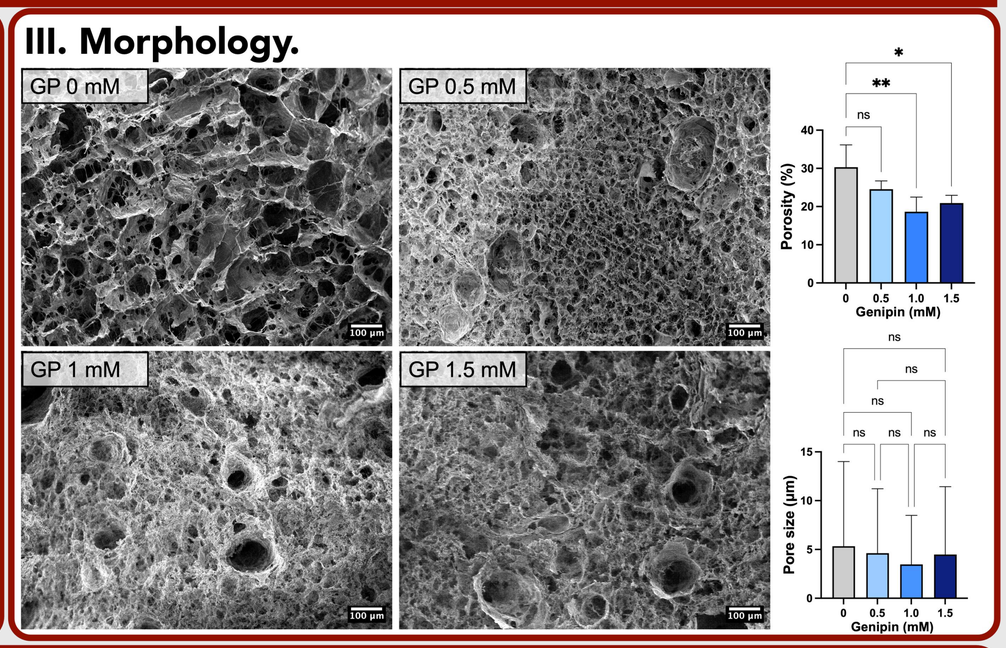
Methods

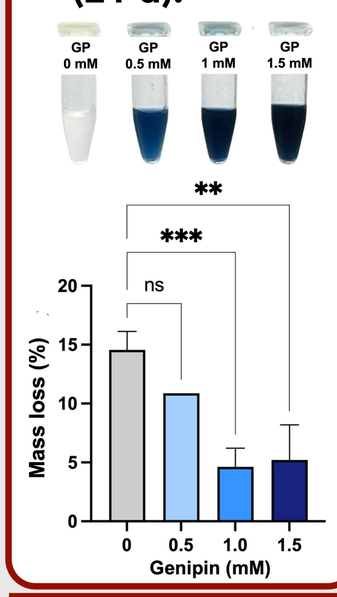


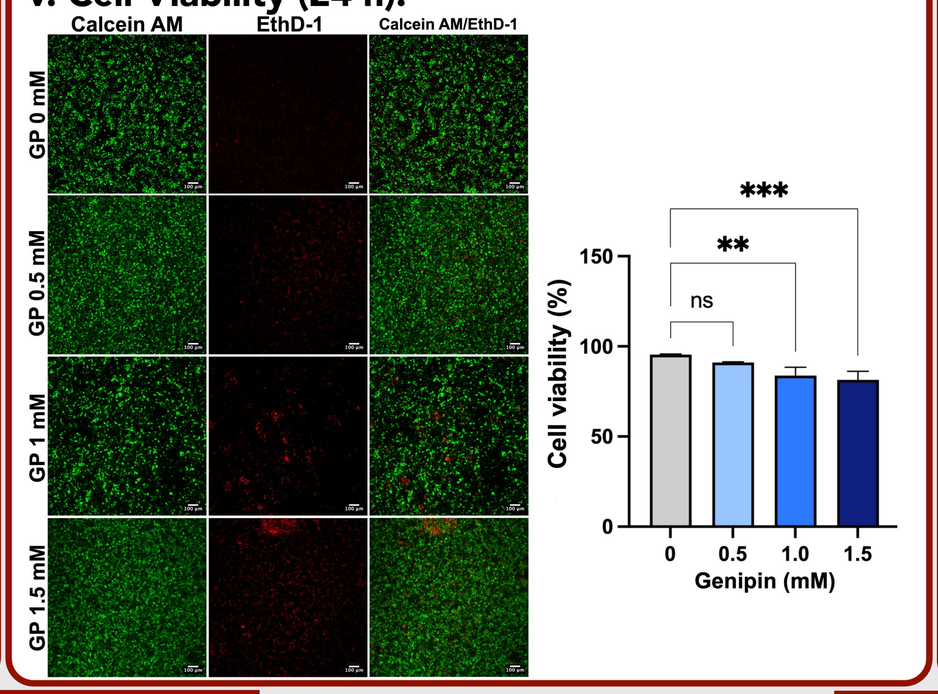
Results

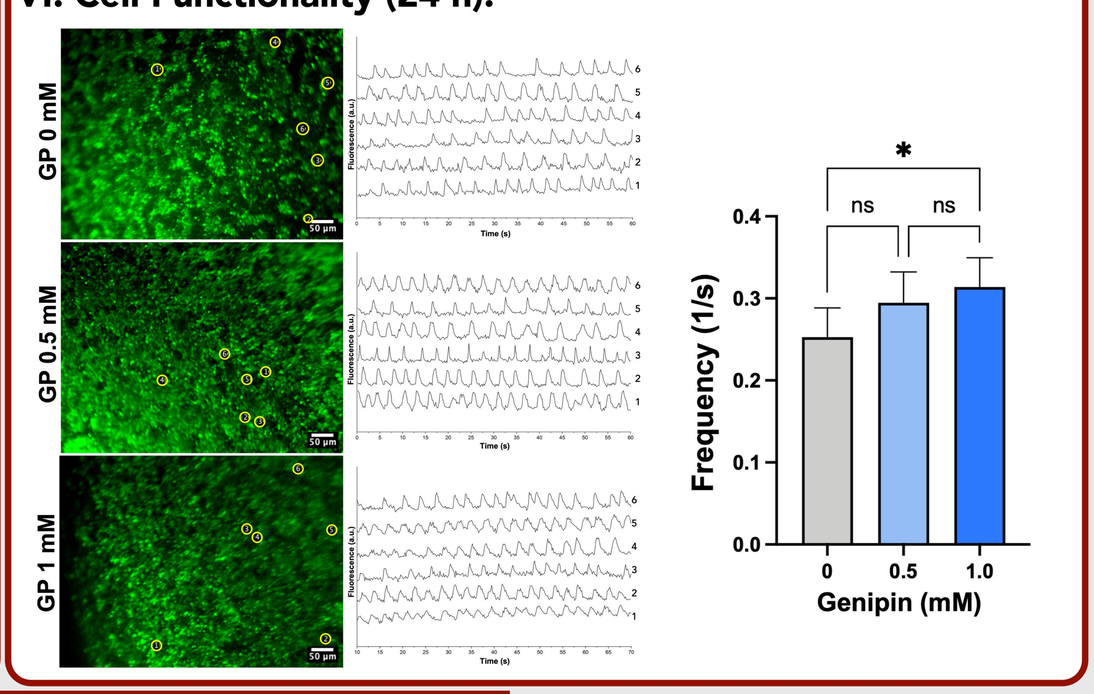












Conclusions

The concentration of genipin played an important role on the hydrogels properties. For example, the porosity and degradability of the hydrogels decreased with a higher concentration of genipin. Furthermore, a low concentration of genipin did not compromise the viability of cardiomyocytes and improved their contractile activity. Therefore, the crosslinking with genipin allowed altering the properties of the porcine myocardial ECM-derived hydrogel, indicating its therapeutic potential in cardiac tissue engineering for post-MI myocardial repair.

Acknowledgments: To the PAPIIT-DGAPA-UNAM IT200525, IN216723 and IA203025 projects for their financial support.

References

1. Frangogiannis, N. G. (2015). Pathophysiology of myocardial infarction. Comprehensive Physiology, 5(4), 1841–1875. https://doi.org/10.1002/cphy.c150006
2. Lu, P., Ruan, D., Huang, M., Tian, M., Zhu, K., Gan, Z., & Xiao, Z. (2024). Harnessing the potential of hydrogels for advanced therapeutic applications: current achievements and future directions. Signal transduction and targeted therapy, 9(1), 166. https://doi.org/10.1038/s41392-024-01852-x
3. Jeffords, M. E., Wu, J., Shah, M., Hong, Y., & Zhang, G. (2015). Tailoring Material Properties of Cardiac Matrix Hydrogels To Induce Endothelial Differentiation of Human Mesenchymal Stem Cells. ACS Applied Materials & Interfaces, 7(20), 11053–11061. https://doi.org/10.1021/acsami.5b03195
4. Hidalgo-Vicelis, J. L., Rivera-Contreras, A. R., Hernández-Téllez, B., Piñón-Zárate, G., Jarquín-Yáñez, K., Fiordelisio-Coll, T., Saniger-Blesa, J. M., González-Gómez, G. H., Falcón-Neri, M. A., Canales-Martínez, M. M., & Castell-Rodríguez, A. E. (2025). Thermosensitive Porcine Myocardial Extracellular Matrix Hydrogel Coupled with Proanthocyanidins for Cardiac Tissue Engineering. Gels, 11(1), 53. https://doi.org/10.3390/gels11010053
5. Liu, W., Zhang, X., Jiang, X., Dai, B., Zhang, L., & Zhu, Y. (2023). Decellularized extracellular matrix materials for treatment of ischemic cardiomyopathy. Bioactive materials, 33, 460–482. https://doi.org/10.1016/j.bioactmat.2023.10.015