3D-printed thermoresponsive scaffolds based on marine GelMA and graphene oxide

Sara Pérez Davila[1], Jesús Valcarcel[1], José Antonio Vázquez[1], Miriam López-Álvarez[2,3], Pío González[2,3]

Contact: sperezdavila@iim.csic.es

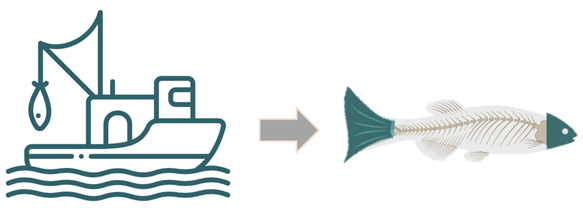
[1]Group of Recycling and Valorization of Waste Materials (REVAL), Marine Research Institute (IIM-CSIC), 36208 Vigo, Spain

[2]CINTECX, Universidade de Vigo, Grupo Novos Materiais, 36310 Vigo, Spain

[3]Galicia Sur Health Research Institute (IIS Galicia Sur), SERGAS-UVIGO, 36213 Vigo, Spain

INTRODUCTION

FISHING AND AQUACULTURE INDUSTRY



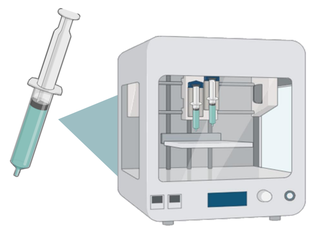
The increase in fisheries, aquaculture and seafood processing has resulted in a **rise in discards and by-products (heads, skins, bones…)**

VALORIZATION



Valorization of **gelatin** extracted from **skin** by-products

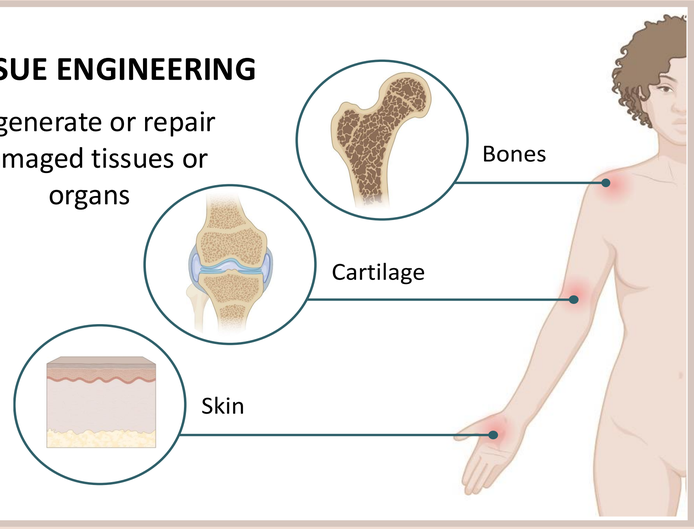
BIOMEDICAL APPLICATIONS



Bioinks for 3D bioprinting, hyperthermia treatments, wound healing, drug delivery…

TISSUE ENGINEERING

Regenerate or repair damaged tissues or organs

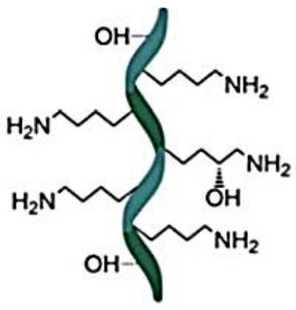


OBJECTIVE

Fabrication and characterization of 3D-printed thermoresponsive scaffolds based on GelMA derived from yellowfin tuna (YT) skin and different graphene oxide (GO) concentrations for use as 3D printing bioinks in various biomedical applications.

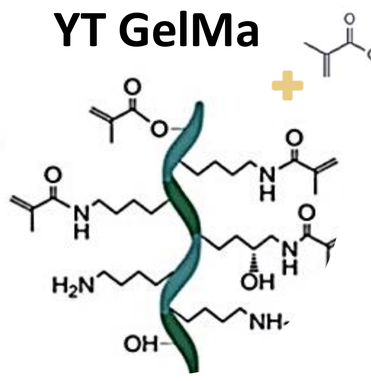
METHODOLOGY

YT Gelatin



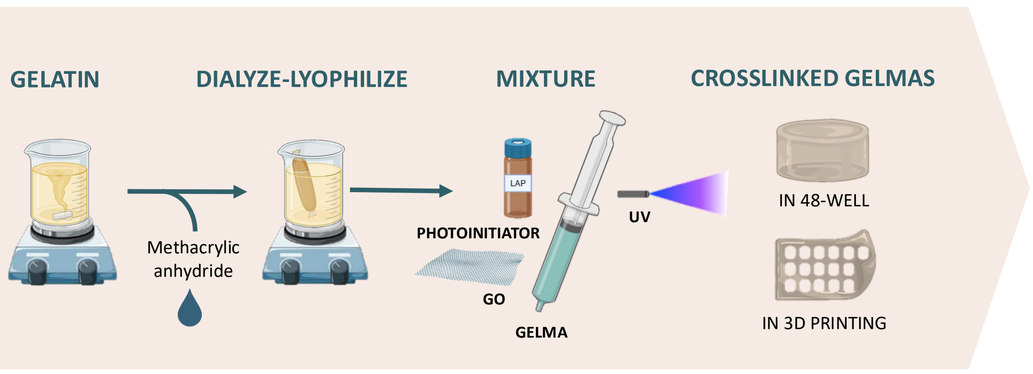
Methacrylic anhydride

YT GelMa

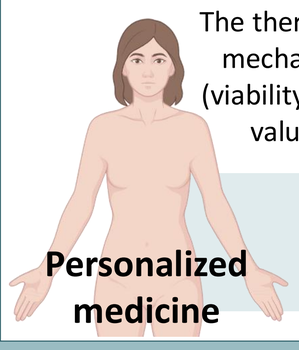


CHEMICAL MODIFICATION = PHOTOPOLYMERIZABLE

Improved mechanical properties
Body temperature stability



CONCLUSIONS



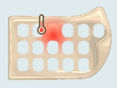
The thermoresponsive 3D-printed GO/GelMA scaffold showed optimal mechanical properties at 0.1% GO, acceptable levels of cytotoxicity (viability > 70% ISO 10993-5), high swelling capacity and hyperthermia values > 60 °C, being promising for biomedical applications as:

Personalized medicine

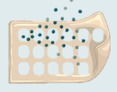
WOUND HEALING



HYPERTHERMIA TREATMENTS



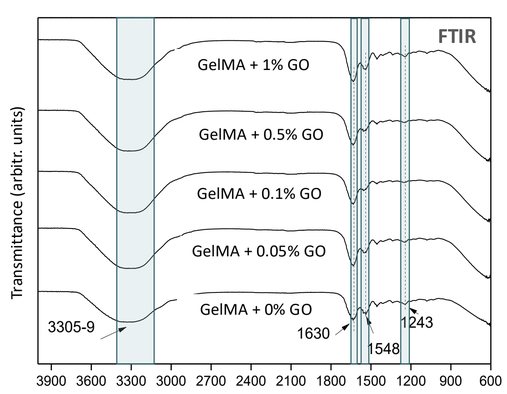
DRUG DELIVERY

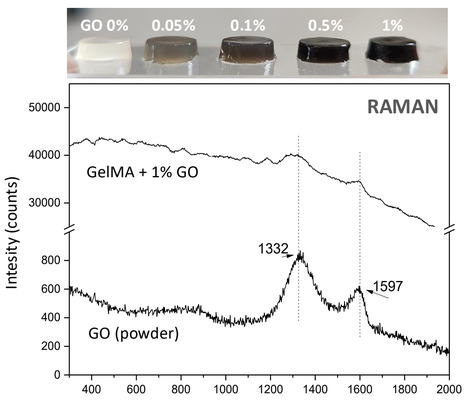


RESULTS

GO/GELMA SERIES

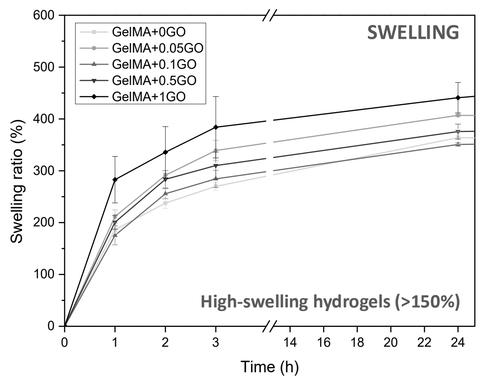
In the FTIR spectra, the characteristic peaks of GelMAs are observed, while Raman spectroscopy confirms the successful incorporation of GO into the GelMA samples.

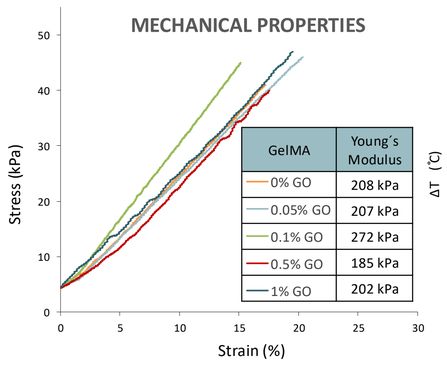


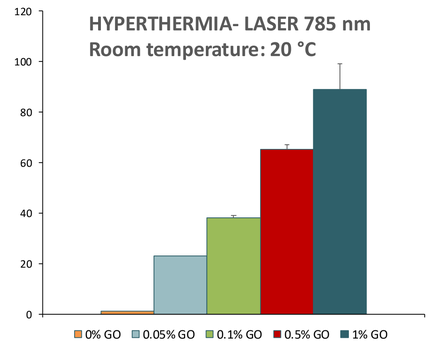


CROSSLINKED GO/GELMA CHARACTERIZATION

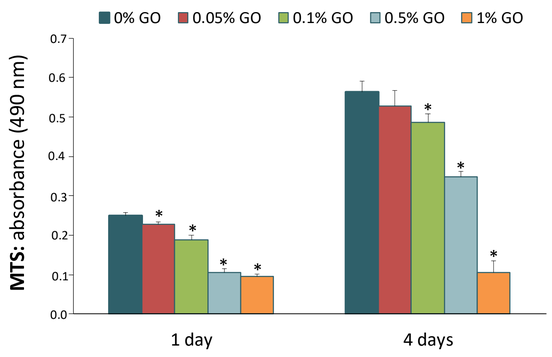
Higher incorporation of GO results in a lower crosslinking degree, which favors an increased swelling degree. The gradual increase of GO does not proportionally improve the mechanical strength of this tuna-derived GelMA hydrogel. GelMA with 0.1% GO can be remotely heated up to 60°C (from room temperature) exhibiting photothermal properties and the best mechanical performance.

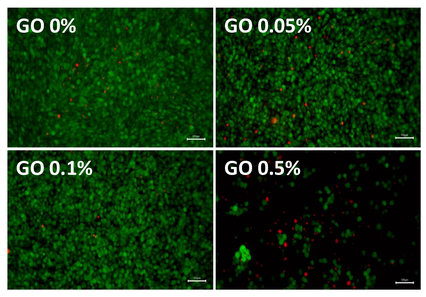


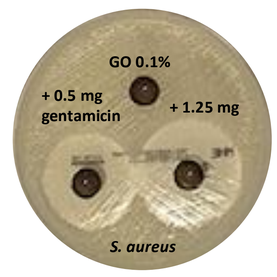




CROSSLINKED GO/GELMA CITOTOXICITY AND DRUG RELEASE (ANTIBIOTIC)



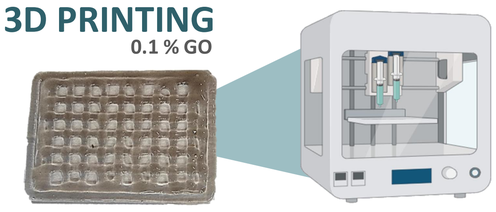




MTS and live/dead assays show a dose-dependent increase in cytotoxicity with graphene (* p≤0.05), with 0.1% GO identified as the limit for maintaining good cell viability after 4 days. These same disks provided efficient release of gentamicin for drug delivery applications and good printability for their use as bioinks.

3D PRINTING

0.1 % GO



TERMIS EU-Chapter 2026 PALMA DE MALLORCA 21-24 APRIL / SPAIN

Interreg España – Portugal

Cofinanciado por la Unión Europea
Cofinanciado pela União Europeia

iberos+ Instituto de Biofabricación en Red para el Envejecimiento Saludable

XUNTA DE GALICIA
ED431C2025_56XuntadeGalicia

CSIC Consejo Superior de Investigaciones Científicas
Instituto de Investigaciones Marinas
Universidade de Vigo

termis EUROPE